

ZOOLOGISCHE MEDEDELINGEN

UITGEGEVEN DOOR HET

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE TE LEIDEN
(MINISTERIE VAN CULTUUR, RECREATIE EN MAATSCHAPPELIJK WERK)

Deel 53 no. 2

22 juni 1978

ON THE TYPE MATERIAL OF *CERVUS NIPPON* TEMMINCK, 1836; WITH A REVISION OF SIKA DEER FROM THE MAIN JAPANESE ISLANDS

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With 4 plates

ABSTRACT

The type material of *Cervus nippon* Temminck, 1836, present in the Leiden museum, is re-examined; a lectotype is chosen, and a new description of lectotype and paralectotypes is given. In an attempt to determine the exact type locality or localities, the type series is compared with published descriptions of Japanese Sika and with material present in the British Museum (Nat. Hist.). The characteristics of the type series are in good agreement with those of Sika from southern Japan; the lectotype closely agrees with specimens originating from the main islands of southern Japan (southern Honshu, Kyushu, Shikoku) and may have come from the surroundings of Nagasaki (Kyushu); the remaining type series agrees better with specimens from the Goto Islands, where several Leiden specimens are known to have been collected. A revision of *Cervus nippon* of the main Japanese islands is given, 3 subspecies being recognized within this area.

INTRODUCTION

When the senior author recently visited the Rijksmuseum van Natuurlijke Historie, Leiden, the opportunity was used to study the type material of *Cervus nippon* Temminck, 1836, the Sika Deer of Japan. Examination of this material proved valuable, since it offered a possibility of clarifying the systematics of this species in the Japanese islands, a theme that has become somewhat complicated during the last century due to the description of a number of putative new forms.

In this contribution, therefore, the Leiden type material is re-described;

a lectotype is chosen; and the type series is compared with Sika material from various parts of Japan.

LEIDEN TYPE MATERIAL

The material present in the Leiden museum was listed by Jentink (1887, 1892). The osteological material was recorded as follows (1887: 147):

- a) Squellette d'un mâle adulte. Japon. De M. Von Siebold. Un des types de l'espèce.
- b, c) Squelettes d'individus mâle et femelle. Japon. De M. Bürger.
- d, e) Crânes de mâles adultes. Japon. De M. Bürger.
- f) Crâne d'un mâle adulte. Japon. De M. Von Siebold. Manquent les mâchoires inférieures. Ce crâne est figuré dans la Fauna japonica, Pl. 17, figs. 2 et 3. Un des types du *Cervus sika* Temminck.
- g) Crâne d'un mâle adulte. Japon. De M. Von Siebold. Un des types de l'espèce.
- h) Crâne d'une jeune femelle. Japon. De M. Von Siebold. Un des types de l'espèce.

In the later catalogue, the skin material was listed as follows (Jentink, 1892: 177):

- a) Mâle adulte monté, un des types de l'espèce et figuré dans la "Fauna japonica", pl. 17, fig. 1. Japon. Des collections de M. von Siebold. (Cr. f du Cat. Ost.).
- b) Mâle passablement adulte monté, un des types de l'espèce. Japon. Des collections de M. von Siebold.
- c) Jeune mâle monté. Japon.

Three mounted skins occur in Jentink's 1892 catalogue, and three mounted specimens are present in the museum, corresponding in age and sex to those mentioned by Jentink. Although the catalogue indications a, b and c (of later date than the specimens) do not appear on the labels or pedestals, the specimens undoubtedly are the same. The adult male therefore must be Cat. syst. a, despite the fact that Jentink attributes it to Von Siebold (thus regarding it as a type specimen, see below) whereas the label gives Bürger as its collector. Similarly, the young adult male of Von Siebold must be Cat. syst. b; the young male, collector unknown, Cat. syst. c.

Jentink (1887, 1892) regarded all specimens collected or procured by Von Siebold as type material, but not those acquired by Bürger. This cannot be correct. After Von Siebold's departure from Japan in 1829, Bürger continued

sending specimens to Leiden, his last shipment arriving here in 1835 (Holt-huis & Sakai, 1970). Since Temminck's description of *Cervus nippon* almost certainly appeared in 1836 (Mees, 1957), there can be no doubt that Temminck, while making his description, had before him both Von Siebold's and Bürger's collections; therefore, all these specimens are to be regarded as type material, unless proved otherwise. It is noteworthy that Jentink, by wrongly attributing Cat. syst. a to Von Siebold instead of to Bürger, regarded the skin as a type specimen, but not its skull (see below)! The same reasoning almost certainly applies to Cat. syst. c; the label of this specimen, like those of the other ones, bears the inscription "F: Jap:" (Fauna Japonica), which implies that Temminck had this animal before him when writing the mammalogical section of this work, which appeared in 1844; on p. 3. Temminck explicitly states that both Von Siebold and Bürger supplied the material on which this work was based. Since no material from Japan arrived between 1835 and 1844, it follows that the 1836 and 1844 descriptions are based on the same specimens. The Leiden type series, therefore, consists of 3 mounted skins, 3 skeletons with their skulls and 5 separate skulls, as follows:

1. Mounted skins (catalogue indications by inference):

Reg. nr. 25987, Cat. syst. a. Adult male with 4-pointed antlers. Coll. Bürger.

Reg. nr. 25988, Cat. syst. b. Young adult male with 3-pointed antlers. Coll. Von Siebold.

Reg. nr. 25989, Cat. syst. c. Juvenile male with 2-pointed antlers. Coll. ?

2. Skeletons with skulls:

Reg. nr. 25990, Cat. ost. a. Adult male with basilar suture partially closed and third molars in wear. Antlers 3-pointed, well-formed. Coll. Von Siebold.

Reg. nr. 25991, Cat. ost. b. Young adult male with basilar suture partially closed and third molars in early wear. Antlers 2-pointed, slightly deformed. Coll. Bürger.

Reg. nr. 25992, Cat. ost. c. Old female with basilar suture almost closed and third molars very heavily worn. Coll. Bürger.

3. Skulls:

Reg. nr. 25993, Cat. ost. d. Young adult male with basilar suture partially closed and third molars in early wear. Antlers 3-pointed (left one only), deformed. Coll. Bürger.

Reg. nr. 25987, Cat. ost. e. Old male with basilar suture almost closed and third molars heavily worn. Antlers and occiput sawn off. Coll. Bürger.

- Reg. nr. 25994, Cat. ost. f. Adult male with basilar suture partially closed and third molars in wear. Antlers 4-pointed, well-formed. Coll. Bürger.
- Reg. nr. 25988, Cat. ost. g. Young adult male with basilar suture beginning to close and third molars in early wear. Antlers sawn off. Coll. Von Siebold.
- Reg. nr. 25995, Cat. ost. h. Young female with basilar suture open and third molars not erupted. Coll. Von Siebold.

ANNOTATIONS TO THE TYPES

The skull belonging to skin 25987, Cat. syst. a, is doubtless Cat. ost. e, an old male and presented by Bürger. The skull of skin 25988, Cat. syst. b, the young adult male, certainly is Cat. ost. g; here too, the age is right (probably about 2½ years old) and it was acquired by Von Siebold. Of both skulls the antlers have been sawn off, as if for mounting with a skin, and the proportions of the skulls exactly match those of the respective skins. Skins and skulls therefore have been given the same registration numbers. There is no skull corresponding to Reg. nr. 25989, Cat. syst. c.

Jentink (1892) states that Cat. syst. a is the specimen depicted in the *Fauna Japonica*, pl. 17, fig. 1. The pose and colouration of the animal on the plate closely resemble those of the mounted specimen, except that the plate shows the animal looking to the left, whereas the skin is mounted with the head turned slightly to the right (Pl. 1a, b). This is explained by the fact that the drawing was made on stone; the printed figure thus appears in reverse. The antlers on the plate, however, are not those on the skin, but almost certainly those of the skull Cat. ost. f, with the brow tines narrower and more erect and the bez, and especially the trez, much smaller than those of Cat. syst. a (Pl. 2b).

The skull depicted on the same plate, figs. 2 and 3, probably is Cat. ost. g (not f, as stated by Jentink, 1887). It has for example a distinctive forward curvature of the fronto-parietal suture at bregma, blunt posterior ends to the nasals, and it looks as if it has a canine; in all these respects it differs from Cat. ost. f, but agrees with Cat. ost. g (Pl. 2a, b). But the antlers are again those of Cat. ost. f!

Temminck's 1844 plate, therefore, is composite. The animal depicted is Cat. syst. a (reg. nr. 25987), with the antlers of Cat. ost. f (reg. nr. 25994); the skull is Cat. ost. g (reg. nr. 25988), again with the antlers of Cat. ost. f.

Since the mounted skin Cat. syst. a (reg. nr. 25987) contributed most to the plate in the *Fauna Japonica*, and because it is the only fully adult specimen among the three mounted skins of the type series, we select this skin, with

its skull Cat. ost. e, as lectotype of *Cervus nippon* Temminck, 1836 and of *Cervus sika* Temminck, 1844 (Pls. 1a; 3a, b; 4a, b).

The skin may be described as follows (Pl. 1a): Flanks greyish brown; mid-dorsal region darker, nearly black on nape, withers and tail root. Tail white with a few brown hairs. Hairs on flanks and dorsum, except the darker ones, dirty pinkish white at base, darkening progressively towards the tip, with a narrow pale band below the dark brown tip. Ventral parts paler and reddish brown, with unringed, reddish hairs with white bases; mid-line of abdomen, axillae, postero-internal surface of upper arms, uppermost section of inner surface of thighs and groin whitish. Long white hairs extending from thighs up the hind surface of the buttocks to the root of the tail, where they are largely concealed by long dark hairs, the latter forming a dark, poorly defined line from the tail root down the buttocks, confining the white patches. Lower parts of haunches paler and more reddish than upper parts, with unringed hairs; the two zones are separated by an inconspicuous line between about the middle of the buttocks and the flanks. Limbs light reddish brown, except for a whitish tuft around the metatarsal gland. Head paler than body, with greyish cheeks and chevron; a faint dark line above and in front of the eye and a whitish rim around the eye. Lower lips whitish till some distance beyond the nostrils, the white extending slightly onto the chin. Ears greyish inside with long, fluffy hairs, less clearly so along the lower margin and extreme tip. Hair on muzzle and forehead directed upwards towards the bases of the antlers or, more laterally, outwards. Hair on sides of neck not swept forwards, not forming a mane.

Shoulder height 800 mm, hind foot 360 mm, ear 125 mm, tail 130 mm; left antler 424 mm.

Antlers with rather long pedicels; well-formed, not worn, pale, surface covered with small warts. Beams slightly bowed outwards, brow tines directed forwards in the same plane as the beams, their tips pointing upwards and a little inwards; third fork some distance above point of bez; small trez pointing up-, in- and slightly backwards; left trez tine smaller than right one.

Skull: tooth row length 70 mm, biorbital breadth 121 mm, braincase breadth 73 mm, breadth across pedicels 89 mm; nasal length 79 mm, proximal breadth of nasals 29 mm. Since the occiput has been sawn off, total and condylo-basal length cannot be measured.

By comparison with the lectotype, Cat. syst. b (reg. nr. 25988) is overall slightly paler and less greyish, with dark and pale bands on hairs less distinct. Dark nuchal stripe less distinct. Trace of a white spot on right shoulder. Midline of ventral side reddish brown, white only in axillae and — more noticeable — in groin. White on upper parts of buttocks less concealed by

dark hairs, contrasting sharply with the dark line from the tail root over the buttocks. Cheeks and chevron less greyish. Antlers shorter, dark, with pale tips; beams curving less outwards; brow tines shorter and pointed upwards, their tips veering medially. Second fork at about two thirds up the beam; bez short, continuing in line of beam, worn, left tine much more so than right one, perhaps slightly deformed; beam itself angles inwards. Shoulder height about 670 mm, hind foot 340 mm, ear 115 mm, tail 90 mm; left antler 271 mm.

Cat. syst. c (reg. nr. 25989) is similar in colouration to the lectotype, the upper side warmer brown, the flanks slightly more greyish. Pale zones on hairs more pronounced, the animal being distinctly speckled. Faint trace of white spot on right lower flank. Antler pedicels concealed in hair; antlers partly covered with skin, but the latter in heavy wear. Antlers bowing outwards, forked near the tips, front tines shorter than hind ones. Left antler a little shorter than right one, pointing further inwards towards the tip. Shoulder height 655 mm, hind foot 340 mm, ear 115 mm, tail 100 mm; right antler 210 mm.

It is clear from descriptions and illustrations (Heude, 1884 et seq.; Imaizumi, 1960; Whitehead, 1972) as well as from observations on captive animals that Japanese Sika become darker and less reddish as autumn proceeds; their summer spots fade away; the nuchal and dorsal areas darken, forming sometimes a well-developed dorsal stripe; the underside becomes paler, contrasting more with the dorsal parts; and the dark bands on the hairs become more accentuated. In addition to this, the antlers lose their velvet (which in the Sika is dark) in preparation for the rut, and become darker as they wear; according to Von Siebold (ms. notes, see app. 1), the rut takes place late October, according to Whitehead (1972), from mid-September to the end of October. It is likely, therefore, that the lectotype and young male are in full winter coat, while the Von Siebold skin may have been taken in autumn.

HISTORICAL REVIEW AND DISCUSSION

The Sika was first made known to science by C. J. Temminck in 1836 under the name of *Cervus nippon*. The species is briefly characterised (p. xxii) as being "moindre de taille que l'Axis de l'Inde" and further (footnote 4) that it is one third smaller than the European Red Deer, with antlers more slender, tail completely white, and posterior border of buttocks and whole of caudal region with long white hairs.

In the Fauna Japonica (1844), Temminck described what is obviously the same species, but this time under the name *Cervus sika*, giving no explanation

for rejecting the previous name, so that the two names are objective synonyms. The description (p. 54-55) partly repeats that of 1836, but is much more detailed, and is accompanied by a plate (considered above). The text specifies that the antlers are nearly straight, with four tines, of which two are in front and one to the side towards the point, which forms the fourth. There is a tuft of long, stiff, white hairs on the posterior surface of the hind feet; a broad blackish-brown band from occiput to withers, gradually dissipating itself in the brown tinge of the rest of the dorsum; colour less red than in the Red Deer; the hairs annulated with red and dirty white; thighs and legs lighter, more uniform reddish; inner surface of ears and chin white. An adult of large size was said to measure "4 pieds 6 pouces" (about 150 cm) in total length (croup to muzzle), the tail "5 pouces" (13.5 cm), height at withers "2 pieds 7 pouces" (84.7 cm), the antlers "1 pied 3 pouces" (39.5 cm) long. These measurements agree well with those of the lectotype, which almost certainly is the animal in question. The species "vit dans le plus grand nombre des îles dependentes de l'empire du Japon". It is clear that Temminck here gave a description of the adult condition in winter.

The precise locality of the lectotype is impossible to pin down. In general, P. F. von Siebold, physician of the Dutch trading mission in Japan from 1824 to 1829, was confined to the trading island of Deshima, near Nagasaki on the island of Kyushu; his assistant Bürger, who stayed in Japan from 1825-1832, evidently did not travel far either. This means that most specimens in Leiden labelled with their names probably came from the neighbourhood of Nagasaki. After Von Siebold left, Bürger began sending specimens to Leiden on his own account. In 1826, the two of them undertook the four-yearly trading mission to Edo (now Tokyo), travelling via Kokura, Shimono-seki (where they stayed for two weeks and did some collecting), Muro, Jasiro Shima, Himi Island, Osaka and Kyoto. It is known that on June 10, at Tennoji, Osaka, Von Siebold purchased a live deer. It is not unthinkable that the Leiden specimen Cat. ost. d (reg. nr. 25993) is the skull of this animal: its deformed antlers with no brow tines and, on the right side, no tines at all, are consistent with the impoverished conditions of captivity that it would have suffered on Deshima. It was sent to Leiden by Bürger, and would, consequently, have lived at Deshima for at least 3 years after its purchase: the skull is indeed that of an adult animal. However, the measurements do not differ from those of most of the other specimens (see below).

In the archives of the Leiden museum, there is an unpublished manuscript by Von Siebold on the mammals of Japan; the section on the Sika is given here in appendix 1. Von Siebold states that the species did occur on all the larger Japanese islands, and was common in some provinces, where it was

kept as a sacred animal. He further says that it must be very numerous on the Goto islands, "and I received several from there". From other paragraphs in this manuscript it appears that Von Siebold received material even from the northernmost parts of Japan, but no Sika is mentioned in this context, nor is it clear whether he acquired more animals from captivity than the one discussed above.

Unfortunately, it is unlikely that all specimens sent to Leiden by Von Siebold and Bürger are still in the Leiden Museum. It was a common practice in those days that many "duplicates" were sent to other museums in exchange. In a list of material, shipped by Von Siebold in 1828 and received in Leiden in 1829, e.g., a total of 18 antlers is mentioned, which cannot be traced any longer. Moreover, there is no documentation as to which of the specimens still present in Leiden may have originated from the Goto islands and which not, or which might have been captive animals. Apart from the specimen dealt with above, the antlers of *Cat. syst. b* (reg. nr. 25988) and of *Cat. ost. b* (reg. nr. 25991) also are slightly deformed, which may be a sign of captivity.

Detailed information on Von Siebold and Bürger and their collections has been given by Holthuis & Sakai (1970).

Subsequent to Temminck's description of the Sika and after its range on the mainland of eastern Asia and on Formosa became known, a number of authors have attempted to trace the geographic variation found within the species. In an attempt to allocate the type series, and particularly the lectotype, to one or other of the described populations, it has been necessary to peruse the literature for comparative descriptions and measurements, since the museum material in Europe is very limited. In the light of Von Siebold's notes on the occurrence of the Sika on the main Japanese islands and the Goto archipelago, interest must clearly centre around the putative subspecies described from these areas; there is no question of Von Siebold's and Bürger's material having come from the mainland or from Formosa, and it is less likely that it came from Tsushima or the Ryukyu islands.

Pierre-Marie Heude, a Jesuit missionary stationed at Shanghai, took a keen interest in the natural history of eastern Asia and also received specimens of Sika from Japan. His interest was in some ways counterproductive, for he had an extraordinary notion of presumed species differences, which failed to allow for even the slightest individual variation. In a series of publications issued between 1884 and 1898, he created altogether 29 "species" of Sika from Japan alone: 14 in 1884, 5 more in 1888, 5 in 1897 and 5 in 1898. For most of these the approximate locality is known: 15 were from the Goto islands (west of Nagasaki), 1 from Kobe, 2 from Tokyo, 1 from "north of Tokyo", 3 from Sendai, 1 from Mino and 5 from Yezo (Hokkaido); the

remaining one, *blakistoninus*, is included (with a number of other, better localized forms) in a group from "Nippon (Honshu) and Yezo", but the context strongly implies that it is, in fact, from the latter island, since its description is immediately followed by that of *dolichorhinus*, which is said to be "aussi de Yezo" (Heude, 1884).

In spite of this, Heude added little or nothing to our knowledge of geographic variation in Sika, any genuine geographic tendencies being lost in the plethora of spurious "species". But the descriptions are, on the whole, not bad; there are some measurements, and the text is accompanied by beautiful line drawings of skulls and antlers, executed in a manner that promotes confidence in their accuracy, although they are rarely reduced to the stated scale. In addition, Heude did point out differences between the deer from the Goto islands and those from northern Honshu (Tokyo and further north) and Hokkaido. However, he did not leave it at this, and in 1898 he separated the Goto populations as a different genus, *Sikaillus*, from the northern ones, *Sika*.

According to Heude (1898), the largest Goto Sika are always smaller than the smallest from elsewhere; as will be shown below, this is not correct, but Heude possibly did not have specimens from Honshu south of Biwa Ko. In addition, Heude states that in Goto specimens the length and breadth of the frontals are always equal, whereas in other Sika the orbits are more prominent, making the breadth greater than the length; his table (p. 109), however, does not bear this out, the "longueur intersourcilière" being always greater than the "longueur frontale", even in Goto forms (there remains, however, a slight average difference in proportions, indicating an allometric effect). Again, Goto Sika are said by him to have shorter nasal bones, with their "anterior ends" (surely meaning the naso-frontal sutures) along a line joining the posterior end of the ethmoid fissures, while in the large Sika from elsewhere these are situated between the posterior ends of the ethmoid fissures and the orbits; this difference does seem to have some substance (see below), though here too, it is average rather than absolute. Finally, no Goto Sika, according to Heude, has the forehead shorter than the nasals, whereas the opposite is the case in the specimens from other regions; his table more or less confirms this: only one specimen out of the four large Sika he gives as having the nasal as much as 1 mm shorter than the frontal, while all twelve Goto skulls have the nasal 2-15 mm shorter; this, of course, is also an aspect of the general shortness of the nasals in Goto Sika.

It is interesting to note that Heude (1884, 1898) apparently accepted that the type series of Von Siebold and Bürger had come from the Goto islands. The first species in his Goto group, *Sika schlegeli* Heude, 1884, is evidently

meant to be a re-naming of Temminck's *Cervus nippon* and *C. sika*, but why he changed the name and on what grounds he identified some of his specimens with it, remains unclear. In 1898, his enumeration of Goto "species" starts with "*Sikaillus sika* T. et S. (?)", "*Cervus sika* T. et S." being given as synonym; no mention is made of his former *Sika schlegeli*. The principal dimensions of the skull and the general aspects of the animal "en pied" are given here as the characters on which this identification is made.

For many specialists today, Heude's work is so unorthodox and confusing that it is generally ignored. For a long time it seems to have remained unknown in Japan, for Kishida described *Cervus matsumotei* from Hokkaido (1924) and *Cervus centralis* from Nikko, north of Tokyo (1936), evidently oblivious of the availability of a great number of names for these forms (these two references appear to be unavailable in Europe or Australia and have been taken from Imaizumi, 1970). Kuroda & Okada (1950) described two "varieties", presumably intended to be subspecies, from the small islets south of Kyushu; these are not far from Nagasaki, but there is no evidence that Von Siebold or Bürger obtained specimens from them. *Cervus nippon* var. *yakushimae* is from Yakushima, *C. n.* var. *mageshimae* from the tiny island of Mageshima nearby. The skull material consisted of 4 specimens from Yakushima and only two from Mageshima; although on this limited material the differences between the two seem convincing, Imaizumi (1960, 1970) synonymized both. A presumed difference was that *yakushimae* usually has only two forks to the antlers, while *mageshimae* develops three "in old males"; knowing, however, how fundamentally this depends on food supply and noting the authors' remark that some Yakushima males do indeed develop three forks, this argument loses much of its strength.

Imaizumi (1960) recognizes four subspecies of *Cervus nippon* in Japan:

- C. n. nippon* Temminck, 1838 [recte: 1836] - Kyushu and Shikoku;
- C. n. yakushimae* Kuroda & Okada 1950 - Yakushima and Mageshima;
- C. n. centralis* (Kishida, 1936) - Honshu;
- C. n. yesoensis* (Heude, 1884) - Hokkaido.

The fourth name, deriving from Heude, makes the adoption of Kishida's *centralis* rather than one of Heude's names for the Honshu form rather puzzling. There are four names in Heude's 1884 work that were given to Honshu specimens: *orthopus* (Kobe), *aplodontus* (north of Tokyo), *mitratus* (Tokyo) and *xendaensis* (Sendai); in 1897, Heude described a further "species" from Tokyo, three more from Sendai and one from Mino, west of Tokyo. Any of these names takes priority over *centralis* for a Honshu subspecies.

The same author later (Imaizumi, 1970) revised his opinion, dividing the Sika into four full species, one of them new. His arrangement became:

Cervus nippon Temminck, 1838 [recte: 1836].

C. n. nippon Temminck, 1838 [recte: 1836] (*centralis* a synonym): Honshu, Shikoku, Kyushu, Goto islands and several other small islands.

C. n. yakushimae Kuroda & Okada, 1950 (*mageshimae* a synonym): Yakushima, Mageshima.

C. n. euopsis (Schlater, 1874) [recte: (Swinhoe, 1874)]: "Southern Manchuria" (see below).

Cervus hortulorum Swinhoe, 1864.

C. h. yesoensis (Heude, 1884): Hokkaido.

Three mainland races.

Cervus taiouanus Blyth, 1860: Formosa.

Cervus pulchellus Imaizumi, 1970: Tsushima.

It may be remarked of this arrangement that the reason given for making four species out of one — different intercepts on a cline of size against "temperature", derived from Bergmann's rule — is unconvincing; that his new taxon, *C. pulchellus*, is doubtlessly valid, but at subspecific level only: and that the form *euopsis*, supposedly from Manchuria, is very likely not from there at all, being named on the basis of a living specimen imported from Tientsin, China; it may well have originated from southern Japan, which would explain why Imaizumi found its skull almost indistinguishable from those from Japan.

In his list of specimens Imaizumi (1970) includes two of the Leiden skulls, giving them the locality "Nagasaki" without discussion. He gives condylobasal and nasal lengths for all the specimens he studied: in the British Museum, in Leiden and in Japan. The number turns out to be disappointing: presumably collectors have generally thought of the Sika as an animal too common to bother about.

Using Imaizumi's list of measurements as a basis, we compared measurements of Sika from different parts of Japan. The specimens measured by Kuroda & Okada (1950) apparently have not been seen by Imaizumi, and some specimens in the British Museum (and the remaining Leiden skulls) are not in his list either. Heude (1898) gives measurements of twelve skulls from the Goto islands and two ("*aplodonticus*") from north of Tokyo, as well as two of "*blakistoninus*", which, as discussed above, most likely is from Hokkaido. Heude's measurement of skull length is taken "from the posterior border of the foramen magnum", which turns out, on the basis of compar-

isons made on British Museum skulls, to be approximately equivalent to the condylobasal length, within 4 mm either way.

Even in the small series considered in Imaizumi's table there appears to be a size difference between the skulls from northern Honshu (Nikko, Mt. Yatsugatake, Mt. Amagi) and those from southern Honshu (Yamaguchi, Hyogo, Nara). The southern Honshu skulls, moreover, cannot be distinguished in condylobasal or nasal length (the only two parameters Imaizumi uses) from those of Shikoku. One skull of uncertain locality, but collected by Pryer, whose specimens as a rule came from the Tokyo area, fits within the northern Honshu group; it should be noted that Imaizumi inexplicably lists this skull as being from Hokkaido, without comment. Males and females do not differ in size in the series from southern Honshu or from Yakushima, but a female from Mt. Yatsugatake, northern Honshu, recorded by Imaizumi, is smaller than any of the males of that region, which seems to indicate that (conforming to a common mammalian trend) sexual dimorphism exists in the larger (here, northern) forms, but not in the smaller (southern) ones.

Table 1 shows the results of our comparisons, using condylobasal and nasal lengths only. Antler dimensions given by Imaizumi (1960) are included for comparison, though it should be noted that, under *C. n. centralis*, Imaizumi in his 1960 book included specimens from both northern and southern Honshu; they may, however, serve as a guide. From this table it is apparent that three groups differ significantly as to size: 1) those from Hokkaido, 2) from northern Honshu and 3) a group from the more southerly localities, both large and small islands. As far as the range of variation goes, the norm for the standard deviation seems to be about 9 or 10, which is about 3-4% of the mean. The standard deviation for the southern Honshu/Shikoku group is very small, doubtless as a consequence of the relatively small sample, that for the Yakushima/Mageshima group quite large, again doubtless for the same reason. If the two skulls — one male, one female — from Mageshima are excluded, the mean for Yakushima alone is 228.0 mm and the standard deviation 12.7, which is no great improvement.

Our main conclusion from the comparison of nasal lengths is that the small island forms (Goto islands, Yakushima, Mageshima) have relatively short nasal bones, a feature pointed out already by Heude (1898) for the Goto Sika as opposed to the northern Honshu and Hokkaido specimens, along with the small size of the former. But the wide standard deviations do not permit this to be used as a subspecific character, at least not at the present state of knowledge.

Antler length decreases from north to south, and among the southern group specimens from the Goto islands and Yakushima have unusually small

TABLE I
Skull and antler measurements of *Cervus nippon* from Japan.

	condylobasal length			nasal length			antler length			Reference of skull measurements 4)		
	mean	s.d.	range	n	mean	s.d.	range	n	mean		range	n
Hokkaido	297.7	7.5	285-305	5	111.8	5.4	105-118	5	751	718-818	8	Imaizumi (1960, 1970), Heude (1898)
N. Honshu, 1)	274.2	10.5	260-293	6	95.6	7.8	83-105	6	(482)	348-718	45) 3)	Imaizumi (1960, 1970), Heude (1898), B.M. material
S. Honshu, 2) Shikoku	238.0	3.8	233-243	6	81.7	4.0	75-87	6	(398)	349-478	8) 3)	Imaizumi (1960, 1970), Heude (1898), B.M. material
Goto Islands	236.6	9.7	220-254	12	74.9	3.8	68-80	12	330	270-350	6	Heude (1898)
Yakushima, Mageshima	231.9	15.3	209-260	8	74.8	5.3	67-82	7	308	260-419	5	Kuroda & Okada (1950), B.M. material
Leiden skulls												
reg.-nr.												
Lectotype, 25987	-				79				424	old ad.		
25988	229	(Imaizumi, 1970: 228)			74	(Imaizumi, 1970: 73)			271	young ad.		
25990	232				72				277	ad.		
25991	229				71				188	(deformed) young ad.		
25992	223				70				-	old ad.		
25993	229				75				239	(deformed) young ad.		
25994	226	(Imaizumi, 1970: 227)			68	(Imaizumi, 1970: 68)			343	ad.		

1) Localities: Nikko, Yatsugatake, Mt. Amagi, "north of Tokyo".

2) Localities: Yamaguchi, Hyogo, Nara (Honshu); Shodoshima Island, Kagawa (Shikoku). The sample does not include Imaizumi's (1970) "Nagasaki", which refers to his two Leiden skulls.

3) These 2 samples do not refer exactly to the same populations on which the skull measurements are based, but are, respectively, Imaizumi's (1960) *centralis* (including both northern and southern Honshu) and *nippon* (including Kyushu and Shikoku).

4) Antler lengths have been taken from Imaizumi (1960) and Kuroda & Okada (1950).

antlers compared to those from Kyushu¹⁾ and Shikoku (southern and northern Honshu not separated by Imaizumi, 1960) and, apparently, those from Mageshima (the mean of the four Yakushima specimens is 285.5, the range 260-330). Reasons have been given above for caution in interpreting antler measurements, though it is possible that insular races can be recognised by using this feature as a criterion, though not as the only one.

The shoulder height of the Hokkaido stag is given by Imaizumi (1960) as 1010 mm; that of the Honshu form recognised by him (i.e. from all over Honshu) as 830-860 mm; and that of the Kyushu/Shikoku form as 804 mm. External measurements of Goto Sika are lacking, but for Yakushima deer Kuroda & Okada (1950) give 600 and 685 mm (4-year old ♀ and ♂, respectively), and for a Mageshima specimen 770 mm (4-year old ♂). These figures do not quite square with those of the condylobasal length of the skulls, in that the figure for Yakushima is less than that for Mageshima, but the inherent inaccuracy of height measurements and the very small sample sizes both seem to reduce the significance of this difference.

Colouration too, is described as different in the various forms. The Hokkaido stag is figured by Imaizumi (1960) as speckled grey in winter and seems to be less brownish than any of the others. Heude (1898) describes the Goto Sika as blackish to dark brown in winter; a skin in the British Museum from Washikaguchi, Nara District, southern Honshu, dated January 14 (5.5.30.29) fits this description, being perhaps greyer than average. The winter coat of *yakushimae* is described by Kuroda & Okada (1950) as pale brown, paler than that of Imaizumi's Honshu form, and is figured as reddish brown in Imaizumi (1960); however, a skin in the British Museum from Yakushima, dated October 18 (5.11.3.44) and thus in transition, is very dark grey-brown with indistinct white spots. On the whole, deer from northern Honshu and Hokkaido seem to average darker, but this is certainly not absolute. On the other hand it seems that Goto, Yakushima and Mageshima Sika do not become truly white on the underparts, whereas Honshu and Hokkaido animals do. A dorsal stripe is developed in full winter coat in all. Spots occur in the summer coat of all forms, but are evidently fainter in the more southerly populations.

THE TYPE LOCALITIES

Comparing the Leiden material with these data, it seems that all six adult skulls, on the evidence of their size, would have come from the southern

1) The source of Imaizumi's (1960) Kyushu statistics is unknown, and cannot have been the Leiden material, the only source of Kyushu measurements in his 1970 paper.

part of Japan; and the shoulder heights of the three mounted specimens: 800, about 670, and 655 mm (the latter probably not fully grown), agree with the single available measurements for Kyushu/Shikoku and Yakushima/Mageshima, as given by Imaizumi (1960) and Kuroda & Okada (1950).

The figures for the nasal lengths agree with those of the small-island forms, except for the lectotype (reg. nr. 25987). The same applies to the antler lengths of the skulls and of the mounted young adult male (reg. nr. 25988); the antlers of the young male (reg. nr. 25989) probably are not fully grown. The shoulder height (800 mm) and antler length (424 mm) of the lectotype agree with Imaizumi's (1960, 1970) measurements for the southern Honshu/Kyushu/Shikoku form. The presence of white on the ventral parts of the lectotype and of the young male 25989, and its absence in the young adult male 25988 may also be of some significance in localising the former two specimens to the southern main islands, the latter to the Goto islands; however, the latter may not be in full winter coat and we must as yet be cautious in using this rather uncertain character.

The characteristics of the type series would, therefore, be consistent with Heude's (1884, 1898) opinion that it came from the Goto islands, with the probable exception of the lectotype itself. This is in good agreement with Von Siebold's notes that he received several specimens from the Goto islands. The lectotype seems to have originated from the southern main islands and may thus have come from the surroundings of Nagasaki.

In our opinion, the similarity between the Sika of the Goto islands on one side and of Yakushima and Mageshima on the other side, may well be the result of convergence in a small-island habitat. A polytopic subspecies for these small-island populations, based primarily on size and on the absence of white on the underparts, does not seem very convincing to us, at least not as long as the available material is so limited. We believe, however, that the significant differences between the Sika of northern Honshu and those of the more southern localities do warrant recognition of a distinct subspecies; from the measurements given in Table 1 it is clear that the type series belongs to the southerly subspecies.

For the northern Honshu race we use the name *aplodontus* Heude, 1884. This is not only the first-mentioned form with its type locality definitely within this area, but also, conveniently, the one for which Heude later (1898) quoted skull measurements (as *aplodonticus*).

SUBSPECIES AND SYNONYMS

The subspecies of Japanese Sika as recognized by us may be listed as follows:

Cervus nippon nippon Temminck, 1836

- 1836 *Cervus nippon* Temminck. "Isles of Japan"; see text.
 1844 *Cervus sika* Temminck. Objective synonym.
 1846 *Cervus (Hippelaphus) japonicus* Sundevall. Objective synonym.
 1874 *Cervus euopsis* Swinhoe. "Newchang, Manchuria"? (see text).
 1878 *Cervus mantchuricus minor* Brooke. Japan.
 1884 *Sika schlegeli* Heude. "Small islands south of Japan", in 1898 specified as Goto Islands.
 1884 *Sika infelix* Heude. Ditto.
 1884 *Sika fuscus* Heude. Ditto.
 1884 *Sika brachypus* Heude. Ditto.
 1884 *Sika hollandianus* Heude. Ditto.
 1884 *Sika orthopus* Heude. Kobe.
 1888 *Sika paschalis* Heude. Figure only; textual description in 1898, where specified as Goto Islands.
 1888 *Sika aceros* Heude. Ditto.
 1888 *Sika rex* Heude. Ditto, but specified as Fukuye Island, Goto group.
 1888 *Sika dejardinus* Heude. Ditto, but specified as Goto Islands.
 1888 *Sika marmandianus* Heude. Ditto.
 1897 *Sika orthopodicus* Heude = *orthopus*.
 1897 *Cervus sika typicus* Lydekker. Japan and northern China.
 1898 *Sikaillus sika* "T. et S. (?)" Heude. Goto Islands.
 1898 *Sikaillus daimius* Heude. Goto Islands.
 1898 *Sikaillus regulus* Heude. Goto Islands.
 1898 *Sikaillus sicarius* Heude. Goto Islands.
 1898 *Sikaillus consobrinus* Heude. Nakadori Island, Goto group.
 1898 *Sikaillus latidens* Heude. Goto Islands.
 1914 *Cervus nippon typicus* Lydekker. New combination.
 1950 *Cervus nippon* var. *yakushimae* Kuroda & Okada. Yakushima.
 1950 *Cervus nippon* var. *mageshimae* Kuroda & Okada. Mageshima.
 Southern Honshu (south and west of Biwa Ko); Shikoku; Kyushu; Goto Islands; Yakushima; Mageshima.

Cervus nippon aplodontus (Heude, 1884)

- 1884 *Sika aplodontus* Heude. North of Tokio.
 1884 *Sika mitratus* Heude. Tokio.
 1884 *Sika xendaiensis* Heude. Surroundings of "Xendai".
 1897 *Sika sendaiensis* Heude = *xendaiensis*. Sendai, but a skull of a fawn from Hakodate (Hokkaido) was also included in this species.
 1897 *Sika aplodonticus* Heude = *aplodontus*.
 1897 *Sika schizodontus* Heude. Tokio.
 1897 *Sika ellipticus* Heude. Sendai.
 1897 *Sika elegans* Heude. Sendai.
 1897 *Sika mimoensis* Heude. Mino.
 1936 *Cervus nippon centralis* Kishida. Nikko.
 Northern Honshu (north and east of Biwa Ko).

Cervus nippon yesoensis (Heude, 1884)

- 1884 *Sika blakistonimus* Heude. No locality beyond inclusion in a group from "Nippon and Yeso"; by inference (see text), Hokkaido.

- 1884 *Sika dolichorhinus* Heude. Yeso.
 1884 *Sika legrandianus* Heude. Yeso.
 1884 *Sika yesoensis* Heude. Hakodate. Selected as valid name by Imaizumi (1960).
 1884 *Sika sylvanus* Heude. Yeso.
 1897 *Sika rutilus* Heude. Yeso.
 1924 *Cervus matsumotei* Kishida. Hokkaido.
 Hokkaido.

ACKNOWLEDGEMENTS

Thanks are due to Dr. G. B. Corbet, former curator, and Dr. I. M. Bishop, present curator of the Mammal Section, British Museum (Natural History), and to Dr. A. M. Husson, former curator of the Mammal Section, Rijksmuseum van Natuurlijke Historie, for their assistance when studying the specimens under their care; and to Prof. Dr. L. B. Holthuis, Rijksmuseum van Natuurlijke Historie, for useful discussions and information on the Von Siebold collections and the Fauna Japonica.

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APPENDIX I

QUOTATION FROM AN UNPUBLISHED MANUSCRIPT BY PH. F. VON SIEBOLD:
 "BEMERKUNGEN ZU DEN SAUGTHIEREN VON JAPAN", PRESENT IN THE RIJKS-
 MUSEUM VAN NATUURLIJKE HISTORIE

Cervus Sika.

Jap. *Sika* (Nom. general.).

(Auch der japanische Jäger hat seine Kunstsprache. *Ka* heisst der Hirsch, *meka*, das Thier, das Kalb *Kago*).

Der Hirsch ist noch auf allen japanischen grössern Inseln zu Hause und in einigen Provinzen, wo er als ein heiliges Thier gehegt wird, häufig. Sehr zahlreich soll er auf den Gotôinseln (also im S.W. Theile des Inselreiches) seyn, und ich habe von dorthier während meines Aufenthaltes mehrere erhalten.

Über die Lebensweise und Nahrung des japanischen Hirsches lässt sich nichts neues sagen. Land und Vegetation bringen in dieser Hinsicht nur unbedeutende Veränderungen zu wege. Die Brunftzeit fällt zu Ende October, und nach Aussage japanischer Jäger werfen die Hirsche *im Winter* (Januar) ab und das Thier soll äusserst selten zwei Kälber setzen. — Zu Ohosaka sah ich in 1826 einen Albinos er wurde mir für 150 Koban's (f 1800) zum Kaufe angeboten. ¹⁾

Das Hirschfleisch wird in einigen Landschaften gegessen. Es ist sehr schmackhaft. Hirschfoetus und Hirschhorn sind officinell.

¹⁾ Die vorhandenen Hundezähne und Rosen an den Hinterbeinen, die rothen Augen, kurz die ganze Haltung des Thieres liess es als ein Albinos von *Cervus Sika* erkennen.

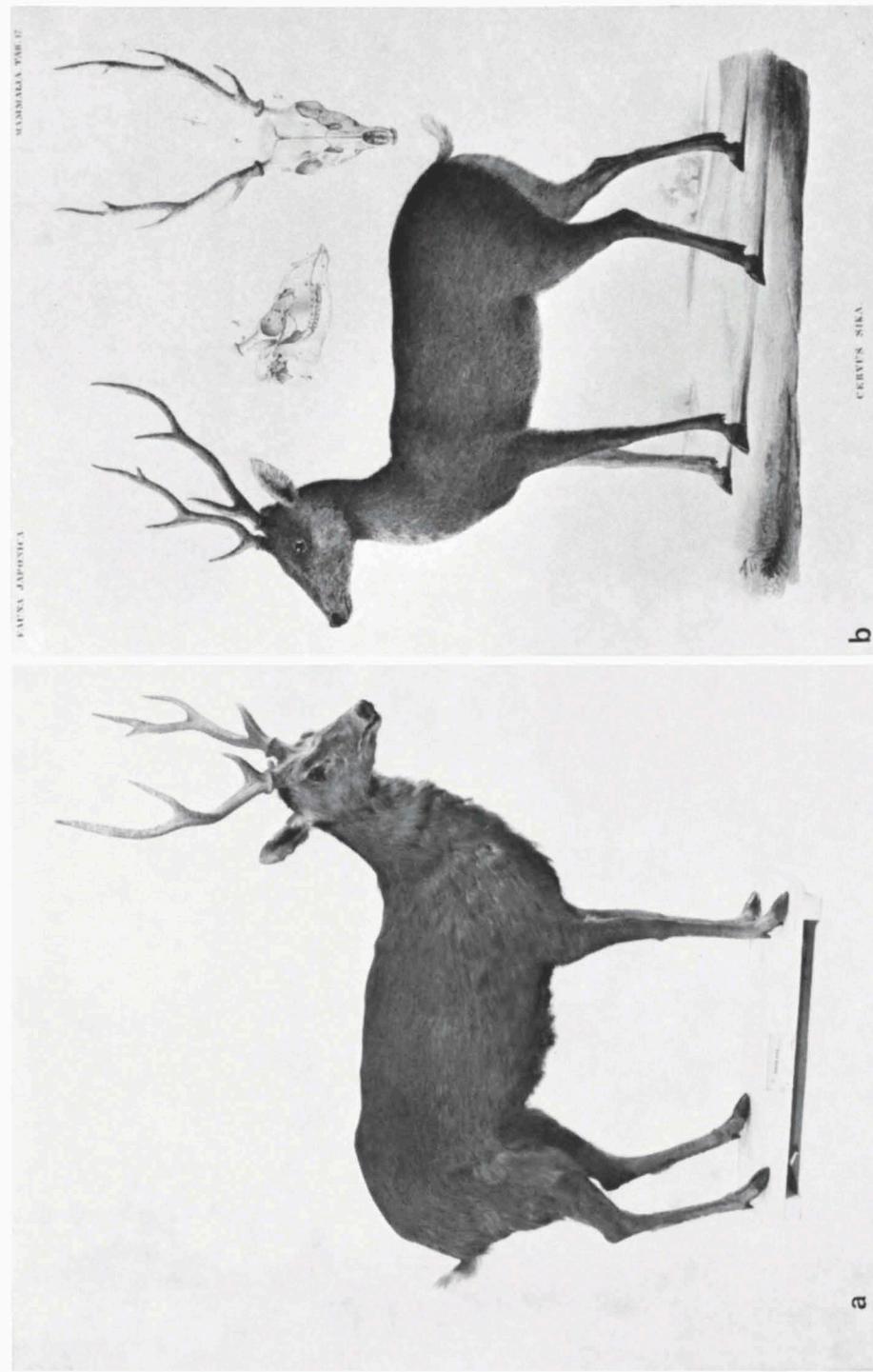


Fig. a. RMNH reg. nr. 25987, lectotype of *Cervus nippon* Temminck, 1836 and of *Cervus sika* Temminck, 1844; Cat. syst. a, figured in Fauna Japonica, pl. 17. Fig. b. Fauna Japonica, pl. 17 of *Cervus sika* Temminck, 1844, showing the lectotype with the antlers of RMNH reg. nr. 25994 and the skull RMNH reg. nr. 25988.

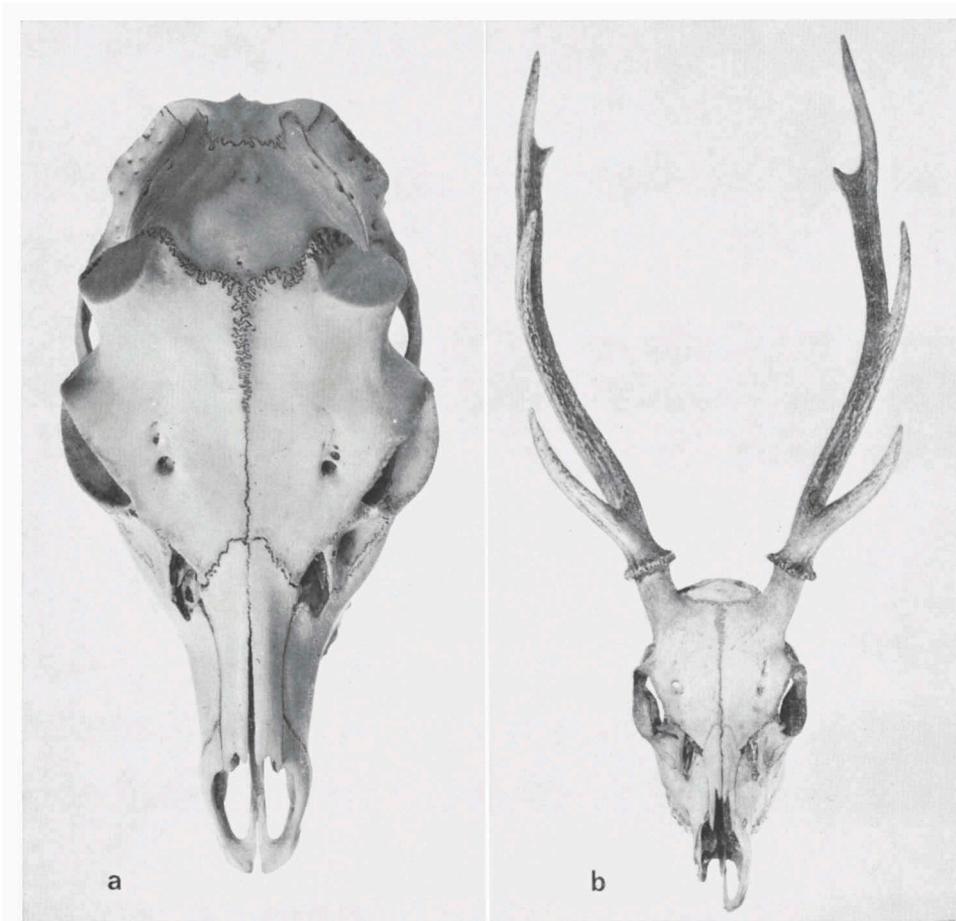


Fig. a. Skull RMNH reg. nr. 25988, paralectotype of *Cervus nippon* Temminck, 1836 and of *Cervus sika* Temminck, 1844; Cat. ost. g, probably figured on Fauna Japonica, pl. 17. Fig. b. Skull with antlers RMNH reg. nr. 25994, paralectotype of *Cervus nippon* Temminck, 1836 and of *Cervus sika* Temminck, 1844; Cat. ost. f, antlers figured on Fauna Japonica, pl. 17.

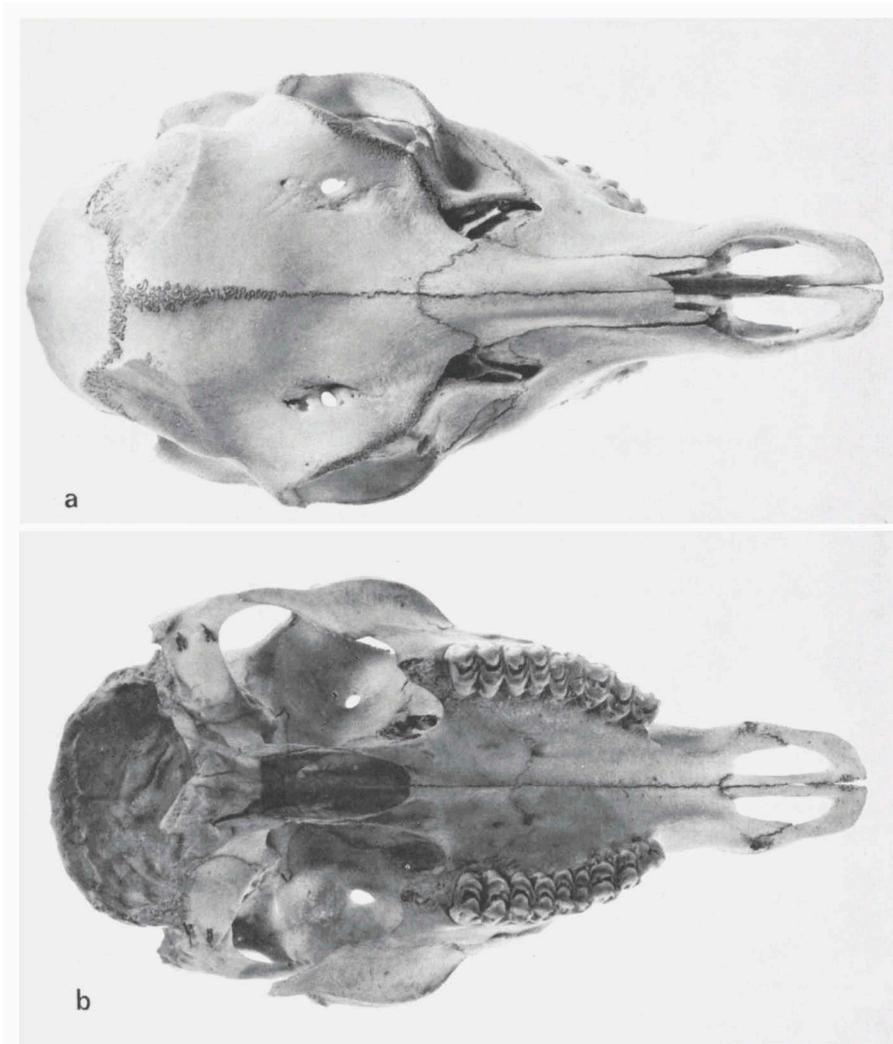


Fig. a. Skull RMNH reg. nr. 25987, lectotype of *Cervus nippon* Temminck, 1836 and of *Cervus sika* Temminck, 1844; Cat. ost. e. Dorsal view. Fig. b. The same, ventral view.

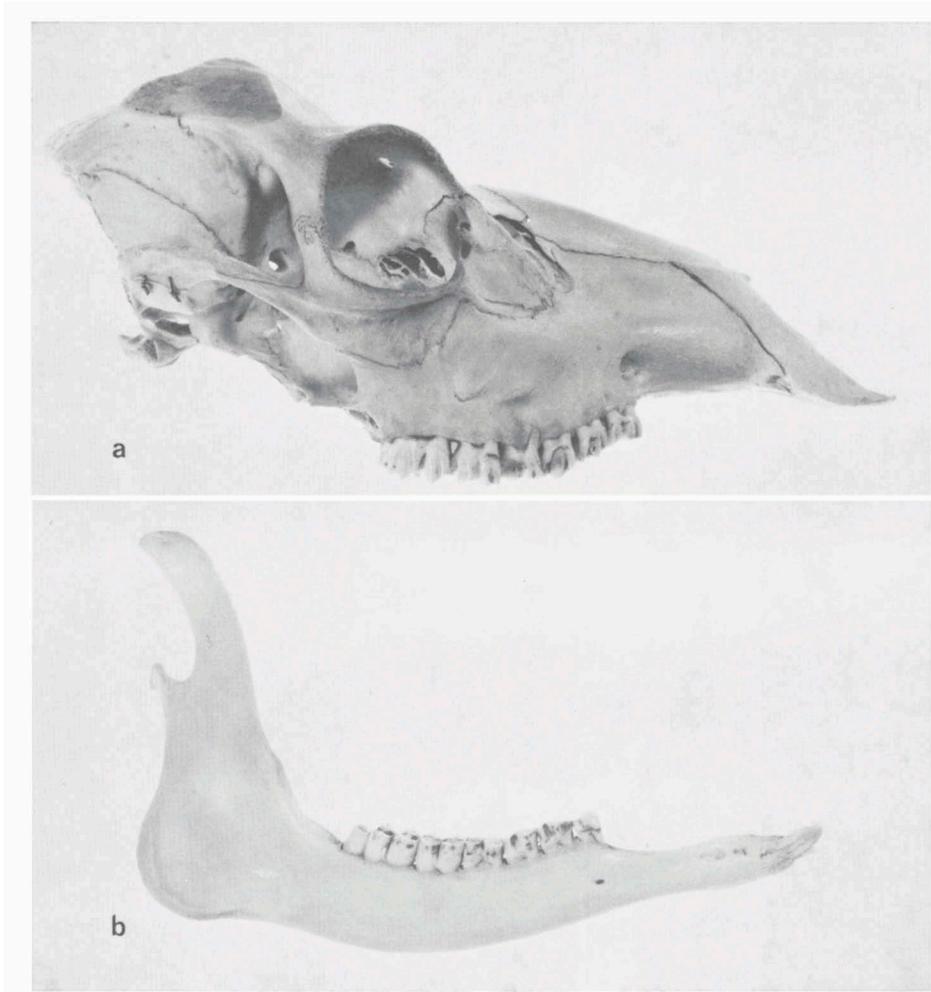


Fig. a. The same as on pl. 3, lateral view. Fig. b. The same, lower jaw.