REVISION OF THE RUSINE DEER IN THE INDO-AUSTRALIAN ARCHIPELAGO

by

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I. GENERAL PART

In some previous notes on deer (VAN BEMMEL: Treubia, hors série, pp. 149-154, 1944; Treubia 19, pp. 403-406, 1948) I already pointed to the necessity to review the larger deer occurring in the Indo-Australian Archipelago. A preliminary note on a method used in the investigations communicated hereafter, has been published in "Bijdragen tot de Dierkunde", 28, pp. 26-31, 1949.

During a leave in Europe in 1946-1947, I had the opportunity to study the material in the Rijksmuseum van Natuurlijke Historie at Leiden (Holland) and the British Museum N.H., London. My thanks are due to Mr R. I. POCOCK, Mr T. S. C. MORRISON SCOTT, the late Mr J. L. CHAWORTH-MUSTERS (London), Dr G. C. A. JUNGE, Dr L. D. BRONGERSMA (Leiden), Prof. Dr L. F. DE BEAUFORT, Dr J. H. WESTERMANN and Mr H. J. V. SODY (Amsterdam) for their kind help and advice, to Dr J. WESTENBERG (Makassar), Mr C. B. ARRIENS (Flores), Mr B. VAN DER SLUYS (Kandangan) and Mr G. A. L. DE HAAN (Weda) for providing me with valuable additional material and to the members of the I.J.G. for valuable information from their hunting experience.

It is a well-known fact to every zoologist interested in big game, that collections of game animals are very scarce in our Musea. The collections used by the present author also often proved to be insufficient. But as many previous treatises on the larger deer of the Indo-Australian Archipelago have been based on material from Zoological Gardens, changed by captivity and often from unknown origin, it seems worth while to give a review here that might be a base for further investigations. I should like to point to the necessity to collect much more information about the biology of our big game, because many laws and regulations concerning the subject of hunting are based on ill-founded suppositions. In the present treatise I tried to collect every fact that might be useful for practical purposes.

INTRODUCTION

The taxonomist comes across difficulties of various kinds if he tries to establish the specific and racial characters in deer during a systematic investigation. To begin with, deer are sexually dimorphic and present an obvious periodicity, connected with the sexual cycle. This periodicity is expressed in the regular shedding and regeneration of the antlers, glandular activity and suchlike. Besides, a seasonal variation occurs, expressed in the colour and condition of the coat. Curiously enough this seasonal variation is present also in tropical species.

The sexual and seasonal variations do occur simultaneously in species of temperate regions, because there the sexual cycle is connected with the seasons. In tropical species this is much less true. Here every individual follows its own cycle and the course of this cycle often may present considerable fluctuations, even among individuals of one and the same population.

Table 1. Sexual differences in some populatio

Collection number	Locality	Sex	Age in years (y.) or months (m.)	Condylobasal length from oral border for. magn.	Index	Occipito-nasal length	Index	Total length of skull	Index	Zygomatic breadth	Index	Greatest width of braincase	Index
1891	W. Java, Tegal Waru Est.	♂	14 m.	258	100	251	97,3	296	114,7	114	44,2	82	31,
1148	id.	♀	14 m.	250	100	235	94	277	110,8	107	42,8	72	28,
1916	E. Java, Jang Highland	♂	5 y.	298	100	278	93,3	324	108,7	141	47,3	84	28,
1921	id.	♀	5 y.	267	100	258	96,6	297	111,2	123	46	80	29,
512	N. E. Komodo	♂	11 y.	253	100	237	93,7	276	109,1	122,5	48,4	68	26,
507	id.	♀	11 y.	230	100	220	95,7	254	110,4	103	44,8	64	27,

But the taxonomist is confronted with other inconveniences. There are differences between years, favourable and unfavourable to the game, expressed in the development of antlers and coat. DÖDERLEIN has given a well-known description of this phenomenon (Abh. Bay. Ak. Wiss. 31, 3, 1927). Last but not least the taxonomist is confronted with characters due to age. These last characters cause most trouble, because they are the least obvious ones. Several times stress has been laid on the fact that important changes may take place in stature, antlers of the males, coat and ratio of skull-measurements, after the animals have attained maturity. The first three items have been treated in some length in European hunting literature. Important treatises on the changes in the ratio of skull measurements were written by A. RÖRIG (Anat. Anzeiger, Jena, 26, pp. 17-25, 1905) and O. INGEBRIGTSEN (Bergens Mus. Aarbok, H.2, 7, pp. 1-262, 1922-'23 and Nyt. Mag. Naturvid., Bd. 65, 1927). Of this last-mentioned paper only an excerpt was available to me.

norensis. Specimens of the same age compared.

Length of frontal suture	Index	Lacrimal notch to tip of premaxillaries	Index	Interorbital breadth	Index	Width of palatinum	Index	Length of mandible	Index	Maxillary toothrow	Index	Mandibular toothrow	Index	Length of glandular pit	Index	Depth of glandular pit	Index
00	38,8	166	64,3	76	29,5	—	—	223	86,4	(76)	—	(78)	—	33	12,8	11	4,3
78	31,2	160	64	67	26,8	—	—	214	85,6	(72)	—	(76)	—	32	12,8	8	3,2
98	32,9	180	60,4	95	31,8	51	17,1	254	85,2	91	30,5	101	33,9	42	14,1	11	3,7
34	31,5	166	62,2	76	28,5	49	18,4	231	86,5	88	33	99	37,1	31	11,6	8	3
36	34	155	61,3	78	30,8	43	17	215	85	75	29,6	85	33,6	34	13,4	12,5	3
'4	32,2	145	63	61	26,5	41	17,8	203	88,3	72	31,3	82,5	35,4	26	11,3	8	3,5

Concluding, we can make the following statement: the factors sex, cyclical stage, season (c.q. year) and age have to be eliminated in a systematic investigation of this group. Only animals of the same sex, cyclical stage and age should be compared and seasonal (c.q. year) factors should be taken into account. Most of these factors can be derived without much trouble, but the determination of the age of museum-specimens requires reliable criteria. Before treating systematics, the various factors will be discussed separately.

SEXUAL DIFFERENCES

The sexual differences are conspicuous because of the antlers of the males, this being the most important secondary sexual character. The sexual characters of the skull are the result of the special demands made upon the structure of the skull by the heavy antlers. The occipital part of the skull in males is entirely adapted to this purpose. The facial part of the skull in females is relatively much longer and narrower, the absolute dimensions of the skull always remaining under those of males. The orbital glandpit of females is considerably less developed than in males (Table 1).

In the western races of *R. timorensis* it can be stated concerning the coat, that a heavy mane is present in males. This mane is much less, or not at all, developed in females. Furthermore there often is a considerable difference in colour of the coat between the sexes, especially in the western representatives of *R. timorensis*. Males are much darker and much less yellowish-red than females of the same age. So, in some populations (a.o. from Jang Highland) females are entirely golden-yellow, males always more gray and darker. Even in very young fawns there is already a perceptible difference in colour between the sexes. In year-olds this difference becomes conspicuous. Sexual differences in colour could, on the other hand, not be stated in the material from the Lesser Sunda Islands.

Only few conclusions can be drawn concerning the material of *R. equina* c. subsp. The females are much more reddish on belly and buttocks than males of the same age. Young males do resemble old females in colour of these parts. Females from Borneo present a conspicuous dorsal stripe, but males from Borneo always show a plain dark blackish-brown back. The coat of males in *R. equina* is mostly somewhat longer and denser. "Sore-throat" was found in males only.

SEXUAL CYCLE

In tropical species of deer the sexual cycle is much less linked up with the seasons than in species of temperate regions. In several parts of the Archipelago a more or less pronounced rutting-season seems to occur. But often only an increasing frequency of rutting animals can

be stated in certain times of the year. The breeding season presents just the same figures. Young are born the whole year through, with an increasing frequency in one or two periods of the year. These periods are extremely variable according to the region and sometimes to the year.

The development of the secondary sexual characters, i.c. the antlers, is closely linked up with this phenomenon. In Borneo antlers in velvet were stated in December, March, April, May and September (BANKS, 1931). In Lombok one roaring stag, a fawn of three months old and two stags in velvet were observed on the same day (LAPRÉ, 1948). Statements of birth (SODY, 1941) for Celebes present the same irregular figures. Quotations will be given in some detail under the systematic part.

The fact that stags in velvet and rutting stags are often observed at the same time, has given cause to the story, to be met everywhere, that the sexual cycle takes much longer than a year. This opinion was strengthened by some observations in captivity, in which the antlers were kept even three years! This may occur exceptionally under abnormal circumstances, but certainly this is not the normal rule.

SEASONAL VARIATION

To get a really satisfactory survey of seasonal variations, large series from the same locality and from different seasons would be needed. The material at my disposal can only give some indications in a certain direction.

Concerning *Rusa equina* c. subspec. the material is insufficient for general conclusions. Small series of *R. timorensis* are available from four different localities in Java: Jang Highland (E.), Tjilatjap (C), Tegal Waru Estates (W.) and Bantam (W.).

Moulting occurs in Java about December. Rusty-red spots appear in the grayish-brown coat and about January-February the animals have become entirely dark. (Sexual differences and differences due to age are described separately). Colour becomes lighter as the year proceeds, in males as well as in females. The principal change occurs in June-July. An obvious second moult could not be stated, the change is much more gradual than in December. Mane in males is much more heavy in the first half of the year than it is in the second half, in Eastern as well as in Western Java. The populations with poorly developed mane from Central Java and Tegal Waru Estates do not present any seasonal variation in this respect. From the Lesser Sunda Islands there is only one beautiful series available from Flores, collected in October and a skin from Sumba collected in February. In the series from Flores moulting has started. The skins are very light-yellow and the new hair shows between as dark maroon-red spots. Moulting seems to start earlier here than in Java. The skin from Sumba is warm rusty-red. Seasonal differences are conspicuous here. In the Sula Islands moulting starts early in September.

CHARACTERS OF AGE IN THE DENTITIONS AND THE DETERMINATION OF AGE IN MUSEUM SPECIMENS

NEHRING Bros. (Forstwiss. Centr. Bl. 33, 1889, pp. 231-243 & "Wild und Hund", pp. 679-682, 696-699, 712-715, 1904) worked on an elaborate scheme of age-determination on account of the dentitions of European red deer (*Cervus elaphus* L.) [1]). Nothing has been published until now about age-determination in East Asiatic representatives of the genus *Rusa*.

Following the results of NEHRING's investigations I tried to arrange the beautiful series of "Javanese deer" (*Rusa timorensis* c. subspec.) in the collection of the Zoological Museum at Buitenzorg, according to age. This proved to be practicable, because in such an extremely variable group as are the *Cervidae*, the morphological structure of the dentition is quite constant and in consequence interspecific and even intergeneric comparison must be possible. In this way I could arrange a series substantially corresponding with those of NEHRING.

As an important indication I used NEHRING's character of the wearing-down of incisiform front teeth, which presented a rough criterium for very old, old, less old and young. I had to assume that a Rusine deer, presenting the same stage of wearing-down as a corresponding specimen of *C. elaphus* is actually of the same age. This could be doubted *a priori* because it is often assumed that tropical species grow old much faster than corresponding species from temperate regions. To conclude these speculations I have to point out the fact that age-determination by NEHRING met with much criticism because his theory of the gradual wearing-down of the dentition was considered to be unproved and an age of twenty years, at the utmost, for *C. elaphus* was considered to be too low. Up to this point my suppositions were totally hypothetical and I had to find proofs.

In the Buitenzorg Museum a collection of shedded antlers and of lower jaws is available, presented by Mr A. LEDEBOER. This series is collected on the Jang Highland (E. Java) and is said to be arranged according to age. I do not know whether this collection was arranged by Mr LEDEBOER himself or maybe in collaboration with the late Mr P. F. FRANCK, formerly taxidermist of the Buitenzorg Museum. Neither do I know whether the valuation of ages is based on field-observation, for which Mr LEDEBOER had the best opportunity in his wonderful game-reserve, or on *post mortem* valuation. The collection is labelled by FRANCK. The arrangement is subject to criticism. The dentitions of the lower jaw are valuated at an age much lower than should be the case according to the scheme of NEHRING's. The sequence too should be altered.

[1]) Modern German hunting-literature was inaccessible to me.

A skull in our collection, presented also by Mr LEDEBOER, and labelled in FRANCK's handwriting: "Etwa 8-jähriger Feisthirsch" is much older, not only according to the scheme of NEHRING, but also according to the series of LEDEBOER & FRANCK. According to NEHRING this stag should be 14 years old, according to LEDEBOER & FRANCK 10 years old! So I had some doubts as to the value of these data. This doubt was strengthened by the much idealised presentation given of the development of antlers. I do not want to belittle the undeniable professional knowledge and merits of LEDEBOER and FRANCK, but I think that their series is insufficiently exact to serve as a scientific proof.

In examining the material available I found, after arranging the series according to the scheme of NEHRING, a small collection of skulls from animals in captivity, which I had put aside as useless for systematic investigation. In this series there proved to be skulls of animals which came to an estate when small fawns. They lived there under nearly normal circumstances with much freedom and their age was exactly known. Inserting these skulls in the series, arranged according to the scheme of NEHRING, I was able to control the method I used. By this control I actually got the confirmation I had expected. That is to say, as far as material not older than five years was concerned. The specimens from captivity older than five years proved to be insufficiently labelled, abnormally developed or pathologically deformed. The material of *Rusa equina* from captivity did not meet the requirements either. So the age-determination in *R. equina* had to be performed by comparison with *R. timorensis.*

Data concerning shedding of teeth are sufficiently exact, a good series from Java and one specimen from Sumba of known age being available. Furthermore I could make some observations about teeth-shedding on a specimen of *R. equina brookei* kept in the Royal Botanic Gardens at Buitenzorg. As far as animals older than five years are concerned I give the valuation for what it is meant to be: an estimation with the greatest chance of probability.

Already the brothers NEHRING pointed out that the dentition of the upper jaw offers a better starting-point than the dentition of the lower jaw. They took M^1 as a criterion and this proved to be useful. The wearing-down of the dentition is subject to some individual variation. In the same stage of wearing-down of the M^1, one specimen has the oral elements, an other the caudally situated elements somewhat more worn. I could not prove any correlation between the wearing-down of the dentition and environment, locality or sex.

In a preliminary communication (v. BEMMEL: Bijdr. Dierk. 28, pp. 26-31, 1949) I offered a survey of the character that proved to be most useful in practice viz. the sequence of the dentine pattern in M^1 of the upper jaw. In the following description most stress has been laid on this

element. Premolars show too much individual variability in wearing-down to be of any use for an exact determination of age.

Upper Jaw.

3 years old (Pl. 2, fig. 1).

Crests and crescents just a little worn, dentine just visible between enamel. In M^1 the dentine of anterior crest (pa.), posterior crest (me.), anterior crescent (pr.) and posterior crescent (hy.) entirely separated by enamel-ridges. The islands of dentine are somewhat broadened centrally. In M^2 this last feature is scarcely developed, in M^3 the dentine is visible only as a narrow fissure. Bifurcation of the caudal parts of crescents is obvious, except in M^3. Cingula not yet worn.

5 years old (Pl. 2, fig. 2).

Grinding surface broadened, crests shifted in buccal direction, crescents shifted in lingual direction. Centre of dentine-islands broadened squarely on axis of the jaw. This broadening is especially obvious in M^1. Cingulum of M^1 and M^2 somewhat worn, in M^3 unworn. In all molars dentine of pa. and me. in contact. In M^1 and M^2 dentine of pr. and pa. in contact orally, dentine of hy. and me. in contact caudally. Dentine of pr. and hy. separated in all molars. Bifurcation of caudal parts of crescents less obvious in the oral elements but in M^3 at this stage visible for the first time.

c. 9 years old (Pl. 2, fig. 3).

In M^1 contact appears between the dentine of pr. and hy. by way of the cingulum-element. No direct contact yet occurs here. In M^2 dentine of cingulum still isolated. In M^3 contact occurs between dentine of pr. and pa. at the oral part of the crown, caudally dentine of hy. and me. are united. In M^2 and M^3 dentine of pr. and hy. are entirely separated. Bifurcation of crescents has become obsolete except in pr. of M^3.

c. 12 years old (Pl. 2, fig. 4).

In M^1 the five dentine-islands are nearly entirely united. Separation is indicated only by some rudimentary enamel-ridges. In M^2 the five dentine-islands are connected by narrow communications. Pr. and hy. are connected both by way of the cingulum and directly. In M^3 pr. and hy. are connected by way of the cingulum but not yet directly.

c. 15 years old (Pl. 2, fig. 5).

In M^1 dentine entirely united, enamel-ridges have entirely or nearly entirely disappeared. The cingulum has disappeared, M^1 typically narrowed in the direction of the axis of the jaw. In M^2 uniting of dentine-elements proceeds. M^3 has little changed.

c. 20 years old (Pl. 2, fig. 6).

The crown of premolars and M^1 is nearly entirely worn down. The stubs of the roots have been smoothly polished. M^2 has strongly been narrowed in the direction of the axis of the jaw. The cingulum has disappeared, the dentine of the other four elements has entirely been united.

Table 2. Scheme of the shedding of teeth in the genus *Rusa*.

Month of life	Incisiform teeth	Canines	Cheek-teeth
1		?	?
2	1 2 3 4		?
3		1	1 2 3
4	1 2 3 4		1 2 3
5			
6			
7		1	1 2 3 IV
8	1 2 3 4		1 2 3 IV
9			
10			
11			
12		1	1 2 3 IV V
13	1 2 3 4		1 2 3 IV V
14			
15		1	1 2 3 IV V
16	I 2 3 4		1 2 3 IV V
17			
18			
19		1	1 2 3 IV V VI
20	I II 3 4		1 2 3 IV V VI
21			
22			
23		1 +	I II 3 IV V VI
24	I II 3 4 +		1 II 3 IV V VI
25			
26			
27		I	1 II III IV V VI +
28	I II III IV		I II 3 IV V VI +
29			
30			
31		I	I II III IV V VI
32	I II III IV		I II III IV V VI

\+ Individual variation.

In M^3 uniting of dentine-elements is proceeding. Just now pr. and hy. are broadly interconnected.

Lower Jaw.

3 years old (Pl. 3, fig. 1).

Crests and crescents just a little worn. The crests of M_1 with centrally broadened dentine-islands. In M_1 the anterior crescent is interconnected with the posterior crest (crossing-over).

c. 6 years old (Pl. 3, fig. 2).

Dentine-islands in all molars with central broadening. Crossing-over also obvious in M_2.

c. 9 years old (Pl. 3, fig. 3).

Dentine-islands in all molars interconnected.

c. 12 years old (Pl. 3, fig. 4).

In M_1 dentine-islands entirely united, most of the enamel-ridges have disappeared without leaving traces. In M_2 and M_3 dentine-islands broadly interconnected.

c. 20 years old (Pl. 3, fig. 5).

Only slightly differing from the preceding stage. All molars have strongly been narrowed squarely on direction of the axis of the jaw.

Milk-dentition (Table 2).

The milk-dentition did not offer much difficulties. The scheme given here has been drawn up after the example of the scheme given by NITSCHE (Forst- und Jagdkalender, JUDEICH. ex RAESFELD: "Das Rotwild", Berlin, 3d ed., p. 22, 1920) for *C. elaphus*. Some striking differences appeared by comparison of these schemes.

In the material of *Rusa* available to me, the permanent incisivi and canini make their appearance somewhat later, the permanent premolars somewhat earlier than in *C. elaphus*. The very early appearance of the third molar should be noted especially. I have the impression that the third molar appears somewhat later in *Rusa equina* c. subsp. than it does in *Rusa timorensis*, but the material is insufficient for definite conclusions. There is much individual variation in the time of appearance of the permanent canine in the upper jaw, and in the sequence in which the permanent premolars appear. The formulae in the table given here present the average of the juvenile material examined by me (38 specimens of *R. timorensis* c. subspec. and 12 of *R. equina* cum subspec.). In some cases one of the deciduous premolars may stay in function till the age of three years. This can be Pd_1 or Pd_3, in the upper or in the lower jaw or in both of them.

AGE DIFFERENCES IN SKULL-MEASUREMENTS (Table 3)

Age differences in skull-measurements were described by me for *Axis* (*Hyelaphus*) *kuhlii* in Treubia 19, p. 404, 1948. In other species the

progress of growth of the different parts of the skull, before reaching maturity, has been described elaborately. (RÖRIG, 1905; INGEBRIGTSEN, 1924).

After reaching maturity small changes occur as well. This is demonstrated in the best way by calculating indices to reduce the changes in shape to comparable proportions. The distance from the median oral border of the *foramen occipitis magnum* to the median tip of the premaxillaries is taken = 100 (c.f. RÖRIG l.c.). This measurement is indicated in Table 3 as "condylo-basal length from oral border for. magn.".

Males and females are not acting exactly in the same way in this respect. In both sexes there is hardly any change in total length of the skull after the age of four years has been reached. Zygomatic breadth increases a little, greatest width of braincase stays unaltered. Length of nasals decreases in males, but increases slightly in females. The frontal suture in males increases in length with age but decreases in females. The distance from lacrimal notch to the tip of premaxillaries decreases a trifle with age in both sexes, the interorbital breadth increases a little. There is no change in the width of the palatinum. I cannot make a statement concerning the length of the mandible because there seems to be much individual variation in this respect. The length of the toothrows decreases during wearing-down because the teeth are broader at the crown than they are at the roots. The length of the pedicles in males decreases with age, but there is also a correlation between length of pedicle and weight of antlers.

In the males of Jang Highland I found a curious anomaly to these rules. Here the zygomatic breadth decreases with age instead of increasing. This phenomenon perhaps also occurs in some populations of *R. timorensis moluccensis*. The rules given here could be checked in *Rusa timorensis* c. subspec. Material of *Rusa equina* proved to be insufficient in this respect.

AGE DIFFERENCES OF ANTLERS

The first traces of the pedicles appear at the age of eight months, the first buds of antlers at the age of one year and the antlers are full-grown and swept at the age of 15 to 17 months. The first antler then consists of a single branch, without ramifications, and is nearly always irregular and asymmetric. The second pair of antlers sometimes consists of single branches too. As a rule four points (2 + 2), exceptionally even six (3 + 3) are present. The third pair of antlers normally carries six points (3 + 3). In *Rusa equina* often four points (2 + 2) or "irregular sixes" (3 + 2) do occur. It is well-known that 3 + 3 is the normal formula in the genus *Rusa*. At the age of seven years the antlers have attained their full development. Whether there will be any further development depends on individual and year-factors. It may differ even in various populations.

Table 3. Correlation between age and ratio of skull-measuremen

Collection number	Locality	Sex	Age in years (y.) or months (m.)	Condylo-basal length from oral border for. m.	Index	Total length of skull	Index	Zygomatic breadth	Index	Greatest width of braincase	Index	Length of nasals in median line	ndex
1916	Jang Highland E. Java	♂	5 y.	298	100	324	108,7	141	47,3	84	28,2	116	38,9
3712	id.	♂	9 y.	293	100	334	114	146	49,8	88	30	112	38,2
1909	id.	♂	11 y.	293	100	326	111,2	137	46,7	85	29	105	35,8
3713	id.	♂	12 y.	303	100	337	111,2	137	45,2	87	28,7	104	34,3
1698	Tegalwaru Est., W. Java	♂	8 m.	205	100	238	116,1	97	47,3	71	34,6	77	37,6
1891	id.	♂	14 m.	258	100	296	114,7	114	44,2	82	31,8	89	3,45
597	id.	♂	6 y.	295	100	333	112,9	134	45,4	83	28,1	127	43
2963	id.	♂	13 y.	293	100	333	113,6	140	47,7	86	29,3	124	42,3
1148	id.	♀	14 m.	250	100	277	110,8	107	42,8	72	28,8	96	38,4
1694	id.	♀	34 m	258	100	290	112,4	114	44,2	75	29,1	96	37,2
1888	id.	♀	4 y.	278	100	319	114,7	116	41,7	77	27,7	113	40,6
1730	id.	♀	7 y.	275	100	312	113,4	126	45,8	79	28,7	110	40

In the material from Java I could observe that at an age of nine years and older there often occurs a broadening of p^2. Sometimes this leads to nearly palmated antlers, "surroyals" or even to a "cup". In the material of the Lesser Sunda Islands and Celebes it is often the "browtine" that shows broadening, sometimes accompanied by accessorial points. Acces-

:a timorensis russa (MÜLL. & SCHLEG.)

Lacrimal notch to tip of premaxillaries	Index	Interorbital breadth	Index	Width of palatinum	Index	Length of mandible	Index	Maxillary toothrow	Index	Mandibular toothrow	Index	Length of pedicles from orbit	Index	Total length of body
180	60,4	95	31,8	51	17,1	254	85,2	91	30,5	101	33,9	81	27,1	1980
180	61,4	110	37,5	53	18	251	85,6	83	28,3	91	31	61	20,8	(2010)
186	63,5	95	32,4	51	18,4	250	85,3	92	31,4	102	34,8	63	21,5	2030
185	61	103	34	53	17,4	262	86,2	84	27,7	93	30,7	65	21,4	2080
127	61,9	60	29,3	(39)	—	178	86,8	(56)	—	(58)	—	(28)	—	1560
166	64,3	76	29,5	—	—	223	86,4	(76)	—	(78)	—	80	31	1840
193	65,4	94	31,9	49	16,7	255	86,4	86	29,2	97,5	33,1	62	21	1800
182	62,1	101	34,5	49	16,7	250	85,3	83	28,3	95	32,4	71	24,2	2120
160	64	67	26,8	(40)	—	214	85,6	(72)	—	(76)	—	—	—	—
168	65,1	68	26,4	43	16,7	229	88,8	87	33,7	99	38,4	—	—	1770
185	66,5	68	24,4	45	16,2	245	80,9	87	31,3	98,5	35,4	—	—	—
177	64,3	78	28,4	46	16,7	244	88,7	86	31,3	98	35,6	—	—	1950

sorial points of the "beam" do occur often in old specimens from the eastern parts of the Archipelago.

The direction of the beams is also dependent on age. As a rule the antlers grow wider with ageing. If this fails to occur, the antlers are "put back" and all sorts of irregularities may appear.

AGE DIFFERENCES IN COAT

Concerning the coat it could be observed that in the western representatives of *Rusa timorensis* the younger animals as a rule are darker and of a warmer colour than the older animals. The differences can be striking, as becomes evident by the fact that the darkest, just moulted coat in old males can even be lighter-coloured than those in young males in their lightest phase just before moulting!

Age differences could hardly be stated in the material from the Lesser Sunda Islands, no more than sexual differences are present there. The only difference that seems to exist is the dorsal stripe, more or less obvious in the younger animals, but absent in old animals of both sexes. In *Rusa equina* c. subspec. the younger animals are lighter and more reddish on the belly and much darker on the back than the older animals.

GEOGRAPHICAL VARIATION

Geographical variation includes measurements of skull and body, colour, coat and length, circumference, and width of antlers.

INGEBRIGTSEN (Bergens Mus. Aarbok, 1922-1923, 2, pp. 1-262, 1924) made an elaborate investigation concerning geographical variation of the skull in *C. elaphus*. This author came to the conclusion that geographical variation concerns the same factors as variation due to age. So INGEBRIGTSEN expressed the opinion that geographical variation was determined by the environment and therefore local races should be considered to be phaenotypes, produced by direct influence of soil, food and climate. He tried to prove that in *C. elaphus* all races could be traced back to the same principal form ("Hauptform") and only represented local tribes of the same principal species ("Hauptart"). He gives a review of the small insular races and demonstrates that these had stayed at a juvenile stage. In every race the starting-stage is the same, only the final stage is different. He tried to prove this thesis by the supposed fact that differences between young animals of two different races are less important than those between older animals and that differences decrease in proportion to the sequence of old to young. And he concluded that there is no reason to diagnose any local races because these can never be valid. Moreover the insular races do differ in the same way from the mainland form and still should not be united under one subspecific name. Therefore INGEBRIGTSEN proposed to bring the whole material of *C. elaphus* under a single binomial. This opinion was supported by impressive figures and an elaborate statistical investigation.

The investigations of INGEBRIGTSEN have contributed most substantially to our general knowledge of geographical variation in deer. Still some objections arise against his conclusions. Of course it is true that a geographical race is the product of local influences. But it is not

only this, it is more. The factors time and isolation play an important part. This is admitted by INGEBRIGTSEN himself, because the oldest and most isolated population, from the island Hitra, described by him, is also the most homogeneous and presents the most clear-cut race-characters. That all local races can be brought to one and the same "Hauptform" cannot arouse surprise because subspecies are per def. conspecific.

It may be true that insular races differ in the same way from (a) continental form (or forms), but they seldom differ in the same degree. Even if the shape and size of skull from one island should correspond exactly to those of any other, geographically widely separated island, both forms will be different in other characters, for instance external features, and will seldom be identical. So there will be no morphological reason to unite both forms in one subspecies.

I tried to check the thesis that the difference between young specimens of two different races is less great than between old specimens of the same races. Results are given in Table 4.

Table 4.

Collection number	Locality	Sex	Age in months (m.) or years (y.)	Condylo-basal length from oral border for. magn.	Index	Greatest width of braincase	Index	Lacrimal notch to tip of premaxillaries	Index	Total length of skull	Index	Total length of body
1917	Java	♀	5 m.	154	100	65	42,2	89	57,8	179	116,2	1090
3730	Meeuwen Eiland	♂	5 m.	(160)	100	69	43,1	95	59,4	193	120,6	1079
1730	Java	♀	7 y.	275	100	79	28,7	177	64,3	312	113,4	1950
3658	Meeuwen Eiland	♂	9 y.	271	100	80	29,5	165	60,9	307	113,3	1870
1891	Java	♂	14 m.	258	100	82	31,8	166	64,3	296	114,7	1840
2378	Flores	♂	16 m.	227	100	69	30,4	141	62,1	253	111	1370
3723	Java	♂	7 y.	301	100	81	26,9	187	62,2	338	112,3	—
505	Flores	♂	7 y.	(255)	100	73	28,6	157	61,6	283	110,9	—
3720	Java	♀	15 m.	250	100	76	30,4	159	63,6	281	112,4	1735
2376	Flores	♀	15 m.	207	100	64	30,9	128	61,8	234	113	1440
1921	Java	♀	5 y.	267	100	80	28,5	166	62,1	297	111,2	1910
2379	Flores	♀	6 y.	230	100	66	28,7	145	63,4	254	110,4	1450

The material available is certainly insufficient for definite conclusions. The youngest animals in Table 4 are differing in sex, so conclusions can hardly be drawn. In both other groups the oldest c.q. the youngest specimens are not of exactly the same age. I had to compare specimens of exactly the same population and therefore was bound to the very incomplete material. But the present figures do not support the opinion of INGEBRIGTSEN that differences between young animals of two different populations are less obvious than between old animals. Concerning his opinion local races being only phaenotypes, INGEBRIGTSEN published a later paper which is not accessible to me, but which, judging by reports, seems to confirm his earlier conclusions. He investigated in which degree the type of a population, after importation in a new habitat, is subject to rapid, phaenotypical changes.

In the Indo-Australian Archipelago deer have been imported repeatedly to islands where, until that moment, deer did not occur. In some cases the exact origin and date of importation is known. Material from three such experiments was available to me viz. Ambon, Aru Is. and Borneo.

F. VALENTIJN (Oud & Nieu — Oost Indien, 3, p. 267, 1726) mentioned import in Ambon from Java and later on from Makassar. This import must have taken place during the 17th century. VALENTIJN himself pointed out that both large and small deer occurred in Ambon, QUOY & GAIMARD (Voy. Astrolable, Zool. 1., pp. 134-135, 1830) have a picture of a young specimen from Ambon, presenting obviously the type of a deer from Java (l.c. Pl. 25). Differences are clear if this picture is compared with their type of *Cervus moluccensis* from Buru (l.c. Pl. 24). A mounted female in the collection of the Rijksmuseum N.H. Leiden (Ambon, leg. S. MÜLLER, vide MÜLLER & SCHLEGEL: Verh. Nat. Gesch. Ned. Overz. Bez. Zool. p. 200, 1839-1844), labelled as *Cervus moluccensis,* is a very large, heavily maned animal of obvious Java-type.

I could not find the stag mentioned l.c. in the Leiden collection. A skull (leg. FORSTEN, 1844) presents measurements corresponding to Java, another skull (leg. REINWARDT) corresponds to Celebes. So, after two hundred years, the Java- and the Celebes-type could still be recognized in the population in Ambon. If the Celebes-form were a phaenotype only of the Java-deer at least the descendants of the import from Java should have amalgamated with the import from Celebes. They did not. Both types lived on side by side. It cannot be assumed that they did not interbreed, so both types had to segregate, according to Mendelian laws, if they had to remain in existence. So it could be concluded that differences are genotypical.

In the Aru Islands deer have been imported from Ceram by Governor CLEERENS in 1855. The originally imported 6 specimens had increased to 80 specimens in 1867 (ROSENBERG). At present the herds number thousands of individuals in total. So it does not need further argument that

conditions in the Aru Islands are optimal. Now antlers from the Aru Islands are famous in hunters' circles for their big size and remarkable because they often present supernumerary points. But if measurements of skulls are compared with those of skulls from Ceram, similarity is most obvious. Differences are completely due to age-differences in the specimens at hand (cf. Table 5).

Table 5.

Collection number	Locality	Condylo-basal length from oral border for. magnum	Occipito-nasal length	Total length of skull	Zygomatic breadth	Greatest width of braincase	Width of 2 nasals	Length of nasals in median line	Length of frontals	Lacrimal notch to tip of premaxillaries	Interorbital breadth	Breadth of palatinum	Maxillary toothrow	Mandibular toothrow	Length of pedicles	Greatest length of antlers	Distance tip to tip	Length of glandular pit	Depth of glandular pit	Age in years	Sex
606	Aru Is.	276	254	303	120	75	31.5	94	96	173	84	39	86	97	65	414	155	36	13	4	♂
605	Aru Is.	268	260	300	126	76	35	99	95	166	87	45	84	96	75	570	250	37.5	16	5	♂
3745	Ceram	—	256	—	133	78	37	102	98	—	95	45	79	—	57	665	325	38	15	9	♂

No alteration has taken place in 75 years, except in the antlers. But antlers are strongly affected by external conditions and may even be different in the same individual from year to year, according to favourable and unfavourable years. This has already been discussed above at some length. If the development of skull were a purely phaenotypical character, this had to become evident with improved conditions as is the case here.

In Borneo, Java-deer have been imported in the neighbourhood of Mataram. The original stock came from Java about 1680. According to MÜLLER & SCHLEGEL this imported stock had increased to enormous herds, occupying the grassy plains near Pulu Lampej and in the Tanah Laut (near Bandjermasin). These authors give many details in Verh. Nat. Gesch. Ned. Overz. Bez. Zoöl. pp. 13, 45, 56-57, 211, 222, 1839-1844. A picture of a hunting party has been published by the same authors (Ibidem: Land- en Volkenk., pl. 55). It is curious that the occurrence of *Rusa timorensis* in Borneo in the long run fell into oblivion and has only been mentioned in passing by authors of later years. The only author who gives a description of *Rusa timorensis* from Borneo is KOHLBRUGGE (Nat. Tijdschr. N. I. 55, pp. 190-192, 1896). It is a great pity that his material got lost in later years.

In the Annual Report of the N.I. Vereeniging voor Natuurbescherming *Rusa timorensis* in Borneo is not mentioned at all. The occurrence of two species of Rusine deer in Borneo did not penetrate to the reporters, and this confuses the image they give of distribution and biology. Still *Rusa timorensis* occurs in the Martapura district. The Zoological Museum Buitenzorg received a perfect and an imperfect skull out of this population by the kind assistance of Mr B. VAN DER SLUYS, Director of the High school at Kandangan and of Mr LIEM SWIE LIONG of our Museum. The antlers are light and thin but the skulls belong within the variation of the deer from Java. KOHLBRUGGE compared his material of skins with those from the Jang Highland and he found some differences, but his figures are insufficient for exact conclusions. A comparison of a Borneo-skull with material from Java of nearly the same age is presented in Table 6.

Table 6.

Collection number	Locality	Condylo-basal length from oral border for. magn.	Occipito-nasal length	Total length of skull	Zygomatic breadth	Greatest width of braincase	Width of 2 nasals	Length of nasals in median line	Length of frontals	Lacrimal notch to tip of premaxillaries	Interorbital breadth	Breadth of palatinum	Maxillary toothrow	Length of pedicles	Greatest length of antlers	Distance tip to tip of antlers	Length of glandular pit	Depth of glandular pit	Age in years	Sex
3748	Distr. Martapura S. E. Borneo	290	274	325	130	78	45	107	109	185	96	49	85	69	535	283	42	17	6	♂
1916	E. Java . .	298	278	324	141	84	40	116	98	180	95	51	91	81	720	350	42	11	5	♂
3728	C. Java . .	293	286	336	(127)	84	42	109	115	191	106	50	88	71	790	445	42	12	6	♂
597	W. Java . .	295	293	333	134	83	40	127	113	193	94	49	86	62	745	355	43	16	6	♂

As in the other cases, changes have been slight during 260 years, except concerning the antlers. The characters of the subspecies remained unchanged.

Finally I compared a Java deer out of captivity, consequently an animal grown up under rather unfavourable circumstances, with a stag from Meeuwen Eiland (Strait Sunda), a biotop where circumstances are said to be extremely unfavourable. This comparison seemed to support the phaenotype theory of INGEBRIGTSEN as far as cranial characters are concerned. As it is, measurements of the animal out of captivity approximated the measurements from Meeuwen Eiland much more closely than those of wild Javan material (Table 7).

Table 7.

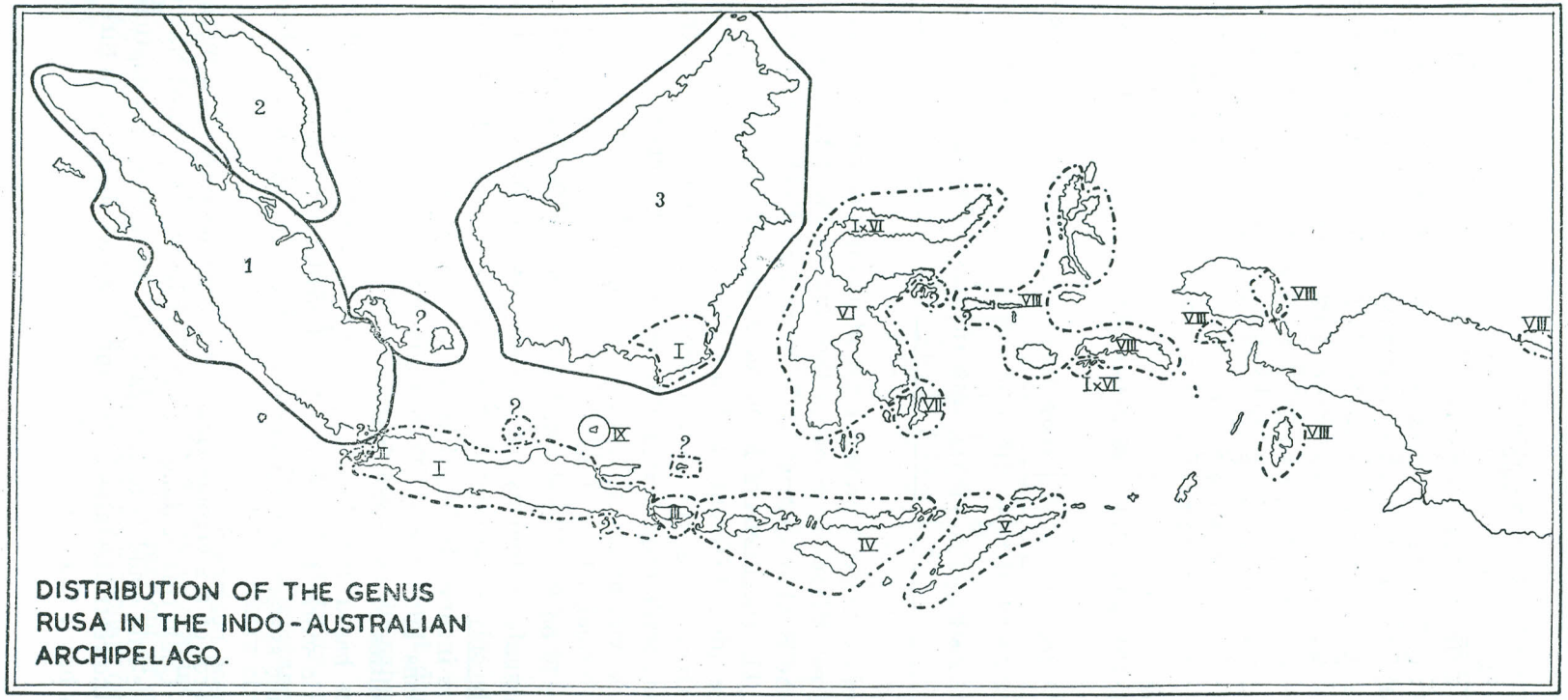
Collection number	Locality	Age in years	Sex	Condylo-basal length from oral border for. m.	Occipito-nasal length	Total length of skull	Zygomatic breadth	Greatest width of braincase	Width of 2 nasals	Length of nasals in median line	Length of frontals	Lacrimal notch to tip of premaxillaries	Interorbital breadth	Breadth of palatinum	Length of mandible	Maxillary toothrow	Mandibular toothrow	Length of pedicles from orbit	Greatest length of antlers	Distance tip to tip	Length of glandular pit	Depth of glandular pit	Total length of body
3729	W. Java (in captivity)	5	♂	268	270	315	131	81	38	96	109	173	92	48	236	87	95	79	730	490	36	10	1878
3658	Meeuwen Eiland . . .	9	♂	271	256	307	131	80	35	93	101	165	91	51	243	81	92	64	750	340	39	13	1870
1916	E. Java . .	5	♂	298	278	324	141	84	40	116	98	180	95	51	254	91	101	81	720	350	42	11	1980
3712	E. Java . .	9	♂	293	288	334	146	88	46,5	112	104	180	110	53	251	83	91	61	1030	580	44	15	(2030)

Comparison of the skins, however, brought another conclusion. There was not the slightest difference between the skin of the captive animal (originally from the Bantam district) and the skin of Bantam specimens in our collection. The specimens of Meeuwen Eiland (West coast of Bantam) proved to be quite different. I should like to draw the conclusion that external characters i.e. the skin, obviously are more stable than skull measurements with respect to certain external influences.

In other cases, viz. great differences in temperature, the skin will perhaps be more influenced. If it has to be proved which characters in a certain case are to be considered genotypical and which phaenotypical, more than one organic system has to be compared. In museological investigation mostly only some special organic systems are compared and the investigator is inclined to forget that after all he should investigate not organic systems but animals! One single organic system will never represent all qualities of the individual.

INGEBRIGTSEN based his theories on craniometrical investigations only. A systematic work, however exact and brilliant it may be, based on a single organic system, will always prove the weakness of one-sidedness.

The outer form of a stereometrical figure can be fixed in a mathematical formula. Could this be done with the products of animated Nature the infallible slide-rule could take the place of the fallible systematicist. But to establish the restrainedness in the unrestrained object of Nature is not mathematics but a fine art.



1. *Rusa equina equina* (CUV.), 2. *Rusa equina malaccensis* (F. CUV.), 3. *Rusa equina brookei* (HOSE), I. *Rusa timorensis russa* (M. & SCHL.), II. *Rusa timorensis larŏnesiotes* nov. subsp., III. *Rusa timorensis renschi* (SODY), IV. *Rusa timorensis floresiensis* (HEUDE), V. *Rusa timorensis timorensis* (BLAINV.), VI. *Rusa timorensis macassaricus* (HEUDE), VII. *Rusa timorensis djonga* nov. subsp., VIII. *Rusa timorensis moluccensis* (Q. & G.), IX. *Axis* (*Hyelaphus*) *kuhlii* (M. & SCHL.).

II. SYSTEMATIC PART

Genus **Rusa** HAMILTON SMITH

Rusa HAMILTON SMITH: GRIFFITH's Animal Kingdom 5, p. 309 (1827); GRAY: List Mamm. B. M. p. 179 (1843); GRAY: Cat. Ungulata B. M. p. 205 (1852); SCLATER: P.Z.S. 1870, p. 115 (1870); WAGNER: SCHREBER's Säugetiere 5, Suppl. (1855); GRAY: Cat. Ruminants B. M. p. 76 (1872); FITZINGER: Sitzungber. Math.-Naturw. Cl. Ak. Wiss. Wien, 68, p. 348 (1873); BROOKE: P.Z.S. 1878, p. 900 (1878); RÜTIMEYER: Abh. Schweiz. Pal. Ges. 8, p. 45 (1881); LYDEKKER: Deer of all Lands, p. 141 (1898); R. I. POCOCK: P. Z. S. 1910, p. 946 (1910); LYDEKKER: Cat. Ung. Mamm. B. M. 4, p. 60 (1915); E. MOHR: Arch. f. Naturgesch. 84, p. 107, p. 124 (1920); F. B. LOOMIS: Am. Journ. Sc. (5) 16, pp. 534-535, p. 540 (1928); R. I. POCOCK: P. Z. S. 1935, p. 183 (1935); R. I. POCOCK: Journ. Bombay N. H. Soc. 44, p. 27 (1943).

Russa S. MÜLLER & H. SCHLEGEL: Verh. Nat. Gesch. Ned. Overz. Bez., Zoologie, I, pp. 209-212 (1839-1844).

Hippelaphus SUNDEVALL: K. Svenska Vet. Ak. Handl. 1844, p. 178 (1846); REICHENBACH: Vollständ. Naturg. In- u. Ausl. III, Säuget. (1845); HEUDE: Mém. conc. l'Hist. Nat. Emp. Chin. III, pp. 47-49 (1896).

Ussa HEUDE: Mém. conc. l'Hist. Nat. Emp. Chin. II, 1 (first ed.) Pl. I-V, VI-XI (1887); HEUDE: Mém. conc. l'Hist. Nat. Emp. Chin. II (new ed.) p. 20 (1888).

Oussa HEUDE: Mém. conc. l'Hist. Nat. Emp. Chin. II (new ed.) p. 20, (1888).

Sambur HEUDE: Mém. conc. l'Hist. Nat. Emp. Chin. II (first ed.) Pl. II, fig. 9-10 (1887); HEUDE: Mém.conc. l'Hist. Nat. Emp. Chin. II (new ed.) pp. 20, 41 (1888).

The genus *Rusa* was described by HAMILTON SMITH (1827) as a subgenus and has since been considered by different authors alternately as a subgenus of the genus *Cervus* L. or as a separate genus. F. B. LOOMIS (1928) even denied a direct relationship with *Cervus*. SIMPSON (Bull. Am. Mus. N. H. 85, p. 154, 1945) united *Rusa* with the genus *Cervus*. The author most recently considering *Rusa* as a separate genus, is POCOCK (1943).

Definition. Large to medium-sized, plesiometacarpal deer of horse-like appearance. Antlers normally three-tined, upper canines present in both sexes, cheekteeth of complicated structure with well-developed styli. Muffle extending some distance below nostrils, tail relatively long and bushy, pedal glands rudimentary, coat usually uniform. Distribution of recent species limited to tropical and subtropical parts of southern and eastern Asia and islands of the West Pacific.

Type of the genus. *Cervus unicolor* KERR, 1792.

Discussion. *Rusa* is distinguished form *Cervus* L. mainly by the typical stature, the primitive build of the antlers, the more composed structure of dentition, the greater extension of the rhinarium and the longer and more bushy tail. The genus *Rusa,* in its geographical distribution, forms a coherent group of tropical and subtropical deer. In my opinion this is a natural unity deserving generic value. The definition of the genus, as given above, is founded merely on the Indo-Australian species. Extra-limital material at my disposal was insufficient to do justice to every detail.

Stature. Large to medium-sized deer. High-legged. Front-legs and hind-legs nearly equally long, back during repose stretched and straight. In alarm the front-legs are put forward and pressed down in the joints, the back is curved somewhat and sloping to the front during this attitude. The head is carried highly erected, the snout is strongly pointed. The gait is supple and elegant. Walking slowly, the males in rutting-season especially, show a gait reminding of the "Stechschritt" of a trained horse. In emotion the tail is stretched behind and is carried in a curve, open below.

External characters. The rhinarium is nearly bare, extending to the dorsal part of the face and forming a broadish rim below the nostrils. In the rear it is shaped in a faintly curved line with the convexity in oral direction. The rhinarium is covered with rather large warts, with some scattered hairs originating between them. The upperlip is short.

The preorbital gland is large, deep and reversible. The supraorbital gland is poorly developed, entirely covered with hair and only to be discovered on the hairy forehead of the living animal. The metatarsal gland is represented by a tuft of protruding hairs at the outer side of the hind-legs, just below the heel. The pedal glands are rudimentary, entirely covered with hair and glandular activity may be doubted. They are, however, to be detected both in the front and hind-legs. The interungual webb is bare. The ears are rather large and completely covered with hair. The tail is rather long and bushy. Digital pads short.

Skin. The coat is shaggy and mostly rather long. The males often with well-developed mane, especially in rutting-season.

The skin is unspotted. In new-born or very young animals there may sometimes be observed more or less obvious markings which soon disappear. Buttocks always concolorous with rest of body, no conspicuous "Spiegel". Dorsal stripe often present, especially in young animals.

Skeleton. Plesiometacarpal, that is to say: the distal portions of the lateral metacarpals are lost, the proximal portions remained. Naviculocuboid and cuneiform separated.

Vomer short and low, no tendency of the caudal nasal cavity to divide into two chambers.

Bullae auditoriae small and flat, hardly projecting beyond the level of the basioccipitale. Nasals vaulted, rhombiform to cruciform. Forehead flat to concave. Lacrimal vacuity long, a very deep preorbital gland pit. Pedicles short.

Antlers. Normally three-tined (six points). Branches round, more or less pearled.

The antlers consist of a base (b) between the burr and the proximal or first, anterior branch (a^1); the so-called "oogtak", "Brow-tine" or "Augenspross". Next a proximal, or first, posterior branch (p^1), the "hoofdtak", "Beam" or "Hauptstange". Finally an anterior terminal

branch (a^2) and a posterior terminal branch (p^2). The position of a^2 and p^2 with respect to each other and to p^1 depends on the species and is sometimes subject to some individual variation.

There is much disagreement about homologies of these branches with those in other genera.

Dentitions. The first, median incisor in the lower jaw of nearly the same breadth as the sum of the second and third. Breadth of incisiform teeth decreases gradually, reckoning from the first incisor to the canine. Canines in the upper jaw present in both sexes, but rather small. Molars in the lower jaw with typical "crossing-over", that means with communication between anterior crescent and posterior crest. The posterior crest with or without communication with the anterior crest, posterior crescent always more or less isolated. Cingula (styli) well-developed.

Molars of the upper jaw with bifurcated caudal ends of crescents. Oral end of posterior crescent broadened and delicately plicated.

Cingula (styli) well-developed likewise.

Distribution. India, Burma, Siam, Indo-China, Malaya, S. China, Formosa, Philippines, Bonin I., Mariannas, Indo-Australian Archipelago as far as New Guinea. Imported in the eastern part of this area. A map of the distribution has been published by E. MOHR (1920) p. 143. The distributional area of recent species is at the moment limited to S. E. Asia and the West Pacific region, but in the lower Pleistocene Rusine deer spread to Europe viz. Senèze and Tegelen, vide; H. G. STEHLIN: Ecl. geol. Helv. 18, 2, pp. 268-281, 1923; J. J. A. BERNSEN & A. SCHREUDER: Natuurh. Maandbl. Zd. Limburg 12 & 13, 1933-1934; C. E. KUNST: "Die Niederländ. Pleistozäne Hirsche", thesis Leiden, pp. 82-95, 1937.

Species of the genus **Rusa**

By many authors of late years the forms of the genus *Rusa*, occurring in the Indo-Australian Archipelago, have been considered wholly or partly as subspecies of *R. unicolor* KERR. LYDEKKER (1915) enumerates five species of his subgenus *Rusa*. Of those five species, two have been inserted in the meantime in another genus (vide i.a. E. MOHR, 1920; VAN BEMMEL: Treubia, hors série, pp. 149-154, 1944; Treubia 19, 2, pp. 403-406, 1948) and one species remains doubtful. E. MOHR (1920) enumerates three species, but the Philippine forms are united in one species by this author, most probably erroneously. CHASEN (Bull. Raffl. Mus. 15, pp. 201-202, 1940) united all remaining forms of the Indo-Australian Archipelago in the single species *C. unicolor*. POCOCK (Ann. Mag. N. H. Ser. 11, vol. 9 pp. 516-525, 1942; ibidem vol. 10 pp. 159-167; ibidem pp. 191-196, 1943; Journ. Bombay N. H. Soc. 44, pp. 27-37, 1943) only indicated two species, of which *R. nigricans* is restricted to the Philippines, but the *R. timorensis* group was left out of discussion by that author.

From the species outside the Indo-Australian Archipelago the material was insufficient for me to give a definite opinion. But uniting both groups occurring in the Indo-Australian Archipelago, viz. *R. equina* and *R. timorensis,* in one species, in my opinion goes too far in the way of lumping. There is a whole world of difference between them, as will be demonstrated below, not only in a morphological respect but also biologically. Both do present characters which they have in common with *R. unicolor* and both could be derived from this very plastic species. But, even if this should be assumed, both followed their own ways. Cross-breeding in captivity is no criterium in this case, because in deer cross-breds are known even between different genera. In nature no cross-breeding occurs in S. Borneo, the only region where both groups live side by side.

Provisionally I should like to propose to distinguish the following four species of the genus *Rusa*: *R. unicolor, R. nigricans, R. equina* and *R. timorensis*. I want to lay stress on the possibility that representatives of the genus in Formosa, the Mariannes and the Philippines (excluding *nigricans*!) might be brought to one or two separate species and that *nigricans* could perhaps represent a separate (sub) genus.

Of the species mentioned here only two occur in the Indo-Australian Archipelago.

Key to the Indo-Australian species

A. Large, high-legged. Belly darker than back. Tail long-haired, bushy, broad, brush-like, black to blackish-brown. Forehead more or less flat, very deep orbital gland-pit. Antlers relatively small, heavy and stout, a^1 strongly turned upwards, a^2 and p^1 in the same line, p^2 mostly shorter than a^2, turned inwards and backwards. Left and right a^2 convergent. Incisiform teeth relatively small. Not gregarious ..... *Rusa equina* (p. 214).

B. Somewhat to much smaller than the preceding species, legs shorter. Belly lighter than back. Tail less long-haired, long and narrow, concolorous with the back. Forehead concave, orbital glandpit less deep. Antlers relatively large, slender and long, a^1 directed forwards, p^2 in the same line with p^1, mostly longer than a^2, a^2 turned outwards and forwards. Left and right p^2 more or less parallel or a little convergent. Incisiform teeth relatively large. Gregarious .... *Rusa timorensis* (p. 226).

Rusa equina (CUVIER).

Cervus equinus CUVIER: Ossements fossiles ed. 2, 4, p. 45 (1823). — Sumatra.

Definition. Large, high-legged deer of horse-like appearance. Coat closely-set and stiff but rather short. Mane of the male especially developed on neck and top of head. Tail long-haired, broad,

brush-like, black to blackish-brown. Dark and rather uniformly coloured, belly darker than back. Arm-pits, groins, inner side of legs and ears much lighter. Lips bordered with white, with or without a spot at the corner of mouth. Fawns at birth and in the first days of their life mostly with obvious white spots [1]). Forehead more or less flat, nasals rhombiform, little constricted. A very deep orbital gland-pit. Antlers relatively small, heavy and thick-set, a^1 strongly turned upwards, a^2 in same line with p^1, p^2 mostly shorter than a^2, turned inward and backward. Left and right a^2 converging. Incisiform teeth relatively small. Directly after teeth shedding, in young animals of about three years, the mandibular tooth row is more than one and a half times as long as the total breadth of all incisiform teeth.

Terra typica. Sumatra.

Type of species. Figured: l.c. Plate V, figs 37 & 38, leg. DIARD & DUVAUCEL.

Biology. Mainly inhabitants of forests and swamps. Not gregarious. At the utmost in small troops of a few specimens.

Distribution. Stated under the heading of the subspecies. I refrain from giving the distribution of subspecies belonging to this species and occurring outside the Indo-Australian Archipelago.

Subspecies of **Rusa equina** (CUVIER).

In the Indo-Australian Archipelago two good subspecies can be distinguished and some other populations occur in which a subspecific status can be considered as uncertain.

Rusa equina brookei (HOSE) was separated on account of the markings of the fawn. This character does not hold good as has been demonstrated several times by different authors. An elaborate discussion is to be found i.a. in LYDEKKER: "Deer of all lands", pp. 152-153 (1898). Nevertheless the form from Borneo was considered as a separate race by most authors, because it was said to be smaller than the nominate race. By every author however, Bornean material has been compared with material from the Asiatic mainland, instead of with topotypical material from Sumatra. Now there proved to be no difference in size between Bornean and Sumatran material. Few material from the mainland of Asia could be reviewed by me, but according to literature I think it most probable that mainland material is distinguished from all animals in the Indo-Australian Archipelago by its larger size. The name *malaccensis* F. CUVIER is available for the form of the Malay Peninsula. It seems that this race has been imported in Sarawak (CHASEN 1940, BANKS 1937) and consequently a large and a small form do occur side by side in this area. Nevertheless I should like to maintain the name *brookei* on account of colour differences with the

[1]) CHASEN: Journ. Mal. Br. R. As. Soc. 3. pp. 89-91, pl. II (1925).

Sumatran race. The name *Pennantii* GRAY (1843) applied by FITZINGER (1874) to the Bornean race is undefinable.

Cervus unicolor oceanus CHASEN & BODEN KLOSS (1927), terra typica: Siberut I., has been described as a small island-race. But in this case also the material was compared with mainland material and it was taken for granted that Sumatran and Malayan animals were identical. Nevertheless measurements of *oceanus* are covered totally by those of the Sumatran race. I had no opportunity to look over any material (the type is lost, according to GIBSON-HILL, 1949), but in view of the literature I think that *oceanus* should be considered provisionally as a synonym of *equina*.

From Banka I. only two skulls and a pair of antlers were available and no material from Billiton I. This proved insufficient to take a decision concerning the subspecific status of the populations.

Key to the subspecies of *Rusa equina*

a) Dorsal parts dark blackish, lower back and buttocks rufous. Females with distinct dorsal stripe. Tail nearly black ... *R.e. brookei* (p. 221).
b) Dorsal parts brown to greyish-brown, little differing in colour from lower back and buttocks. Females without dorsal stripe. Tail dark-brown ..... *R.e. equina* (p. 216).

Rusa equina equina (CUVIER).

Cervus equinus CUVIER: Ossements fossiles ed. 2, vol. 4, p. 45, (1823); BLYTH: P. Z. S. 1869, p. 659, (1869); S. MÜLLER & H. SCHLEGEL: Verh. Nat. Gesch. Ned. Overz. Bez. Zool. pp. 44, 212, 213-217, Pl. 42, 45: 7-11, (1839-1844); J. H. VAN BALEN: Album der Natuur, pp. 117-118, (1906); Dierenwereld van Insulinde, pp. 190-193, (1914); E. B. KIEL: Trop. Natuur 14, p. 158, (1925); L. COOMANS DE RUITER: Trop. Natuur 18, pp. 68-69, (1929).

Cervus unicolor equinus R. LYDEKKER: Cat. Ung. Mamm. B. M. 4, pp. 78-79, (1915); F. N. CHASEN: Bull. Raffles Mus. 15, p. 201, (1940); T. D. CARTER, J. E. HILL & G. H. H. TATE: Mammals Pacific World, New York, p. 144, (1945).

Cervus unicolor oceanus F. N. CHASEN & C. BODEN KLOSS: P. Z. S. 1927, p. 818, (1927); H. C. RAVEN: Bull. Am. Mus. N. H. 68, p. 265, (1935); F. N. CHASEN: Bull. Rafffles Mus. 15, p. 202, (1940); C. A. GIBSON-HILL: Bull. Raffles Mus. 19, p. 194 (1949).

Cervus aristotelis equinus H. C. RAVEN: Bull. Am. Mus. N. H. 68, p. 264, (1935).

Rusa equina J. E. GRAY: Cat. Rumin. Mamm. B. M. p. 77, (1872); L. J. FITZINGER: Sitzungsber. Math.-Naturw. Cl. Ak. Wiss. Wien 70, pp. 290-294, (1874-1875) (Elaborate list of literature); M. W. LYON: Proc. U. S. Nat. Mus. 52, pp. 458, 460, (1916); G. S. MILLER: Proc. Ac. Sc. Philad. 94, pp. 162-163, (1942).

Rusa equina equina E. MOHR: Arch. f. Naturgesch. 84, 1918, pp. 128-132, (1920) (Elaborate list of literature).

Rusa unicolor equinus W. STONE & J. A. G. REHN: Proc. Ac. Sc. Philad. 54, p. 132 (1902); H. J. V. SODY: Ned. Ind. Jager 11, 7, p. 155, (1941); id. 11, 12, pp. 257, 264, (1941).

Rusa unicolor equina R. I. POCOCK: Ann. Mag. N. H. Ser. 11, vol. IX, pp. 517-518, (1942); Journ. Bombay N. H. Soc. 44, 1, pp. 35-37, (1943).

Cervus axis — *Rusa* — T. S. RAFFLES: Trans. Linn. Soc. 13, pp. 263-265, (1822). ——— F. J. NAINGGOLAN: Bull. N. I. Jagers Gen. 53, XI, p. 96 (1935); ANON.: "3 Jaren Indisch Natuurleven", N. I. Vereen. Natuurbescherming, pp. 110, 112, 115, 118, 125, 129, 130, 132, (1939); M.: Ned. Ind. Jager 10, 5, p. 106, (1940); F. J. NAINGGOLAN: Ned. Ind. Jager 11, 3, p. 170, (1941); R. D.: De Ind. Jager 2, Nr. 10, pp. 153-155 (1948).

Definition. Dorsal parts brown to grayish-brown, little or no difference in colour from lower back and buttocks, unicoloured. Tail dark brown. Light spots round the eyes indistinct. Old stags ventrally much less rufous than young stags, old females resembling young males in this respect. Measurements vide Table 8 & 9.

Terra typica. Conform species.

Type of subspecies. Conform species.

Material. 19 ♂ (19 skulls, 4 skins), 5 ♀ (5 skulls, 2 skins).

Diagnosis. Smaller than the form (or forms) of the mainland, same size as *brookei* but antlers mostly somewhat shorter and more massive. Lighter coloured than *brookei*, no distinct difference in colour between back and buttocks, dorsal stripe of the females of *brookei* obsolete. Tail dark brown instead of black as in *brookei*.

Variation of populations in Sumatra. The subspecies in Sumatra is not homogeneous. Series at my disposal are too small and too incomplete to determine local races. Because of the great plasticity of the species (a general feature in deer) and the many factors to be taken into account (*vide antea*) this can be done only if large series are available. Some examples will be mentioned here.

Lampongs (*S. Sumatra*). A brachycephalous kind, with well-developed, but rather slender antlers (Nos. 2375, 3662, 3695, 3698). In our collection a nearly even, four tined specimen (8 points) is present.

Palembang (*S. E. Sumatra*). A dolichocephalous type, with heavy, massive but short antlers. (Nos. 616. 3661, 3697). Very large, robust animals.

Indragiri (S. E. Sumatra). Antlers slender with extremely developed browtine. In No. 3747 length of browtine is 400 mm, total length of antlers only 525 mm. In No. 3707, browtine: 360 mm, total length of antlers 548 mm. Browtines are curved and convergent. (Nos. 3701, 3702, 3703, 3704, 3705, 3706, 3707, 3747).

Pulau Siuntjal (*Strait Sunda*). Very small; typical insular population. Only 2 ♀ in our collection (Nos. 3708, 3709). Probably representing a good subspecies.

Biology. Habitat very variable: coastal forest, secundary jungle (blukar), swamps, parkland, alang-alang fields and even high in the mountains. But never far from water. Not gregarious, at the utmost in small troops of a few specimens. In Sumatra locally abundant.

Stags often present a larger or smaller naked area at the throat. This phenomenon, mostly called "sore throat", has been described several times

Table 8. *Rusa equina equina* (CUV.) Sumatra

Collection number	Locality	Collector	Date	Sex	Age in years or months (m.)	Condylo-basal length	Condylo-basal length from oral border for. magn.	Occipito-nasal length
3708	P. Siuntjal, Straits Sunda.	Dr J. D. F. HARDENBERG	9.VII.41	♀	2¼	298	278	276
3709	„ „ „	„	10.VII.41	♀	4	306	286	276
3698	Gng. Sugih, Lampongs.	A. F. WEHLBURG	23.VIII.37	♂	6	324	301	296
2375	Telok Betong, „	CH. E. JANS	26.IX.29	♂	6	335	315	305
3700	Tdj. Karang, „	—	—	♂	8	347	318	308
3662	Saputih, „	PIETERS	15.V.32	♂	10	352	330	321
3695	Natar, „	P. SIJNJA	21.III.39	♀	14 m.	291	270	260
3696	Bukit Sanggul, Benkulen.	J. J. MENDEN	30.VIII.36	♂	16 m.	314	292	284
3694	„ „ „	„	20.VIII.39	♀	1	270	249	240
R.M.N.H. nr.d	— „	WIENECKE	1865	♀	—	—	314	302
3661	Kluang, Palembang.	SOEKARNO	21.X.33	♂	4	357	334	328
616	Talang Betutu, Palembang.	H. W. TH. DE SANTY	—	♂	old	—	342	325
3697	Kluang, „	SOEKARNO	14.VIII.33	♀	3	352	330	315
3701	Tambilahan, Indragiri.	—	—	♂	—	—	—	—
3702	„ „	—	—	♂	—	—	—	—
3703	„ „	—	—	♂	—	—	—	—
3704	„ „	—	—	♂	—	—	—	—
3705	„ „	—	—	♂	—	—	—	—
3706	„ „	—	—	♂	—	—	—	—
3707	„ „	—	—	♂	—	—	—	—
3747	„ „	—	—	♂	—	—	—	31(
R.M.N.H. nr.f	Tdj. Morawa, Deli, S.O.K.	HAGEN	1882	♀	—	—	328	31
Philad. 20236	Blangbeke Dua, Atjeh.	VANDERBILT *	10.V.39	♀	imm	—	—	—
R.M.N.H. —	"Sumatra"	REINWARDT	—	♀	—	—	322	31
R.M.N.H. nr.o	"Sumatra"	DRAAK	—	♂	—	—	325	33
Philad. 20408	Hilisimaetano, Nias.	VANDERBILT *	—	♂	ad	—	—	—

acent Islands. * After MILLER.

Greatest width of 2 nasals	Length of nasals in median line	Length frontal suture	Lacrimal notch to the tip of premaxillaries	Interorbital breadth	Width of palatinum between M^3	Length of mandible	Maxillary toothrow	Mandibular toothrow	Length of pedicles from caudal border of orbit	Greatest length of antlers	Distance tip to tip of antlers	Greatest width of antlers	Length of glandular pit	Depth of glandular pit	Total length body	Length of tail	Length of ear	Points (total number)
33	112	87	176	76	50	243	(103)	(117)	—	—	—	—	37	14	—	—	—	—
34	116	96	187	72	47	250	98	108	—	—	—	—	41	17	—	—	—	—
35	121	110	200	88	51	266	104	116	87	372	287	312	41	18.5	1700	210	150	5
52	126	111	197	95	53	275	106	117	93	467	220	290	43	20	1940	230	170	6
52	125	114	200	103	54	270	97	109	82	473	380	435	48	23	—	—	—	8+
39	139	116	208	101	57	279	92	106	78	572	340	405	50	20	1893	230	180	6
28	104	93	176	68	(53)	239	(88)	(91)	—	—	—	—	38	14	—	—	—	—
35	105	125	191	76	(48)	262	(111)	(95)	97	206	140	—	43	—	—	256	166	2
29	83	97	160	64	(48)	220	(90)	(74)	—	—	—	—	33	—	1768	225	160	—
36	134	—	—	—	—	281	102	113.5	—	—	—	—	—	—	—	—	—	—
43	139	122	218	87	51	280	106	117	103	392	270	345	45.5	22	2295	198	190	6
56	135	126	222	112	58	—	(110)	—	89	490	390	420	50	25	—	—	—	6
29.5	140	115	223	72	51	292	108	120	—	—	—	—	44	14	—	244	177	—
—	—	101	—	78	—	—	—	—	87	330	187	233	—	—	—	—	—	6
—	—	117	—	90	—	—	—	—	83	340	228	260	—	—	—	—	—	6
43	135	124	—	98	—	—	—	—	90	450	230	290	—	—	—	—	—	4
37	—	108	—	82	—	—	—	—	78	405	340	373	42	21	—	—	—	6
—	—	—	—	—	—	—	—	—	86	445	290	345	—	—	—	—	—	6
—	—	—	—	—	—	—	—	—	74	500	360	420	—	—	—	—	—	6
50	144	112	—	91	—	—	—	—	41	548	350	395	46	—	—	—	—	6
42	127	110	202	—	—	—	—	—	87	525	173	275	45	17	—	—	—	6
40	137	—	—	—	—	290	114	118.5	—	—	—	—	—	—	—	—	—	—
31	98	—	—	—	—	(263)	110	114	—	—	—	—	—	—	1696	189	200	—
40	148	—	—	—	—	281	(100)	111	—	—	—	—	—	—	—	—	—	—
51	144	—	—	—	—	—	111	—	78	465	—	—	—	—	—	—	—	6
49.5	120.5	—	—	—	—	—	104.6	—	—	—	—	—	—	—	—	—	—	—

Table 9. Best heads of *Rusa e. equina* (CUVIER) from Sumatra.

Collection	Locality	Greatest length of antlers	Circumference above burr	Circumference of burr	Tip to tip	Greatest width	Literature
W. GROENEVELDT Loan Z. M. Btzg.	Padang, W.-Coast	650	200	224	477	565	Waidwerk d. Welt 1938, p. 410
MULLER	E.-Coast	640	190	—	—	—	Ned. Ind. Jager, 8, p. 53, 1938
"	E.-Coast	610	190	—	—	—	id.
"	E.-Coast	580	270	—	—	—	id.
Z. M. Btzg. Nr. 3662	Saputih, Lampongs	572	152	212	340	405	—
M. BARTELS	Wai Ratai, Lampongs	570	155	197,5	—	—	De Trop. Natuur, p. 82, 1937
Z. M. Btzg. Nr. 3707	Tambilahan, Indragiri	548	187	232	350	395	—
Z. M. Btzg. Nr. 616	Talang Betutu, Palembang	490	235	240	390	420	De Trop. Natuur, p. 49, 1937

and has been explained in several ways (vide: S. R. DAVER: Journ. Bombay N. H. Soc. 40, pp. 118-122 (1938); W. S. THOM: ibidem 39, pp. 309-319 (1937).

Breeding-times are very variable. SODY (1941) mentioned birthdates in May, June (Kotabumi), October, November (Palembang, Sibolga). "R.D." (1948) mentioned: May-June (Takengon), March-June (Atjeh). In "Drie Jaar Indisch Natuurleven" (1939) p. 129, fawns are recorded in Benkulen "the whole year through"; VAN BALEN (1914) mentioned May, June, July (Deli?).

E. MOHR recorded birth-dates in European Zoological gardens from February till July, with a maximum in June. Rutting-seasons, according to E. MOHR, are varying from May till October, with a maximum in September and October. Antlers are shed in April till September with a maximum in May and June. A highly pregnant hind from Atjeh has been recorded in May by G. S. MILLER (1942). In our collections fawns are present born about January (Lampongs), about May and about August (Benkulen). Vide also VAN BEMMEL: Ind. Jager 2, 4, pp. 52-53 (1948). Mating has been recorded in August and September from Isaq-valley, Atjeh (R. D., 1948).

Geographical distribution. Bengkalis, Rangsam, Sumatra, Siberut, Sipora, Pagai Is., Nias, P. Siuntjal.

Rusa equina brookei (HOSE).

Cervus brookei HOSE: Ann. Mag. N. H. ser. 6, vol. 12, p. 206 (1893);

Cervus equinus S. MÜLLER & H. SCHLEGEL: Verh. Nat. Gesch. Ned. Overz. Bez. Zoölogie, pp. 212, 216, Pl. 45, f. 10 (1839-1844); BLYTH: P. Z. S. 1869, p. 659 (1869); V. BROOKE: P. Z. S. 1878, p. 901 (1878); GÜNTHER: P. Z. S. 1880, p. 452 (1880); J. H. F. KOHLBRUGGE: Natuurk. Tijdschr. N. I. 55, pp. 189-190 (1896); J. H. VAN BALEN: Dierenwereld Insulinde, p. 191 (1914).

Cervus aristotelis equinus H. C. RAVEN: Bull. Am. Mus. N. H. 68, pp. 264-265 (1935).

Cervus unicolor equinus R. LYDEKKER: Deer of all Lands, London, pp. 152-153 (1898); E. BANKS: Journ. Mal. Branch. Roy. As. Soc. 9, 2, pp. 30-33 (1931); E. BANKS: Sarawak Mus. Journ. 4, pp. 449-452 (1937).

Cervus unicolor brookei R. LYDEKKER: Cat. Ung. Mamm. B. M. 4, pp. 80-81 (1915); F. N. CHASEN & C. BODEN KLOSS: Bull. Raffl. Mus. 6, p. 18 (1931); F. N. CHASEN: Bull. Raffl. Mus. 15, pp. 201 (note), 202 (1940); T. D. CARTER, J. E. HILL, G. H. H. TATE: Mammals Pacific World, New York, p. 144 (1945).

Rusa equinus J. E. GRAY: Cat. Ung. B. M. p. 210 (1852); Cat. Rumin. B. M. p. 77 (1872).

Rusa equina J. E. GRAY: List Mamm. B. M. p. 179 (1845).

Rusa equina equina E. MOHR: Arch. f. Naturgesch. 84, 1918, p. 128-132 (1920) (List of literature).

Rusa equina pennantii L. J. FITZINGER: Sitzungsber. Math. Naturw. Cl. Kais. Ak. Wiss. Wien 70, I, 1874, pp. 296-298 (1875) (List of literature).

Russa equina F. A. JENTINK: Notes Leyden Mus. 19, p. 63 (1897).

Rusa unicolor equinus HILZHEIMER & HECK: Brehms Tierleben, Säugetiere IV, pp. 124-125, pl. VI, p. 126, f. 1. (1916); ROWLAND WARD: Records of Big Game, 10th. ed. p. 23 (1935); ANON.: "3 Jaren Indisch Natuur Leven", Ned. Ind. Ver. Natuurbesch. pp. 357-358 (1939).

Rusa brookei LYON: Proc. U. S. Nat. Mus. 31, p. 584 (1906); id. 33, p. 550 (1907); id. 40, p. 67 (1911).

Rusa unicolor brookei R. I. POCOCK: P. Z. S. 1935, pp. 183-184 (1935); H. J. V. SODY: Ned. Ind. Jager 11, pt. 7, p. 155 (1941); id. 11, pt. 12, pp. 257, 264 (1941); R. I. POCOCK: Ann. Mag. N. H. Ser. 11, vol. 9, p. 522-525 (1942).

Hippelaphus hamiltonianus HEUDE: Mém. conc. l'Hist. Nat. Emp. Chin. III, pp. 49-50, Pl. XI, fig. 1, 2, 3 (1896).

Definition. Dorsal parts dark blackish brown, lower back and buttocks with distinct rufous tinge, strikingly contrasting with the rest of the dorsal parts. Tail nearly black. A contrasting yellowish-brown spot round the eyes. Stags with a dark back, no distinct dorsal stripe. Females of all ages with distinct dorsal stripe. Stags darker than hinds, less rufous at belly, lower back and buttocks. Young females more rufous and somewhat darker than old females. Coat of males a little longer and more closely set than in females.

Measurements vide Table 10 & 11.

Terra typica. Mount Dulit, Sarawak.

Table 10a. *Rusa equina*

Collection number	Locality	Collector	Date	Sex	Age in years or months (m.)	Condylo-basal length	Condylo-basal length from oral border of for. magn.	Occipito-nasal length	Total length of skull	Zygomatic breadth
3692	Muara Muntai, Kutai, E. Borneo.	VAN HOUTEN	1934	♂	5	—	325	306	360	146
3693	Cp. Mangkalihat „ „	„ „	1934	♀	6	307	290	279	327	131
1166	Long Petah „ „	H. C. SIEBERS:	21.X.25	♀	7	295	275	263	311	126
R.M.N.H.	(S.E.) Borneo.	SAL. MÜLLER	—	♂	2	—	295	278	—	126
R.M.N.H. nr.h	(S.E.) Borneo.	v. RAALTE	1826	♀	—	—	—	—	—	143
3763	S.E. Borneo, N. Hulu Sungai.	B. v. d. SLUYS	1948	♂	7	—	—	321	382	14
3764	„ „ „ „ „	„ „	1948	♂	9	363	340	332	381	15
3691	Riam, Kotawaringin, S.W. Borneo.	J. J. MENDEN	14.XI.35	♂	3	346	323	309	367	14
3686	„ „ „ „	„ „	20.XI.35	♀	6 m.	228	312	194	237	9
3690	„ „ „ „	„ „	1.XII.35	♀	7	332	310	301	348	12
3689	„ „ „ „	„ „	1.XII.35	♀	10	335	311	301	353	13
3687	Perbuwah, Landak, W. Borneo.	„ „	5.VIII.37	♀	2 1/2	315	295	270	325	12
3688	„ „ „ „	„ „	20.VII.37	♀	9	360	340	326	382	13
B.M. 79.6.3.19	Sarawak N.W. Borneo.	EVERETT	—	♀	?	314	296	282	324	1
B.M. 79.5.3.18	„ „ „	„	—	♀	?	325	304	297	—	1
B.M. 1.3.13.1	Sarawak, Baram, „ „	HOSE	—	♂	?	344	322	297	356	1
B.M. 79.1.27.2	„ „ „	—	—	♀	?	344	—	—	354	
B.M. 86.1.20.9	Sandakan, N. Borneo.	—	—	♂	juv.	—	—	288	345	

Table 10b. *Rusa equ*

R.M.N.H. nr.n	Muntok, Banka.	BUDDINGH	1876	♂	—	—	324	321	—	
R.M.N.H. nr.r	„ „	„	1876	♂	—	—	353	334	—	
3699	Kobak, Tg. Brikat, Banka.	C. G. G. J. v. STEENIS	VIII.41	♂	—	—	—	—	—	

ei (HOSE), Borneo.

nasals	Length of nasals median line	Length frontal suture	Lacrimal notch to the tip of premaxillaries	Interorbital breadth	Width of palatinum between M^3	Length of mandible	Maxillary toothrow	Mandibular toothrow	Length of pedicles from caudal border of orbit	Greatest length of antlers	Distance tip to tip of antlers	Greatest width of antlers	Length of glandular pit	Depth of glandular pit	Total length body	Length of tail	Length of ear	Points (total number)
	127	102	209	93	54	280	104	116	86	405	280	305	51	24	—	—	—	4
	114	97	192	73	56	260	96	113	—	—	—	—	40	15	—	—	—	—
	104	102	182	74	52	250	96	104.5	—	—	—	—	47	17.5	1710	223	—	—
	110	—	—	—	—	257	(98)	(111.5)	85	—	—	—	—	—	—	—	—	(2)
	134	—	—	—	—	274	95	116.5	—	—	—	—	—	—	—	—	—	—
	143	112	226	89	57	299	99.5	116	94	472	382	420	58	21	—	—	—	6
	134	123	223	96	55	295	101	114	78	520	175	230	50	29	—	—	—	6
	124	119	218	92	51.5	283	114	126	94.5	265	255	298	59	23	2282	232	165	6 +
	68	79	127	55	(40)	189	(68)	(75)	—	—	—	—	24	9	1262	196	148	—
	132	111	203	73	54	272	94	105	—	—	—	—	48	17	2310	270	148	—
	124	111	206	83	57	279	93	108	—	—	—	—	48	19	2185	235	160	—
	106	108	192	78	53	262	104	116	—	—	—	—	43	19	2161	276	149	—
	135	121	227	86	58	300	99	110	—	—	—	—	48	18	2767	249	116	—
	132	—	—	—	—	—	100	—	—	—	—	—	38	—	—	—	—	—
	132	—	—	—	—	—	98	—	—	—	—	—	—	—	—	—	—	—
	126	—	—	—	—	—	101	—	81	—	—	—	48	—	—	—	—	?
	—	—	—	—	—	—	—	—	—	—	—	—	48	—	—	—	—	—
	120	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	?

:., Banka.

126	—	—	—	—	—	110	—	94	297	—	—	—	—	—	—	—	6
140.5	—	—	—	—	—	116	—	93.5	454	—	—	—	—	—	—	—	6
—	—	—	—	—	—	—	—	—	545	—	—	—	—	—	—	—	6

Table 11. Best heads of *Rusa equina brookei* (HOSE) from Borneo.

Collection	Locality	Greatest length of antler	Circumference above burr	Tip to tip	Widest inside	Points	Literature
Sir EDMUND C. LODER	"Borneo"	784	165	439	499	14	ROWLAND WARD: Rec. of Big Game 10th. ed., 1935
British Museum	id.	767	111	521	540	6	id.
D. I. GRACE	id.	757	140	388	356	6	id.
J. H. DAUBER	id.	731	140	458	508	6	id.
Mus. Btzg. No. 3764	N. Hulu Sungai, S. Borneo	520	190	175	185	6	—

Type of subspecies. British Museum N. H. 92.9.4.3 juv. leg. C. HOSE, 1892.

Material. 10 ♂ (10 skulls, 2 skins), 12 ♀ (12 skulls, 5 skins).

Diagnosis. Smaller than the form (or forms) of the mainland. As large as *equina* but differing in colour (*vide antea*). Antlers on the average somewhat longer and more slender than in *equina*. Very variable. p^2 sometimes as long as or even longer than a^2, a variation seldom occurring in Sumatra.

Variation of populations in Borneo. Concerning colour of coat no local differences could be found, but there are differences in size. BANKS (1937) suggested the occurrence of two races in Borneo but obviously had in mind imported stock from the mainland.

E. Borneo (Kutai, E. Borneo). The smallest population. The smallest full-grown hind (No. 1166) was collected in Long Petah (Distr. Kutai). A stag from Kutai does not differ much from a younger stag from Riam, but the toothrow is nearly 10 mm shorter (Nos. 1166, 3692, 3693).

S. Borneo (Riam, Kotawaringin, Kandangan). Much larger than the preceding population (Nos. 3686, 3689, 3690, 3691, 3763, 3764).

W. Borneo (Landak). Largest population. The old hind is the largest Sambur hind I ever saw from the Indo-Australian Archipelago, Nos. 3687, 3688), and as large as the stags from N. Hulu Sungai.

N. W. Borneo (Sarawak). Nearly the same size as in S. Borneo. Ages are not given in literature, so estimation is difficult. Vide also BANKS (l.c.).

Biology. Occurring on different altitudes: swimming in the sea and even living on Mount Kinabalu at 10.000 ft. Preferences in habitat as in the preceding subspecies. Locally abundant, especially in S. E. and W. Borneo. In Benuwa district extinct, in the cultivated area of Bandjermasin and Hulu Sungai decreasing.

"Sore-throat" seems to occur frequently in Sarawak. Material from Borneo in our collection does not show any traces of "sore-throat". A young male, originally from the vicinity of Bandjermasin, and now living in the Royal Botanic Gardens at Buitenzorg showed the first traces of "sore-throat" at an age of one and a half years.

Breeding-seasons are very variable. BANKS (1931) mentioned August as the rutting-season (Sarawak). Fawns are born in May, June, July and September. SODY (1941) mentioned birth-dates in March, May and July. In "Drie Jaren Indisch Natuurleven" July and August are recorded as rutting-season in S. Borneo. Elsewhere September-October are recorded. A fawn from Riam (Kotawaringin District) in our collection (No. 3686) was born early in May. Shedding of antlers is recorded by BANKS (1931) in March. But antlers in velvet have been recorded in December, March, April, May and September. According to BANKS the antlers are not shed every year, but I disputed this point of view already (*vide antea*). A young stag from Riam (No. 3691) shot November 14th, is still in velvet but has just started rubbing. The young stag from Bandjermasin living in the Botanic Gardens at Buitenzorg started rubbing his first antlers in April 1948, shed October 31st, rubbed his second pair of antlers March 1949. First rut started May 1949.

Geographical distribution. Borneo; Pulau Laut, S. E. Borneo; Banguey; Balambangan (Billiton; Banka?).

Rusa equina subspec.

Cervus unicolor brookei F. N. CHASEN: Bull. Raffles Mus. 15, p. 202 (1940); LYDEKKER: Cat. Ung. B. M. IV, p. 80 (1915).

Cervus (Rusa) unicolor brookei T. D. CARTER, J. E. HILL, G. H. H. TATE: "Mammals of the Pacific World" New York, p. 144 (1945).

Rusa unicolor brookei R. I. POCOCK: Ann. Mag. N. H. Ser. 11, vol 9. p. 522 (1942).

———— ANON.: "3 Jaren Indisch Natuurleven" N. I. Vereen. Natuurbescherming, p. 137 (1939).

The localities Banka and Billiton are mentioned by only a few authors, but these populations always are considered to belong to *brookei* because of the smaller size if compared with animals from the mainland. That this is not a criterion has been demonstrated above. Deer from Banka (Billiton material was not available), are rather large, with short, heavy and massive antlers. I should bring them rather to *equina* than to *brookei* because of the type of antlers, but as long as no skins are available subspecific status must remain uncertain. Measurements vide table 10a.

Material. 3 ♂ (2 skulls, 1 set of antlers).

Occurrence. In Banka sporadical, perhaps already extinct. In 1939 the stock of deer in Billiton was fairly good.

Geographical distribution. Banka; (Billiton).

Rusa timorensis (BLAINVILLE).

C. Timorensis (L' A. de Timor) M. H. D. DE BLAINVILLE: Journ. de Phys., de Chimie et d'Hist. Nat. 94, p. 267 (1822). — Timor.

Definition. Large to rather small-sized deer. Fairly highlegged with long neck, but of less horse-like appearance than *equina*. Coat thick-set, shaggy and often long. Mane of the stag, if present, covering hind-neck, neck, throat and breast. Tail long, narrow and shaggy, but uniformly planted with hair and with a thin terminal brush. Tail of the same colour as the back, light and uniformly coloured. Belly lighter than back, mostly with a more or less pronounced dark pectoral spot. Arm-pits, groins and inner sides of ears yellowish-white to white. Few or no white markings at the lips, spot at the corner of mouth nearly always indistinct. Fawns at birth without or with indistinct spotting. Forehead concave, nasals always constricted. Orbital gland-pit deep, but less deep than in *equina*. Antlers large, slender and mostly long. a^1 turned forwards, more than in *equina*, p^2 in the same line as p^1, mostly longer than a^2, a^2 turned outwards and forwards, left and right p^2 mostly parallel, or somewhat convergent. Incisiform-teeth relatively large. Directly after teeth-shedding, in young animals of about three years, the mandibular tooth-row is one-and-a-half times as long as the total breadth of all incisiform teeth or somewhat shorter.

Terra typica. Timor.

Type of the species. Musée d'Hist. Nat. Paris, skull, leg. PÉRON & LESUEUR.

Biology. Generally in light forest, parkland and open plains. Distinctly gregarious.

Geographical distribution. Limited to the Indo-Australian Archipelago. Details are given under subspecific heading.

Key to the subspecies of *Rusa timorensis*

1.	Large	*R.t. russa*
	Medium-sized or small	2
2.	Medium-sized	3
	Small	6
3.	Pectoral spot very large	*R.t. macassaricus*
	Pectoral spot less large or absent	4
4.	Pectoral spot indistinct or absent	*R.t. laronesiotes* nov. subsp.
	Pectoral spot distinct	5
5.	Throat white	*R.t. moluccensis*
	Throat not white	*R.t. renschi*
6.	Pectoral spot large	7
	Pectoral spot medium-sized	*R.t. floresiensis*
7.	Throat dark	*R.t. timorensis*
	Throat light-coloured	*R.t. djonga* nov. subsp.

Rusa timorensis russa (MÜLLER & SCHLEGEL).

Cervus russa MÜLLER & SCHLEGEL: Verh. Nat. Gesch. Ned. Over. Bez. Zoölogie p. 212, pp. 217-220, p. 222, Pl. 43, 45 f. 1-4 (1839-1844); S. MÜLLER: ibidem pp. 13, 45, 56-57; J. G. KONINGSBERGER: De zoogdieren van Java, Med. 's Lands Plantentuin, 54, pp. 64-65 (1902); J. H. VAN BALEN: Album der Natuur, p. 119 (1906); L.: Ned. Ind. Jager, 7, pt. 7, p. 135 (1937).

Cervus russa javanicus MÜLLER & SCHLEGEL: Verh. Nat. Gesch. Ned. Overz. Bez. Zoöl. p. 217 (1839-1844); J. H. VAN BALEN: Album der Natuur, p. 119 (1906).

Cervus rusa BLYTH: P.Z.S. 1869, p. 659 (1869).

Cervus hippelaphus CUVIER: Ossements fossiles, ed. 3, 4, p. 40 (1825); V. BROOKE: P.Z.S. 1878, p. 903 (1878); SCLATER: Cat. Mamm. Ind. Mus. 2, p. 179 (1891); J. H. VAN BALEN: De dierenwereld van Insulinde, pp. 193-195 (1914); P. F. FRANCK: Natuur in Indië 2, pp. 33-41 (1937); F.F.; Ned. Ind. Jager 11, pt. 3, pp. 51-53 (1941); T. D. CARTER, J. E. HILL, G. H. H. TATE: Mammals of the Pacific World, New York pp. 144-145 (1945); H. C. RAVEN: Bull. Am. Mus. N. H. 68, p. 264 (1935).

Cervus hippelaphus typicus R. LYDEKKER: Deer of all Lands, London, pp. 164-166 (1898).

Cervus timorensis tunjuc R. LYDEKKER: Cat. Ung. Mamm. B. M. 4, pp. 66-69 (1915) (list of literature).

Cervus unicolor russa F. N. CHASEN: Bull. Raffl. Mus. 15, p. 202 (1940).

Cervus moluccensis S. MÜLLER: Verh. Nat. Gesch. Over. Bez. Zool., p. 5, p. 45 (1839-1844).

Cervus lepidus SUNDEVALL: Vet. Akad. Handl. 1844, p. 180 (1846).

Rusa hippelaphus J. E. GRAY: Cat. Rumin. Mamm. B. M. p. 77 (1872); L. J. FITZINGER: Sitzungsber. Math.-Naturw. Cl. Ak. Wiss. Wien 70, 1, Hf. 1-5, 1874, pp. 312-317 (1875) (list of literature); HILZHEIMER & HECK: Brehms Tierleben, Säuget., 4, pp. 125-127, Pl. VI, Paarhufer f. 2, p. 126 (1916).

Rusa hippelaphus hippelaphus E. MOHR: Arch. f. Naturgesch. 84, 1918, p. 133-136 (1920) (list of literature); H. J. V. SODY: Tectona 33, p. 6-7 (1940).

Rusa timorensis R. MERTENS: Zool. Jahrb. (Abt. Syst.) 68, 4/5, p. 317 (1936).

Rusa timoriensis VAN BEMMEL: Treubia, Hors Série, p. 149 (note) (1944).

Rusa timoriensis hippelaphus R. MERTENS: Senckenbergiana 7, 1-2, p. 31 (1925).

Rusa timoriensis russa VAN BEMMEL: Treubia, Hors Série, p. 152, f. 4 (1944).

Rusa timoriensis tunjuc ROWLAND WARD: Records big game 10th ed. p. 27 (1935).

Rusa unicolor russa H. J. V. SODY: Ned. Ind. Jager 11, pt. 7, pp. 155-156 (1941); ibidem: pt. 12, p. 264 (1941).

Rusa moluccensis J. E. GRAY: Cat. Rum. Mamm. B. M. p. 77 (1872).

Russa russa J. H. F. KOHLBRUGGE: Nat. Tijdschr. N.I. 55, pp. 190-192 (1896).

Russa hippelaphus J. H. VAN BALEN: Album der Natuur p. 119 (1906).

Rusa T. S. RAFFLES: Trans. Linn. Soc. 13, p. 264 (1822).

——— FRANCOIS VALENTIJN: Oud- & Nieu-Oost Indien, III, p. 267 (1726); L. F. DE BEAUFORT: Zoögeogr. Ind. Arch. p. 62 (1926); N. N.: Bull. N. I. J. G. Sept. 1933, p. 1 (1933); TOENGALA MOSA: Ned. Ind. Jager 7, pt. 5, p. 74 (1937): F. J. APPELMAN: Natuur in Indië 2, p. 54 (1937); A. HOOGERWERF: De Tropische Natuur 27, pp. 25-28, 30, 39, 43, 68-72, 77, 79, 80, 86 (1938); F. J. APPELMAN: De Trop. Natuur 28, p. 213 (1939); A. HOOGERWERF: 3 Jaren Ind. Natuurleven, Batavia, pp. 198-199, p. 287 (1939): ANON.: ibidem pp. 38, 46, 62, 72 (1939); J. G. T. LOOGEN: De Trop. Nat. 29, pp. 152-155 (1940).

Definition. Largest representatives of the species. In full-grown stags shoulderheight amounts to 1100 mm, total length of body amounts to 2150 mm. In full-grown hinds these measurements amount

Table 12. *Rusa timorensis russ*

Collection number	Locality	Collector	Date	Sex	Age in years or months (m.)	Condylo-basal length	Condylo-basal length from oral border for. magn.	Occipito-nasal length	Total length of skull	Zygomatic breadth
Bot. Garden	Baluran, E. Java.	A. HOOGERWERF	XI.1941	♂	9	312	292	286	328	141
1916	Jang Highland, E. Java.	GROOTHENGEL	14.XI.28	♂	5	317	298	278	324	14
3712	id.	A. J. LEDEBOER	10.VIII.33	♂	9	316	293	288	334	14
1909	id.	P. F. FRANCK	12.XI.28	♂	11	315	293	276	326	13
3736	id.	A. J. LEDEBOER	—	♂	11	328	304	282	333	14
3713	id.	id.	16.VII.35	♂	12	325	303	290	337	13
3710	id.	id.	16.VII.35	♀	3 m.	152	140	134	158	7
1917	id.	P. F. FRANCK	15.XI.28	♀	5 m.	169	154	152	179	8
1921	id.	id.	17.XI.28	♀	5	292	267	258	297	12
3717	Tjilatjap, M. Java.	BALGOOY	15.VII.33	♂	1	252	231	232	272	1
3719	id.	id.	11.VII.35	♂	10	321	299	289	339	1
3716	id.	id.	13.VI.33	♀	15 m.	262	242	231	272	1
3718	id.	id.	13.VII.33	♀	15 m.	269	247	239	282	1
3721	Balong, Japara, M. Java.	—	—	♂	(4)	—	—	—	—	
3728	Keling, „ „	—	—	♂	6	318	293	286	336	(
3722	„ „ „	—	—	♂	old	—	—	—	—	
1694a	Tegalwaru Est., W. Java.	P. F. FRANCK	24.II.27	♂	Fetus	119	109	103	129.5	
1698	id.	T. L. TAN	8.X.25	♂	8 m.	225	205	208	238	
1891	id.	id.	11.VI.28	♂	14 m.	280	258	251	296	
597	id.	id.	13.XII.23	♂	6	315	295	293	333	
2963	id.	ROMSWINCKEL	11.IV.31	♂	13	313	293	293	333	

LER & SCHLEGEL). Measurements.

Length of nasals in median line	Length frontal suture	Lacrimal notch to the tip of premaxillaries	Interorbital breadth	Width of palatinum between M^3	Length of mandible	Maxillary toothrow	Mandibular toothrow	Length of pedicles from caudal border of orbit	Greatest length of antlers	Distance tip to tip of antlers	Length of glandular pit	Depth of glandular pit	Total length body	Length of tail	Length of ear	Points (total number)	Remarks
16	107	186	98	55	—	84	—	79	820	455	39	14	—	—	—	6	
16	98	180	95	51	254	91	101	81	720	350	42	11	1980	280	170	6	
12	104	180	110	53	251	83	91	61	1030	580	44	15	(2010)	—	—	6	
05	107	186	95	51	250	92	102	63	766	650	42	14	2030	250	170	6	
11	107	185	107	53	—	83	—	66	950	620	41	12	—	—	—	6	
04	110	185	103	53	262	84	93	65	916	662	39	15	2080	200	165	6	
34	55	75	44	(29)	120	(41.5)	(41)	—	—	—	9	2	970	112.5	97.5	—	
50	54	89	47	(32)	137	(40)	(42)	—	—	—	13	3 5	1090	135	110	—	
105	84	166	76	49	231	88	99	—	—	—	31	8	1910	225	157	—	
84	97	149	69	(43)	197	(75)	(78)	98	—	—	31	8.5	—	—	—	—	
113	113	191	102	51	254	81	93	62	880	515	40	16	—	—	—	6	
88	90	154	65	(43)	209	(72)	(77)	—	—	—	29	7	—	—	—	—	
91	92	161	67	(42)	212	(75)	(77)	—	—	—	28	6	—	—	—	—	
—	130	—	97	—	—	—	—	89	310	270	—	—	—	—	—	6	
109	115	191	106	50	—	88	—	71	790	445	42	12	—	—	—	6	in velvet
—	—	—	99	—	—	—	—	(80)	690	530	—	—	—	—	—	$4^1/_2$	
25.5	48	56	34.5	(20 5)	98	—	—	—	—	—	—	—	615	72	75	—	Fetus taken from nr 1694
77	74	127	60	(39)	178	(56)	(58)	(28)	—	—	25	5.5	1560	193	145	—	
89	100	166	76	—	223	(76)	(78)	80	205	—	33	11	1840	225	155	2	
127	113	193	94	49	255	86	97.5	62	745	355	43	16	1800	230	150	6	
124	114	182	101	49	250	83	95	71	(710)	(270)	44	15	2120	160	170	7	in velvet

Table 12. *Rusa timorensis ru*

Collection number	Locality	Collector	Date	Sex	Age in years or months (m.)	Condylo-basal length	Condylo-basal length from oral border for. magn.	Occipito-nasal length	Total length of skull	Zygomatic breadth
1148	Tegalwaru Est., W. Java	T. L. TAN	7.X.25	♀	14 m.	270	250	235	277	1
1694	id.	P. F. FRANCK	24.II.27	♀	± 3	278	258	252	290	1
1888	id.	T. L. TAN	28.X.28	♀	± 4	300	278	273	319	1
1730	id.	P. F. FRANCK	12.VI.28	♀	7	297	275	270	312	1
3727	P. & T. Estates, W. Java.	E. G. TAYLOR	1940	♂	7	—	294	285	—	1
3284	Tjibarusa, Btzg., W. Java.	CH. JANS	10.I.32	♂	8 m.	—	—	202	235	
3285	id.	CH. JANS	21.I.32	♂	3	300	277	279	318	1
3286	id.	CH. JANS	21.II.32	♀	11 m.	243	223	220	255	1
3724	Pameungpeuk, Garut, W. Java.	—	1933	♂	old	—	—	—	—	
3725	Udjon Kulon, Bantam, Java.	DE KANTER	—	♂	—	—	—	—	—	
3723	id.	—	9.IX.42	♂	7	319	301	293	338	1
Bot. Garden	id.	A. HOOGERWERF	—	♂	14	329	306	302	351	
3720	id.	P. F. FRANCK	25.X.38	♀	15 m.	267	250	242	281	
2992	Tjilangkahan, Bantam, W. Java.	CH. JANS	26.V.31	♀	8	307	290	294	334	
3726	Malingping, Bantam, W. Java.	—	28.XI.32	♂	9	327	304	305	351	
R.M.N.H. Nr. m.	Java.	—	(1830?)	♂	—	325	307	295	340	
R.M.N.H.	id.	VAN RAALTEN	(1827?)	♂	—	—	282	283	—	
3748	Binuwang, S. E. Borneo.	B. v.d. SLUYS	1948	♂	6	313	290	274	325	
3765	id.	id.	1948	♂	6	—	—	272	—	

LER & SCHLEGEL). Measurements (Continued).

median line	Length frontal suture	Lacrimal notch to the tip of premaxillaries	Interorbital breadth	Width of palatinum between M^3	Length of mandible	Maxillary toothrow	Mandibular toothrow	Length of pedicles from caudal border of orbit	Greatest length of antlers	Distance tip to tip of antlers	Length of glandular pit	Depth of glandular pit	Total length body	Length of tail	Length of ear	Points (total number)	Remarks
96	78	160	67	40	214	72	76	—	—	—	32	8	—	—	—	—	
96	93	168	68	43	229	87	99	—	—	—	40	6	1770	210	150	—	pregnant
13	98	185	68	45	245	87	98.5	—	—	—	36	8	—	—	—	—	
10	94	177	78	46	244	86	98	—	—	—	38	10	1950	200	160	—	pregnant
17	110	—	107	55	—	87	—	70	840	440	42	16	—	—	—	6	
68	79	126	59	(38)	172	(57)	(57)	—	—	—	21	5	1360	185	140	—	
07	115	180	84	44	235	93	101	80	145	180	39	11.5	1900	215	155	4	
81	84	144	59	(40)	187	(58)	(59)	—	—	—	23	5	1500	180	145	—	
19	106	—	103	—	—	—	—	66	805	330	—	—	—	—	—	7	
—	—	—	—	—	—	—	—	65	770	475	—	—	—	—	—	6	
21	113	187	98	49	250	90	97	64	820	575	42.5	13	—	—	—	6	
24	115	197	106	48	—	83	—	57	710	560	42	16	—	—	—	6	
90	91	159	69	(40)	(212)	(73)	(73)	—	—	—	33	6.5	1735	200	155	—	
14	115	180	104	54	246	82	91	65	(780)	370	43	14	—	—	—	6	in velvet
21	119	195	102	49	257	90	101	80	785	370	44	11	(2000)	—	—	7	
10	130	193	101	—	269	91	102	63	828	390	46	—	—	—	—	6	Type of subsp.
12	—	—	—	—	240	92	102	—	800	—	—	—	—	—	—	6	
07	109	185	96	49	—	85	—	69	535	283	42	17	—	—	—	6	Imported
11	98	—	83	48	—	86	—	67	472	280	36	10	—	—	—	6	id.

Table 13. Best heads of *Rusa timorensis russa* (MÜLLER & SCHLEG.) from Java.

Collector	Locality	Greatest length of antler	Circumference above burr	Circumference of burr	Shortest beam	Circumference above burr	Circumference of burr	Tip to tip	Greatest width	Literature
A. J. M. LEDEBOER	Jang Highland. E. J.	1115	200	230	1100	200	230	470	—	N. I. J. VIII, 1938, 6, p. 131 (vide Pl. 4)
Z. M. Btzg. 3712	Jang Highland. E. J.	1030	145	194	960	152	188	580	780	
H. DE STUERS	Baluran — Idjen E. J.	980	188	215	970	170	205	—	—	N. I. J. VIII, 1938, 3, p. 58
Z. M. Btzg. 3736	Jang Highland E. J.	950	185	210	945	175	210	620	710	T. N. 1937, p. 50
Z. M. Btzg. —	(Java)	940	175	217	920	173	212	350	650	
F. C. HARTWIG	Malang E. J.	950	190	—	—	—	—	—	720	N. I. J. VII, 1937, 12, p. 257
VAN MAARSEVEEN	(Java)	930	—	230	895	—	220	—	—	N. I. J. X, 1940, 4, p. 77
VAN BEEKUM	Tjidjulang, Z. W. Java	930	190	—	920	195	—	—	—	N. I. J. VII, 1937, 12, 1937, p. 233
T. TACOMA	Bululawang	920	170	—	880	170	—	—	700	N. I. J. VII, 1937, 12, p. 257
Z. M. Btzg. 3713	Jang Highland E. J.	915	153	192	840	147	185	660	870	
VELDMAN	Subang W. J.	910	170	175	—	—	—	—	—	N. I. J. VII, 1937, 10, p. 190
E. J. W. PIEPLENBOS	Malang E. J.	900	170	—	890	170	—	—	710	N. I. J. VII, 1937, 12, p. 257
Z. M. Btzg. 3719	Tjilatjap M. J.	880	190	243	860	175	215	515	630	
Z. M. Btzg. 3723	Udjon Kulon W. J.	860	175	215	820	170	215	575	660	
VAN DER HARST	Tjipatudjah	860	160	215	810	205	255	520	—	N. I. J. X, 1940, 4, p. 79
F. H. FELTKAMP	Baluran E. J.	850	—	230	840	—	220	—	—	N. I. J. XI, 1941, p. 52
Z. M. Btzg. 3727	P. & T. Estates W. J.	850	182	225	840	178	220	440	630	
Btzg. Bur. Nature Protection	Baluran E. J.	820	170	195	800	165	188	455	680	

to 1000 mm, resp. 1950 mm. Mane in the rutting stag mostly strongly developed, in hinds less developed or obsolete. Colour of upper side varies from dark oakwood-brown in old stags in spring-coat, to golden yellow in hinds in autumn-coat. The bright parts vary from brownish yellow in old stags to yellowish-white in young stags and hinds. Dorsal stripe only distinct in hinds and fawns. Dark pectoral spot rather large, in old stags running far backwards on the belly. Often a yellowish-brown to dark brown spot on both sides of chin. Forehead dark, in contrast with rest of head. Always distinct sexual, seasonal and age differences. Coat long, shaggy and harsh. Total length of skull: ♂, 320-350 mm; ♀ 290-320 mm. Measurements are given in table 12. Antlers long, slender, maximal length measured 1115 mm, good antlers averaging from 800-900 mm (Table 13, Pl. 4). Left and right p^2 as a rule parallel. In old stags slightly convergent. Width of antlers increases with age. Maximal width measured 870 mm. Accessorial points mostly limited to p^2. p^2 as a rule becomes more or less palmate at an age of about nine years. In some cases even "surroyals" or a "cup" may be produced.

A fetus of about 5 months in our collection (Cat. No. 1694 a) has a small dark pectoral spot and a faintly indicated dorsal stripe, caudally bordered by rows of small yellowish-brown spots. Faint spots are also present on the buttocks and ten somewhat larger spots are found on the shoulders. At birth spots have always vanished.

Terra typica. Java.

Type of subspecies. Lectotype, Rijksmuseum N.H. Leiden, Skull, ♂, Java, No. m (figured in MÜLLER & SCHLEGEL: l.c. Pl. 45, f. 1).

Material. 35 ♂ (35 skulls, 14 skins), 14 ♀ (13 skulls, 12 skins),

Diagnosis. Differing from other subspecies by larger size, p^2 of left and right side running mostly parallel, palmate p^2 at old age. Differing moreover from south-eastern races of the species by longer coat, mane of stag and great sexual and age variation in colour of coat. Differing from *R.t. moluccensis* by darker throat.

Variation of populations in Java. Populations in Java are not homogeneous. As a rule populations in East Java are distinguished by smaller measurements from those of West Java. Antlers, on the other hand, are heavier in East Java. The best heads come from East Java. The facial part of the skull is somewhat more protracted there. Coat and colour, apart from other variations, vary geographically as follows:

Jang Highland (E. Java). Coat thick-set and heavy, with heavy mane. Warm colours with predominating yellow tinge, hinds golden-yellow.

Tjilatjap (C. Java). Much less thick-set coat, less heavy mane, more grayish, less yellow tinge.

Tegal Waru (W. Java). Coat as in the preceding race, poorly developed mane, less yellow, more rusty-red than deer of Jang, less gray than Tjilatjap-deer. Dorsal stripe more distinct than in the other populations.

Tjibarusa (W. Java). More heavy mane than in the preceding population, but less heavy than in deer of Jang. Grayish-brown predominating, no traces of a yellow tinge. Dorsal stripe inconspicuous, even in fawns.

Bantam (W. Java). Heavy mane and coat as thick-set as in Jang-deer. Hinds lighter and more grayish than in other populations.

Variation of populations outside Java (imported stock).

Borneo. My material consists of two skulls of stags. Measurements belong within the variational width of Java, but the antlers are light and thin. Skins not available. The only description at my disposal is KOHLBRUGGE l.c. (1896). According to this author the coat is thin, dark coloured and dorsal stripe distinct.

Biology. There is a marked preference for parkland and grass plains. Woods are mostly used for shelter but for feeding pastures are desirable (HOOGERWERF 1938). Sometimes the subspecies has been recorded in tidal coast-forest. Less water-bound than *R. equina,* but they do not despise a mud-bath. The stock of deer in Java has seriously decreased. A somewhat satisfactory stock was present in 1939 in the following areas: Baluran (250), Idjen (good), Jang (numerous), Ardjuno (moderate), Tjilatjap (moderate), Japara (good), Garut (increasing), Papandajan (many), Tegalwaru (protected), Bantam incl. Udjon Kulon peninsula (moderate). Elsewhere extinct or sporadical. It is impossible to make a satisfactory review of the present status. Owing to the Japanese occupation and the troubles that followed, disforestation and poaching occurred to such a degree that consequences may prove serious. On the Jang Highland JUNGHUHN recorded 50.000 specimens in 1844. In 1908 only about 100 were left. In 1940, after drastic guarding and managing by the brothers LEDEBOER, deer on the Jang Highland amounted to 10.000 specimens. According to the most recent data, recorded by the Government Forestry Service, there are at the moment still 7000 left.

"Sore-throat" never occurs.

Birth-dates. April, May, June, July, September (SODY), April-May (Jang, LEDEBOER). In our collection fawns are present born about March, April, June and July. First impregnation of hinds at an age of 2 years and 3 months (LEDEBOER).

Rutting-season. June-August, varying according to favourable and unfavourable years (LEDEBOER), September-October (TOENGALA MOSA), July-September (P. F. FRANCK). Rutting-season starts somewhat later in the mountains than in the lowlands (LEDEBOER).

Duration of pregnancy: 267 days (SODY), 280 days (LEDEBOER), 249-284 days (E. MOHR: Zoological Garden, Hamburg) and 284 days (HILZHEIMER & HECK: Zoological gardens).

Shedding of antlers in December-January (LEDEBOER). In our collection antlers in velvet from April and May (W. Java). In European

Zoological gardens shedding has been recorded in May (HILZHEIMER & HECK) and May-July with a maximum in June (E. MOHR). Rubbing of the velvet occurs after five months. The story that antlers are carried for more than a year is also told here (VAN BALEN, 1906). It seems that the rutting-season is more bound to season in Java than it is elsewhere.

In rutting-season the stags collect a harem and fierce fights occur between rivals. Rutting stags are roaring day and night. During this season the weight of the stags decreases, often by 30 kg. Before the fight takes place they approach each other in "Stechschritt", upper lip retracted. "Verkampfen" does occur (LEDEBOER, FRANCK, LOOGEN). Outside the rutting-season stags and hinds often live in separate herds. Hinds mostly act as watch-keepers (LEDEBOER, HOOGERWERF).

Little is known about the biology of the imported stock in Borneo. MÜLLER & SCHLEGEL mentioned herds of more than a hundred heads on the grassy plains of Pulu Lampej, where at that time thousands of deer could be counted. In the course of 160 years these herds arose from one single pair. These authors especially pointed to the absence of natural enemies. No reliable data are available concerning the present status.

Geographical distribution. Java, S.E. Borneo (imported), Ambon (imported, cross-breds only), Celebes (imported, cross-breds only). Importing has been mentioned in Mauritius and Horsburg Isl. (LYDEKKER). I cannot check the reliability of this record. The occurrence in Sumatra has been reported several times (LYDEKKER, 1915; BEAUFORT, 1926). CHASEN (1940) critically reviewed and rejected this occurrence. But the possibility should be considered (HOOGERWERF, 1939, p. 287!).

Rusa timorensis laronesiotes nova subspec.

Definition. Middle-sized representatives of the species. Exact shoulder height not known. Total length of body of stags up to 1870 mm, of hinds up to 1700 mm. Mane in rutting stags heavily developed, much less developed in females. Colour light, passing into grayish. Young hinds in summer-coat light oakwood-brown, old hinds in autumn-coat light grayish-brown. Old stags grayer and darker. Light parts yellowish-white, inner side of ears dirty white. Dorsal stripe in females indistict, only distinct in fawns. Dark pectoral spot small or absent. No spots at the chin. Forehead darker than rest of head. Distinct sexual, seasonal and age differences in colour. Coat thickset, shaggy but soft and nearly woolly. Total length of skull of stags 290-310, hinds 270-290 mm. Other measurements vide table 14.

Antlers long and slender. Maximal measured length 750 mm, maximal measured width 520 mm. Accessorial tines and palmation not observed.

Terra typica. Meeuwen Eiland, Strait Sunda (between Java and Sumatra).

Tab

Collection number	Locality	Collector	Date	Sex	Age in years or months (m.)	Condylo-basal length	Condylo-basal length from oral border for. magnum	Occipito-nasal length	Total length of skull	Zygomatic breadth	Greatest width of braincase
3730	Meeuwen Eiland Strait Sunda.	DE KANTER	27.XI.33	♂	5 m.	175	(160)	164	193	83	69
3658	id.	TEN ZELDAM	4.VIII.32	♂	9	290	271	256	307	131	80
3287	id.	H. v. POLANEN PETEL	III.32	♂	9	282	263	246	293	128	79
3731	id.	JANS	16.XI.32	♀	3	—	—	220	264	112	73
3659	id.	P. F. FRANCK	5.VIII.32	♀	3	244	226	211	256	116	72
3660	id.	id.	3.VIII.32	♀	7	275	255	244	290	116	77
3733	id.	id.	24.X.38	♀	11	—	—	—	-	—	(75)
3734	id.	id.	24.X.38	♀	12	257	237	—	269	117	75
3732	id.	SOERADI	29.XI.33	♀	12	265	248	242	287	121	79
3735	Nusa Barung	Ir J. VAN OMME	XI.40	♂	16	268	250	223	277	126	77
2716	Karimon Djawa	Purchased	25.XI.30	♂	18 m.	247	231	225	260	107	71
1452	id.	P. F. FRANCK	6.V.25	♂	20	286	264	261	301	123	79

Type of subspecies. Buitenzorg Museum, skin & skull, ♂, Meeuwen Eiland, Strait Sunda, 4.VIII.32, leg. TEN ZELDAM, Cat. No 3658.

Material. 3 ♂ (3 skulls, 2 skins), 6 ♀ (6 skulls, 4 skins).

Diagnosis. Smaller than *Rusa t. russa,* less heavy antlers. Mainly distinguished by measurements, the soft coat, the equal colour and nearly always the absence of dark markings.

Biology. Little known. Meeuwen Eiland is covered with light forest without pastures. A fawn in our collection must have been born about June. The stag shot in August just finished rubbing velvet. M. A. LIEFTINCK recorded general roaring of stags in September. HOOGERWERF (Drie Jaar Ind. Natuurleven 1939, p. 198) considered the population on Meeuwen Eiland as degenerated because of the absence of good pastures and supposed that the stock was replenished by deer swimming

Length of frontal suture	Lacrimal notch to the tip of premaxillaries	Interorbital breadth	Width of palatinum between M^2	Length of mandibel	Maxillary toothrow	Mandibular toothrow	Length of pedicles from caudal border of orbit	Greatest length of antlers	Distance tip to tip of antlers	Greatest width of antlers	Length of glandular pit	Depth of glandural pit	Total length of body	Length of tail	Length of ear	Points (total number)	Remarks
73	95	52	(33)	142	(39)	(42)	—	—	—	—	16	3	1079	128	117	—	
101	165	91	51	243	81	92	64	750	340	480	39	13	1870	220	155	6	*Rusa timorensis laronesiotes* nov. subspec.
97	159	82	47	225	81	94	59	630	505	520	32	—	—	—	—	6	
82	147	60	40	204	82	93	—	—	—	—	30	5.5	1520	(130)	150	—	
80	140	64	45	209	79	91	—	—	—	—	29	5	1590	200	150	—	
89	163	70	46	226	81	90	—	—	—	—	33	8	(1280)	200	150	—	
—	165	72	46	—	77	—	—	—	—	—	29	7	—	—	—	—	
77	147	67	46	—	75	—	—	—	—	—	—	—	—	—	—	—	
94	161	77	51	221	76	87	—	—	—	—	31	8	1701	210	145	—	
81	155	80	45	213	78	91	47	410	345	360	30	9	—	—	—	abn 6	Subspec.
90	147	68	(38)	195	(78)	(86)	66	(18)	(50)	—	30	6.5	1498	198	142	2	Subspec.
98	167	86	47	216	70	84	—	—	—	—	37	10	1845	201	140	abn 6	

over from Udjon Kulon Peninsula. This does not appear from our material. The local stock is so uniform and so entirely different from the population on Udjon Kulon that in my opinion it represents an isolated island-race (vide p. 209). There remains a possibility that a few specimens may really cross the narrow passage between Udjon Kulon and Meeuwen Eiland, but I do not believe in a regular exchange between both stocks. Mr. LIEFTINCK told me that the deer he saw on Meeuwen Eiland were beautifully developed and, apparently, large animals. Certainly no degenerates.

Geographical distribution. Only known from Meeuwen Eiland. It is not known whether Prinsen Eiland, lodging a large stock of deer, presents the same race.

Rusa timorensis subspec.

——— F. J. APPELMAN & G. F. H. W. RENGERS HORA SICCAMA: 3 Jaren Indisch Natuurleven, pp. 289-292 (1939); F. J. APPELMAN: Trop. Natuur 30, 3, p. 48 (1941).

Description. Small, brachycephalous. Exact measurements of body unknown. Skin not seen by me, but the coat is said to be long and coarse. Skull-measurements vide Tabel 14. Poor antlers.

Antlers of the specimen available abnormal, a^2 lacking at both sides, left a^1 doubled, a third a^1 forms a pendulum (description and photo: APPELMAN 1941). Hence nothing can be decided.

Material. 1 ♂ (skull).

Diagnosis. Smaller than *russa* and *laronesiotes*.

Biology. On the island Nusa Barung deer are obviously not rare but they do not occur in herds. There are no pastures. They feed on tree-fruits, bark and pandanus leaves (APPELMAN & SICCAMA 1939). The island is a game-preserve because of the deer. Old adat rights allowed the people of Puger to have a beat on the island once a year.

Geographical distribution. Nusa Barung (island off the S.E. coast of Java, District Djember).

Rusa timorensis subspec.

Cervus russa S. H. KOORDERS: Natuurk. Tijdschr. N. I. 48, pp. 111-112, 37-38 (1889).

Description. Middle-sized. Greatest measured shoulderheight: stag, 915 mm; greatest measured total length 1845 mm. Mane of stags poorly developed. Rather lightly coloured. Young stag in autumn-coat light reddish-brown, old stag in spring-coat dull grayish-brown. The light coloured parts yellowish-buff, inner side of ears light buff. Young stag with an indistinct dorsal stripe. Dark pectoral spot very large, nearly covering the whole breast. Chin-spots indistinct. Colour of the forehead hardly contrasting with the rest of the head. Obviously there are marked seasonal and age differences. Coat relatively thin-set and short. Greatest measured length of skull: stag, 301 mm. Only abnormal antlers seen by me. These antlers belonged to a very old animal. The beams are capriciously bent, a^1 nearly absent, left beam with some short protuberances, tines totally absent at the right hand side. Measurements: table 14.

Material. 2 ♂ (skins and skulls).

Diagnosis. Middle-sized, smaller than *russa*, as large as *laronesiotes* but with a more protruded skull. Distinguished by thin coat, poorly developed mane and large pectoral spot.

Biology. Occurs in large herds. Antlers shed in May. KOORDERS recorded roaring stags in November.

Geographical distribution. Island Karimon Djawa and Island Kamudjan (Karimon Djawa Archipelago, Java Sea). On Pulu

Genteng perhaps a few specimens. On Pulau Mendjangan Besar (mendjangan = deer) and P. Mendjangan Ketjil extinct. In 1854 TEYSMAN still recorded large herds.

Note. KOORDERS mentioned two "species": mendjangan-lulung and mendjangan-ranti (lulung = large, ranti = small). This has a bearing on old and young animals (DAMMERMAN: Expedition Diary, unpublished).

Rusa timorensis subspec.

Cervus timorensis tunjuc R. LYDEKKER: Cat. Ung. Mamm. B. M. 4, p. 69 (1915).
——— F. J. APPELMAN: Trop. Natuur 27, p. 182 (1938).

Description. Not seen by me. R. LYDEKKER mentioned two half skulls with antlers from "Sapandjang Isl. near Kangean-Isl.", coll SHORTRIDGE. APPELMAN stated: "conspicuously small and dark coloured".

Biology. In July herds of hinds only. Rutting-season had not started in that month (APPELMAN, 1938).

Geographical distribution. Sepandjang (Kangean Arch.).

Rusa timorensis renschi (SODY).

Cervus hippelaphus renschi SODY: Natuurk. Tijdschr. N. I. 92, 2, pp. 235-237 (1932); Natuurk. Tijdschr. N. I. 93, 1, p. 92 (1933).

Rusa unicolor renschi SODY: Ned. Ind. Jager 11, pt. 12, p. 264 (1941); CHASEN: Bull. Raffl. Mus. 15, p. 202 (1940).

Rusa timorensis timorensis R. MERTENS: Zool. Jahrb. (Syst.) 68, 4-5, pp. 316-317 (1936).
——— DONKER VAN HEEL: Ned. Ind. Jager 7, pt. 10, p. 191-192 (1937); ANON.: 3 Jaren Indisch Natuurleven, pp. 148, 149 (1939).

Definition. Middle-sized representatives of the species. Exact measurements of body unknown. According to LEDEBOER (cf. SODY 1932, 1933) this subspecies can attain only half the weight of *russa*. Coat and colour unknown. Length of skull very variable, more than in other races, which could be an indication that the populations are not pure-bred, but mixed with more recent importations. Size differences between the sexes less important than in other races. Habitus of antlers unknown to me. Total length of antlers of 570 mm appears to be a good head. Measurements: Table 15.

Terra typica. Serdang, W. Bali.

Type of subspecies. In collection SODY, Leiden, skull, ♂ ad., Nr. 281.

Material. 4 ♀ (4 skulls).

Diagnosis. Characterized by measurements smaller than *russa* and larger than *floresiensis*. SODY based the difference from other races on the relatively short nasals. This character was rejected by MERTENS (1936).

Biology. Little known. In 1938 numerous, but numbers decreasing because of reckless poaching. Birth-season, according to SODY (1941), in October.

Geographical distribution. Only known from Bali.

Table 15. *Measurements of*

Collection number	Locality	Collector	Date	Sex	Age in years or months (m.)	Condylo-basal length	Condylo-basal length from oral border for. magn.	Occipito-nasal length	Total length of skull
SODY E 286	Sendang. W. Bali	—	—	♂	17 m.	217	—	206 5	245
SODY E 285	id.	—	—	♂	22 m.	—	—	217	—
SODY E 283	id.	—	—	♂	?	242.5	—	231	279
SODY E 284	id.	—	—	♂	?	—	—	228	274
SODY E 282	id.	—	—	♂	?	239.5	—	219 5	264
SODY E 281	id.	—	—	♂	?	275	—	259	311
3683	Banju Wetan W. Bali	J. J. MENDEN	23.VII.33	♀	2	255	239	224	268
3684	id.	id.	16.VII.33	♀	6	266	248	238	280
3682	id.	id.	21.VII.33	♀	11	262	244	234	279
3685	id.	id.	21.VII.33	♀	15	259	244	232	273

Rusa timorensis floresiensis (HEUDE).

Hippelaphus floresiensis HEUDE: Mém. conc. l'Hist. Nat. Emp. Chin. III, p. 92, Pl. XV, f. 1-4 (1896).

Hippelaphus sumbavanus HEUDE: Mém. conc. l'Hist. Nat. Emp. Chin. III, p. 92, Pl. XV, f. 5 (1896).

Hippelaphus timoriensis HEUDE: Mém. conc. l'Hist. Nat. Emp. Chin. III. pp. 51-52, Pl. XIV (1896) (part).

Cervus hippelaphus K. W. DAMMERMAN: Treubia 10, 2-3, pp. 310-312 (1928).

Rusa hippelaphus moluccensis E. MOHR: Arch. f. Naturg. 84, 1918, p. 137 (1920).

Rusa Peronii J. E. GRAY: Cat. Rumin. Mamm. B.M. pp. 78-79 (1872).

Rusa timorensis timorensis R. MERTENS: Zool. Jahrb. (Syst.) 68, 4-5, pp. 316-317 (1936).

Rusa unicolor renschi SODY: Ned. Ind. Jager 11, pt. 7, p. 156 (1941).

Russa russa M. WEBER: Zool. Ergeb. Reise N.I. 1, p. 112 (1890-1891).

——— K. W. DAMMERMAN: De Trop. Natuur 15, p. 77 (1926); ANON.: 3 Jaren Ind. Natuurleven, Batavia 1939, p. 149, 151 (1939); C. N. A. DE VOOGD: De Trop. Natuur 30, p. 123 (1941); L.: De Ind. Jager, April 1948, pp. 61-63 (1948).

Definition. This race belongs to the smallest representatives of the species. Total length of body amounts to 1450 mm in adult females (greatest measured length from Flores). Measurements of adult males

ensis renschi (SODY).

2 nasals	Length of nasals in median line	Length of frontal suture	Lacrimal notch to the tip of premaxillaries	Interorbital breadth	Width of palatinum between M^3	Length of mandibel	Maxillary toothrow	Mandibular toothrow	Length of pedicles from caudal border of orbit	Greatest length of antlers	Distance tip to tip of antlers	Greatest width of antlers	Length of glandular pit	Depth of glandular pit	Total length of body	Length of tail	Length of ear	Points (total number)	Remarks
3	74	77.5	132	66	—	—	± 83	—	—	—	—	—	—	—	—	—	—	?	After SODY 1932
1.5	79	82	—	67	42.5	—	79.5	84.5	-	112 +	84	—	—	—	—	—	—	—	id.
2	79.5	88.5	153	80	48	—	79.5	94	—	224 +	254	—	—	—	—	—	—	—	id.
1.5	81.5	87	151	77	42.5	—	81	89	—	259 +	207	—	—	—	—	—	—	—	id.
1	79	82	147	75	46.5	—	69.5	84.5	—	539 +	335	—	—	—	—	—	—	—	id. (abnormal?
1.5	103	93.5	181	91	48.5	—	83 5	93	—	568 +	405	—	—	—	—	—	—	—	id. (type)
3	89	80	155	64	36	209	81	91	—	—	—	—	28	5	—	—	—	—	
3	93	86	161	70	44	217	78	88	—	—	—	—	33	7.5	—	—	—	—	
1	89	86	157	67	41	206	72	84	—	—	—	—	30	7	—	—	—	—	
3.5	91	87	157	70	44	213	70	82.5	—	—	—	—	30.5	8.5	—	—	—	—	

in the flesh have not been taken, but there seems to be only little difference in size between the sexes. Mane seems to be lacking in both sexes. Colour varying from very light yellowish-gray in autumn-coat to dark rufous-brown in spring-coat. Dorsal stripe only indistinctly present in young animals, absent in adults. Light coloured parts yellowish-white to dirty-white. Dark pectoral spot running backwards over the whole breast. Chin-spot mostly totally absent. Forehead only little darker than rest of head. Rest of head evenly coloured, without white markings, darker than body. No sexual or age-differences in colour, but seasonal variation most obvious. Coat short, harsh and thinly set. Total length of skull, in stags 265-288 mm, in hinds 254-262 mm. Measurements vide Table 16. Antlers short and light, length and form varying geographically (Table 17), but left and right p^2 as a rule parallel or slightly convergent. Accessorial points typically limited to a^1. Especially in old animals brow-tine medially broadened, even sometimes palmate and sometimes with accessorial tines (a.o. Cat. Nr. 514).

Terra typica. Ilimandiri, Flores.

Table 16. *Rusa timo*

Collection number	Locality	Collector	Date	Sex	Age in years or months (m.)	Condylo-basal length	Condylo-basal length from oral border for. magnum	
3677	Sembalun, Lombok.	Sunda Exp. RENSCH	13.X.27	♂	(15 m)	—	—	–
3680	Segare Anak, Lombok.	id.	6.IV.27	♂	3	—	—	–
3678	Sembalun, „	id.	10.IV.27	♂	?	—	—	–
3681	Segare Anak, „	id.	5.IV.27	♂	?	—	—	–
3679	Sembalun, „	id.	10.IV.27	♂	?	—	—	–
496	Bima, Sumbawa.	H. H. the Duke A. VON MECKLENBURG	VII.23	♂	4	259	247	2
494	id.	id.	VII.23	♂	5	268	256	2
495	id.	id.	VII.23	♂	6	271	257	2
929	Sumbawa.	BERKHOLZ	III.25	♂	?	—	—	–
928	id.	id.	III.25	♂	?	—	—	–
500	Bima, Sumbawa.	H. H. the Duke A. VON MECKLENBURG	VII.23	♀	16 m.	—	—	(2
3663	Dompu, Sumbawa.	Sunda Exp. RENSCH	31.V.27	♀	± 2	—	—	–
498	Bima, „	H. H. the Duke A. VON MECKLENBURG	VII.23	♀	4	245	229	2
499	„ , „	id.	VII.23	♀	4	247	233	2
497	„ , „	id.	VII.23	♀	5	240	226	21
511	N.E. Komodo.	id.	VII.23	♂	6	261	245	2
510	N.E. Komodo.	id.	VII.23	♂	6	261	246	2
513	N.E. Komodo.	id.	VII.23	♂	7	263	244	24
514	C. Komodo.	id.	VII.23	♂	9	272	252	24
512	N.E. Komodo.	id.	VII.23	♂	11	272	253	23
506	Komodo.	id.	VII.23	♀	3	238	220	21

resiensis (HEUDE)

Greatest width of braincase	Greatest width of 2 nasals	Length of nasals in median line	Length of frontal suture	Lacrimal notch to the tip of premaxillaries	Interorbital breadth	Width of palatinum between M^3	Length of mandibel	Maxillary toothrow	Mandibular toothrow	Length of pedicles from caudal border of orbit	Greatest length of antlers	Distance tip to tip of antlers	Greatest width of antlers	Length of glandular pit	Depth of glandular pit	Total length of body	Length of tail	Length of ear	Points (total number)
—	—	—	—	—	—	—	—	—	—	64	85	112	125	30	10	—	—	—	2
72	29	—	76	—	74	42	199	76.5	87	64	174	177	187	—	—	—	—	—	5
—	35.5	89	78	148	82	—	—	—	—	63	305	265	361	—	—	—	—	—	6
—	—	—	—	—	—	—	—	—	—	—	360	—	—	—	—	—	—	—	6
—	—	—	—	—	—	—	—	—	—	66	370	260	330	—	—	—	—	—	6
71	29	99	78	148	77	37	198	79.5	88	61.5	181	152	212	32.5	12	—	—	—	6
72	33.5	104	85	160	88	43	207	78	87	57	368	230	330	35	16	—	—	—	6
74	38.5	109	81	161	92	43.5	212	79.5	89	64	394	280	350	38	17.5	—	—	—	7
—	—	—	90	—	84	—	—	—	—	66	375	318	335	—	—	—	—	—	6
—	—	—	82	—	84	—	—	—	—	57	492	374	385	—	—	—	—	—	7
65	20	79	70.5	—	52	(38)	177	(74)	(76)	—	—	—	—	27	7	—	—	—	—
—	—	—	—	—	—	—	189	—	(87.5)	—	—	—	—	—	—	—	—	—	—
67	27	96	72	146	63	37	199	77	88	—	—	—	—	30	7	—	—	—	—
69	26	105	69	148	62	38	195	76	87	—	—	—	—	31	7.5	—	—	—	—
68	23	89	69	142	64.5	36.5	190	76	83.5	—	—	—	—	30	7.5	—	—	—	—
69	24	95	80	152	72.5	41	209	79.5	89	63.5	413	158	340	31	12.5	—	—	—	6
69	28	98	78	150	74	42.5	213	79	89	56	342	135	255	34	15	—	—	—	6
73	27	98	(88)	152	80	43	208	77	86.5	64	417	(162)	290	32	12	—	—	—	6
70.5	29.5	(88)	91	155	79	43.5	213	75.5	86.5	61	515	150	365	35	17.5	—	—	—	7
68	29	91.5	86	155	78	43	215	75	85	64	352	230	305	34	12.5	—	—	—	6
66	23	84	74	136	59	35.5	192	76	88	—	—	—	—	29	10	—	—	—	—

Table 16. *Rusa timo*

Collection number	Locality	Collector	Date	Sex	Age in years or months (m.)	Condylo-basal length	Condylo-basal length from oral border for. magnum	
508	Komodo	H. H. the Duke A. VON MECKLENBURG	VII.23	♀	8	246	232	2
509	id.	id.	VII.23	♀	8	245	230	2
507	id.	id.	VII.23	♀	11	246	230	2
2378	Mbura, W. Flores.	Dr J. K. DE JONG	16.X.29	♂	16 m.	242	227	2
2377	id.	id.	16.X.29	♂	17 m.	232	220	2
2380	id.	id.	16.X.29	♂	28 m.	242	226	2
504	Badjawa, S. Flores.	H. H. the Duke A. VON MECKLENBURG	1923	♂	6	—	—	2
505	id.	id.	1923	♂	7	—	—	2
501	id.	id.	1923	♂	7	—	—	2
502	id.	id.	1923	♂	9	—	—	—
503	id.	id.	1923	♂	12	—	—	(24
2376	Mbura, W. Flores.	Dr J. K. DE JONG	16.X.29	♀	15 m.	221	207	2
2379	id.	id.	16.X.29	♀	6	245	230	2
857	Sumba.	Dr K. W. DAMMERMAN	1925	♂	?	—	—	—
856	id.	id.	1925	♂	?	—	—	—
859	id.	id.	1925	♂	?	—	—	—
860	id.	id.	1925	♂	?	—	—	—
858	id.	id.	1925	♂	?	—	—	—
855	id.	—	3.II.28	♀	3	251	237	2

resiensis (HEUDE) (Continued).

Greatest width of braincase	Greatest width of 2 nasals	Length of nasals in median line	Length of frontal suture	Lacrimal notch to the tip of premaxillaries	Interorbital breadth	Width of palatinum between M^3	Length of mandible	Maxillary toothrow	Mandibular toothrow	Length of pedicles from caudal border of orbit	Greatest length of antlers	Distance tip to tip of antlers	Greatest width of antlers	Length of glandular pit	Depth of glandular pit	Total length of body	Length of tail	Length of ear	Points (total number)
65	21	89	71.5	144	58	37	193	71	83	—	—	—	—	27	7.5	—	—	—	—
66	21	86	81	144	58	40	203	73	83	—	—	—	—	27	7.5	—	—	—	—
64	24.5	88	74	145	61	41	203	72	82.5	—	—	—	—	26	8	—	—	—	—
69	22.5	85	79	141	59	(37)	194	(80)	(81)	69	134	124	126	28	8	1370	150	129	2
70.5	22	81	70	135	66	(37)	188	(74.5)	(80.5)	71.5	144	(93)	110	24	7	1405	182	125	2
67	22	83	81	140	60	40	191	78.5	86	68	182	(75)	105	28.5	7	1416	162	128	2
71	29	93	84	—	80	42	—	78	—	68	362	255	338	37	15	—	—	—	6
73	33.5	99	85	157	85	43	—	82	—	69	395	243	370	33	14	—	—	—	6
72	28	93	88	158	87.5	42	—	79	—	61	435	235	360	32	15	—	—	—	6
—	32	98	87	159	88	—	—	74.5	—	69	425	267	395	40	16	—	—	—	8
74	33	103	84	156	85	46	—	74	—	51	462	195	290	33	13	—	—	—	6
64	21	78	67	128	52.5	36.5	173	(74.5)	(76)	—	—	—	—	22	6	1440	140	115	—
66	23	90	72	145	60	38	203	76	89.5	—	—	—	—	28	7.5	1450	170	119	—
—	27	95	90	160	85	—	—	—	—	53	386	(115)	290	—	—	—	—	—	6
—	31	96	85	155	87	—	—	—	—	62	520	262	420	—	—	—	—	—	6
—	—	—	(90)	—	—	—	—	—	—	(60)	510	283	415	—	—	—	—	—	6
—	—	—	88	—	86	—	—	—	—	(64)	525	230	395	—	—	—	—	—	6
—	—	—	92	—	87	—	—	—	—	(62)	535	200	410	—	—	—	—	—	6
67	24	91	78	149	57	36	199	75.5	87.5	—	—	—	—	28	7.5	1445	120	122	—

Table 17. Best heads of *Rusa timorensis floresiensis* (HEUDE).

Collection	Locality	Greatest length of antler	Circumference above burr	Circumference of burr	Tip to tip	Greatest width	Points
Zool. Mus. Berlin	Sembalun, Lombok.	390	—	—	283	400	—
id.	„ „	385	—	—	328	433	—
id.	„ „	370	—	—	295	425	—
Zool. Mus. Btzg. 3679	„ „	370	134	160	260	330	3 + 3
id. 928	Sumbawa.	492	123	157	374	(385)	3 + 4
id. 3664	„ , Wawo.	425	121	170	—	—	3 + ?
id. 495	„ , Bima.	394	117	165	280	350	3 + 4
id. 929	„	375	120	155	318	335	3 + 3
id. 514	M. Komodo.	515	140	170	150	365	3 + 4
id. 513	N.E. Komodo.	417	110	145	162	290	3 + 3
id. 511	N.E. Komodo.	413	110	135	158	340	3 + 3
id. 512	N.E. Komodo.	352	115	145	230	305	3 + 3
id. 503	W. Flores, Badjawa.	462	125	170	195	290	3 + 3
id. 501	id. id.	435	138	175	235	360	3 + 5
id. 502	id. id.	425	180	190	267	395	3 + 5
id. 505	id. id.	395	130	150	243	370	3 + 3
id. 858	Sumba, Waingapu.	535	138	165	200	410	3 + 3
id. 860	id. id.	525	135	160	230	395	3 + 3
id. 856	id. id.	520	130	160	262	420	3 + 3
id 859	id. id.	510	140	165	283	415	3 + 3

Type of subspecies. Lectotype: Collection HEUDE, skull, ♂, Flores, Ilimandiri (cf. l.c. Pl. XV, f. 1), leg. dom. LORENZO.

Material. 29 ♂ (29 skulls, 3 skins), 12 ♀ (12 skulls, 3 skins).

Diagnosis. Distinguished from the western races by smaller size, lack of sexual and age-differences in colour, thin coat without mane, palmate browtine at old age and deviating markings. Distinguished from N.E. races principally by smaller size and thinner coat, from *timorensis* by lighter colour and less developed mane.

Variation of populations. Antlers especially do present a geographical difference. The best heads are found in Sumba; skull and body measurements are also somewhat larger in this island. The population from Komodo offers the next best heads. The series from the same locality are strikingly uniform.

Biology. Mostly found in the grassy plains and palm-savannas which are widely spread in the Lesser Sunda Islands. In Lombok, deer have been recorded up till 2600 m above sea-level (MERTENS 1936), in alang-alang fields and parklands. Vegetation is strongly influenced by grazing of deer (DE VOOGD 1941). The stock of deer is plentiful nearly everywhere, and deer skins are forming an important product for export. In 1936 80.000 kg of deer skins were exported from Sumbawa, amounting to a value of f. 14.000. In 1937 a decree for protection was enacted.

Birth-season: October-November (SODY 1941). Rutting-season: June (WEHLBURG) but, at least in Lombok, there is much variation in rutting-time. LAPRÉ recorded in January 1948 observations on the same day of: a roaring stag, a fawn of three months old and two stags in velvet on a total of 9 deer observed! Fawns in our collection all must have been born between March and July. DAMMERMAN (1926, 1928) assumed that deer formerly have been imported in Sumba. He based his opinion on the native name of deer and on the absence of deer in Western Sumba. Deer would have been imported from Java or Flores. In my opinion import from Java is out of the question according to my material. Deer in Sumba have developed an own type that does not show any more connections with Flores deer than it does with populations of the other Lesser Sunda Islands.

Geographical distribution. Lombok, Sumbawa, Rintja, Komodo, Flores, Adonare, Solor, Sumba.

Rusa timorensis timorensis (BLAINVILLE).

Cervus timorensis M. H. D. DE BLAINVILLE: Journ. de Phys., de Chimie et d'Hist, Nat. 94, p. 267 (1822).

Cervus timoriensis V. BROOKE: P.Z.S. 1878, pp. 903-904 (1878); BLYTH (in SWINHOE) P.Z.S. 1869, p. 659 (1869); J. H. VAN BALEN: Dierenwereld van Insulinde, p. 195 (1914).

Cervus timoriensis timoriensis R. LYDEKKER: Cat. Ung. Mamm. B. M. 4, p. 65 (1915).

Cervus russa timoriensis MÜLLER & SCHLEGEL: Verh. Nat. Gesch. Overz. Bez. Zoöl., pp. 212, 220, Pl. 45, f. 6 (1839-1844); J. H. VAN BALEN: Album der Natuur, p. 120 (1906).

Cervus hippelaphus timoriensis R. LYDEKKER: "Deer of all Lands", London, pp. 170-171 (1898); H. C. RAVEN: Bull. Am. Mus. N. H. 68, p. 264 (1935).

Cervus moluccensis S. MÜLLER: Verh. Nat. Gesch. Ned. Overz. Bez. Zoöl. pp. 8, 45 (1839-1844).

Rusa Peronii J. E. GRAY: Cat. Rumin. Mamm. B. M. pp. 78-79 (1872) (nec *Cervus Peronii* F. CUVIER 1833, vide M. PUCHERAN: Rev. & Mag. de Zool. GUÉRIN — MÉNEVILLE 2e Ser. 16, pp. 376-378, 1864); L. J. FITZINGER: Sitzungsber. Math. Naturw. Cl. Ak. Wiss. Wien 70, I, 1874, pp. 317-320 (1875).

Rusa timorensis timorensis E. SCHWARZ: Zoöl. Timor II, Stuttgart pp. 126-127 (1914).

Rusa timoriensis timoriensis ROWLAND WARD: Records of Big Game 10th ed. p. 26 (1935); VAN BEMMEL: Treubia, hors sér. pp. 149, 152, f. 5 (1944).

Rusa hippelaphus moluccensis E. MOHR: Arch. f. Naturg. 84, 1918, p. 137 (1920).
Hippelaphus timoriensis HEUDE: Mém. conc. l'Hist. Nat. Emp. Chin. III, pp. 51-52, (1896).

——— ANON.: 3 Jaren Ind. Natuurleven, Batavia, p. 151 (1939); E. K. A. H.: Ned. Ind. Jager 11, 3, p. 60 (1941).

Definition. This race belongs to the smallest representatives of the species. No exact measurements of body are known to me. The mane in male slightly developed. Very dark. Back and head dark blackish brown. Seasonal, sexual and age variation not studied. Dorsal stripe sometimes occurs. Light parts light brown to gray, inner side of ears dirty white.

Table 18. Best heads of *Rusa t. timorensis* (BLAINV.)

Collection	Locality	Greatest length of antlers	Circumference above burr	Circumference of burr	Tip to tip	Greatest width	Points	Remarks
Dr WADE	Timor	495	89	—	330	—	—	ROWLAND WARD p. 26. (1935)
Z.M. Buitenzorg nr. 3760	Kalabahi, Alor.	490	135	175	227	368	3+3	Leg. C.B. ARRIËNS
R.M.N.H. Leiden	Rotti (?)	456	—	—	301	—	—	Leg. ten KATE
R.M.N.H. Leiden	id.	455	—	—	290	—	—	id.
C.B. HANIEL	Timor	455	—	—	240	425	—	E. SCHWARZ: Zool. Timor, II, p. 127 (1914)
id.	id.	430	—	—	332	495	—	id.
Z.M. Buitenzorg nr. 3669	id.	390	140	180	195	370	3+4	Leg. HEISE
C.B. HANIEL	id.	380	—	—	240	412	—	E. SCHWARZ: Zool. Timor, II, p. 127 (1914)
Z.M. Buitenzorg nr. 3667	id.	370	140	165	295	395	3+3	Leg. HEISE
Z.M. Buitenzorg nr. 3670	id.	358	155	170	230	350	3+3	id.

Dark pectoral spot large, spreading far backwards. Coat shaggy, thickset and harsh. In stags a white stripe on the cheeks has been recorded by several authors (MÜLLER & SCHLEGEL 1839-1844, FITZINGER 1875, LYDEKKER 1898). This character is certainly not generally found. Tail

very long and thin, with dark terminal brush. Accessorial tines mostly limited to a^1, which often is flattened medially. Sometimes "surroyals" are present. HEUDE (1896) has described a fawn of only a few days old as follows: "..... porte deux rangées de taches spinales et quelque taches disséminées, mais rousse et peu visible". However a very young fawn in the collection of R.M.N.H. Leiden is uniformly coloured. Total length of skull in stags up to 275 mm.

Terra typica. Timor.

Type. As in the species.

Material. 12 ♂ (11 skulls, 3 skins), 2 ♀ (1 skull, 1 skin), 1 fawn (skin).

Diagnosis. As large as *floresiensis* but darker, especially ventrally. Coat longer, mane in stags present, but lacking in *floresiensis*. Spotted fawns only known in this race. Spotting of unborn young has been recorded also in other races. Some characters, viz. the dark underside, this race has in common with *macassaricus* but *timorensis* is much smaller and its general colour more gray, less yellow.

Variation of populations.

Timor. Antlers very much deviating from all other races of the species. As a rule p^2 and a^2 equally long, forming an isosceles triangle. Both branches of antlers turned widely outwards, p^2 convergent. Width of antlers therefore relatively large and exceeding sometimes greatest length. Maximal measured length 495 mm, maximal measured width 495 mm.

Rotti. Antlers of normal type, well developed, but in old age a striking reduction of a^2.

Alor. Antlers similar to *floresiensis*.

P. Rusa. Somewhat larger animals with feebly developed antlers.

Biology. A marked preference for open country. The stock of deer in Timor seems to be decreasing. In 1936 export of antlers and skins was unimportant. Deer survive only in hunting-grounds, the so-called "larangangs", which have been indicated by old adat rights and in which the native governors have a right to organize a beat. Herds are small and scattered. In Pulau Rusa stock of deer is still good. There is little known about propagation. HEISE (1941) recorded pregnant hinds from July till November. During the same period he regularly observed hinds with fawns. In August 50% of the hinds that had been shot proved to be pregnant. Rutting has not been observed during this period. In Pulau Rusa birth-time is said to be in August-September (ARRIËNS in litt.).

Geographical distribution. Timor, Rotti, Semau, P. Kambing, Alor, Pantar, P. Rusa (W. of Pantar).

Table 19. *Rusa timorer*

Collection number	Locality	Collector	Date	Sex	Age in years or months (m.)	Condylo-basal length	Condylo-basal length from oral border for. magnum	Occipito-nasal length
3665	Timor	E. K. A. HEISE	—	♂	18 m.	—	—	222
3666	id.	id.	—	♂	(3)	—	—	—
3670	id.	id.	—	♂	7	—	—	—
3668	id.	id.	—	♂	?	—	—	—
3667	id.	id.	—	♂	?	—	—	—
3669	id.	id.	—	♂	?	—	—	—
C. B. H. 85 München	Baung, Amarassi.	C. B. HANIEL	—	♂	?	—	246	—
C. B. H. 9 München	Lelogama.	id.	—	♀	?	—	230	—
R. M. N. H.	Rotti.	ten KATE	1891	♂	?	—	—	224
id.	(Rotti?)	id.	1891	♂	?	—	248.5	233
id.	id.	id.	(1891)	♂	?	—	—	222.5
C. B. H. 4 München	P. Semau.	C. B. HANIEL	—	♀	?	—	235	—
R. M. N. H.	P. Kambing.	S. MÜLLER	—	♀	?	—	248	240
3762	Kalabahi, Alor.	C. B. ARRIËNS	X.48	♂	(4)	—	—	—
3760	id.	id.	VIII.48	♂	7	264	248	232

Rusa timorensis macassaricus (HEUDE).

Hippelaphus macassaricus HEUDE: Mém. conc. l'Hist. Nat. Emp. Chin. III, p. 50, Pl. XIII (1896).

Cervus moluccensis V. BROOKE: P. Z. S. 1878, p. 904 (1878); A. B. MEYER: Abh. u. Ber. K. Mus. Dresden 7, pp. 29-30 (1898-1899); K. W. DAMMERMAN: Treubia 17, pp. 63-65 (1939).

Cervus hippelaphus L. COOMANS DE RUITER: De Trop. Natuur 18, pp. 68-69 (1929); H. C. RAVEN: Bull. Am. Mus. N. H. 68, p. 191 (1935).

Cervus hippelaphus moluccensis R. LYDEKKER: "Deer of all Lands", London, p. 167, (1898).

Cervus hippelaphus timoriensis H. C. RAVEN: Bull. Am. Mus. N. H. 68, p. 191 (1935).

rensis (BLAINV.)

braincase	Greatest width of 2 nasals	Length of nasals in median line	Length of frontal suture	Lacrimal notch to the tip of premaxillaries	Interorbital breadth	Width of palatinum between M^3	Length of mandibel	Maxillary toothrow	Mandibular toothrow	Length of pedicles from caudal border of orbit	Greatest length of antlers	Distance tip to tip of antlers	Greatest width of antlers	Length of glandular pit	Depth of glandular pit	Total length of body	Length of tail	Length of ear	Points (total number)
0	29	83	82	143	77	—	—	—	—	74	156	133	—	—	—	—	—	—	2
-	32	93	84	148	78	—	—	—	—	66	260	258	—	33	(12)	—	—	—	6
-	34	100	85	155	80.5	(36.5)	208	79.5	89	62	358	230	350	34	15	—	—	—	6
-	33	97	78	148	83	—	—	—	—	58	318	320	430	—	—	—	—	—	6
-	33	102	77	—	87	—	—	—	—	58	370	295	395	—	—	—	—	—	6
-	33.5	98	81	150	89	—	—	—	—	(58)	390	195	370	—	—	—	—	—	7
	36	100	—	—	—	43	—	73	—	—	—	—	—	—	—	—	—	—	—
	30	89	—	—	—	45	—	74	—	—	—	—	—	—	—	—	—	—	—
	31	(91)	—	—	—	—	—	76.5	—	62.5	395	235	—	—	—	—	—	—	6
	31.5	116	—	—	—	—	—	86	—	52.5	455	290	—	—	—	—	—	—	6
	30.5	95.5	—	—	—	—	—	79	—	53.5	456	301	—	—	—	—	—	—	6
	31	96	—	—	—	39	—	74	—	—	—	—	—	—	—	—	—	—	—
	26	111	—	—	—	—	215	82.5	90	—	—	—	—	—	—	—	—	—	—
	—	—	79	—	—	—	—	—	—	71	250	190	260	—	—	—	—	—	—
	31.5	90.5	82	153	80	44	212	79	87	70	490	227	368	32	14	—	—	—	6

Cervus russa S. MÜLLER & H. SCHLEGEL: Verh. Nat. Gesch. Ned. Overz. Bez. Zoöl. p. 211 (1839-1844).

Cervus equinis (!) L. COOMANS DE RUITER: De Trop. Natuur 18, p. 68 (1929).

C. (Rusa) sp. *celebensis?* G. RÖRIG: Geweihsammlung Kön. Landw. Hochsch. Berlin p. 49, fig. 19 (1896).

Russa russa MAX WEBER: Zoöl. Ergb. Reise N.O.I. I, p. 112 (1890-1891).

Rusa hippelaphus moluccensis E. MOHR: Arch. f. Naturgesch. 84, 1918, pp. 136-141 (1920).

Rusa unicolor moluccensis H. J. V. SODY: Ned. Ind. Jager 11, Nr. 7, pp. 156-157 (1941); ibidem Nr. 12, pp. 257, 264 (1941).

——— P. & F. SARASIN: Mat. Naturgesch. Ins. Celebes 5, Pt. 1, pp. 33-36, 53-54 (1905); ANON.: 3 Jaren Ind. Natuurleven, Batavia, pp. 145, 147 (1939); C. J. DE W.: Ned. Ind. Jager 9, Nr. 11, pp. 298-299 (1939).

Presumable Hybrids:

Hippelaphus menadensis HEUDE: Mém. conc. l'Hist. Nat. Emp. Chin. III, pp. 50-51, Pl. XII (1896).

Cervus moluccensis A. B. MEYER: Abh. u. Ber. K. Mus. Dresden 7, Nr. 7, pp. 29-30 (1898-1899).

——— N. GRAAFLAND: De Minahassa, Haarlem — Batavia, Appendix, 2nd ed., p. 3 (1898).

Definition. Middle-sized representatives of the species. No reliable measurements of body available. Mane in stags more or less developed. General colour light oakwood-brown. Head equally coloured, forehead slightly darker. Chin yellowish-white, no dark spots on chin. Age variation slight, young animals somewhat darker than old ones. Seasonal variation insufficiently known. Dorsal stripe mostly absent. Light parts ochraceous-yellow to grayish-yellow. Dark pectoral spot very

Table 20. *Rusa timore*

Collection number	Locality	Collector	Date	Sex	Age in years or months (m.)	Condylo-basal length	Condylo-basal length from oral border for. magnum	Occipito-nasal length	Total length of skull	Zygomatic breadth	Greatest width of braincase
3753	Vicinity Makassar S. E. Celebes	J. A. B. HEYNNEMAN	VII.41	♂	unborn	118	108	119	124.5	60	56.5
3756	Vicinity Malino S. E. Celebes	C. J. MARINKELLE	2.V.48	♂	20 m.	247	227	225	256	111	72
3752	Bumbulan Minahassa, N. Celebes	J. J. MENDEN	13.X.39	♂	3	288	270	251	307	122	76
3749	Maros plains. S. E. Celebes	H. W. LIJDING	XII.47	♂	5	283	265	254	300	126	76
3675	Baramasih, Palopo, C. Celebes	MOHARI	15.XII.09	♂	9	270	252	246	285	120	73
3751	Auduh, Paloppo, C. Celebes	id.	1.I.10	♂	12	291	271	267	311	132	76
3676	Baramasih, Palopo, C. Celebes	id.	15.XI.09	♂	12	285	265	257	302	120	73
615	„Celebes"	P. OUWENS	—	♂	—	—	—	—	—	—	—
3757	Gg. Rapat, Malino, S. E. Celebes	C. J. MARINKELLE	8.VII.48	♀	2½	232	216	206	239	104	67
3750	Baramasih, Palopo, C. Celebes	MOHARI	15.XII.09	♀	11	261	243	232	271	111	69

large, nearly covering the whole breast and belly. In hinds the caudal part of the belly is light, in stags only arm-pits and groins are light-coloured. In this character the subspecies stands alone in the whole species! Coat rather short. Tail of medium length, rather thin with somewhat darker terminal brush.

In the unborn fawn a row of light-brown spots occurs on both sides of the faintly indicated dorsal stripe, on the thighs faint, scattered spots are present. The newly born fawn, however, is evenly coloured, without spots or dorsal stripe and with an ochraceous-yellow belly. Pectoral spot already present.

Total length of skull: ♂ 285-311, ♀ 271 mm. Antlers follow the normal scheme of the species, but are characterized by the relatively narrow width. Only very old stags present wider antlers. Maximal

cassaricus (HEUDE) from Celebes

Length of frontal suture	Lacrimal notch to the tip of premaxillaries	Interorbital breadth	Width of palatinum between M^3	Length of mandibel	Maxillary toothrow	Mandibular toothrow	Length of pedicles from caudal border of orbit	Greatest length of antlers	Distance tip to tip of antlers	Greatest width of antlers	Length of glandular pit	Depth of glandular pit	Total length of body	Length of tail	Length of ear	Points (total number)	Remarks
48	56	36	25	92	—	—	—	—	—	—	0	0	684	74	72	—	Fetus
73.5	145	72	41	205	(76)	(81.5)	80	—	—	—	30	6	—	—	—	—	Antlers just shedded
89	175	80	43.5	230	90	98	75	330	235	309	33	8	1915	215	160	(3+3)	Hybrid with *R. t. russa*
96	166	82	47	227	82.5	91	65	325	193	305	35	7.5	—	—	—	(3+4)	—
94	156	81.5	43	217	77.5	86	64	485	170	300	29	12	—	—	—	(3+3)	—
101	170	91	50.5	232	78	—	61	450	200	340	30	8	—	—	—	(4+4)	—
103	171	81	43	225	76	84	79	490	400	460	36	9	—	—	—	(3+3)	—
95	—	92	—	—	—	—	61	684	404	—	—	—	—	—	—	(4+3)	—
70	134	62.5	36.5	194	73	87	—	—	—	—	24	4.5	—	—	—	—	Pregnant
34	152	65	41	218	74.5	85	—	—	—	—	30.5	7	—	—	—	—	—

measured length of antlers 684 mm. Accessorial points mostly limited to a^1, which also in this subspecies inclines to median flattening.

Terra typica. Gowa, near Makassar, Celebes.

Type. ♂, incomplete skull, leg. H.H. the Sultan of Gowa, 1895. In collection HEUDE.

Figured in: Mém. conc. l' Hist. Nat. Emp. Chin. III, Pl. XIII, fig. 1. 1896.

Material. 7 ♂ (3 skins, 7 skulls), 3 ♀ (2 skins, 3 skulls), 1 unborn fetus (skin & skull).

Diagnosis. Best characterized by dark ventral side, the narrow antlers and the warm colour. Smaller sized than *russa,* less thick-set coat and less developed mane. Differing from *moluccensis* by large pectoral spot, much warmer colour and dark throat.

Nomenclature. The name *C. (Rusa) celebensis* RÖRIG might have priority over *Hippelaphus macassaricus* HEUDE. Both names were published in 1896, but the exact date of publication could not be checked. I give preference to the name by HEUDE because the description by RÖRIG has been based on a trophy of uncertain origin, whereas the type of HEUDE is more complete, the description more elaborate and the terra typica exactly indicated. *H. macassaricus* has page-priority over *H. menadensis* HEUDE.

Hybrids between *R. t. macassarius* and *R. t. russa.*

Several authors have defended the theory that originally deer did not occur in Celebes and that all deer in Celebes were imported by man. This point of view has been advocated by the SARASIN cousins (1905), RAVEN (1935), and DAMMERMAN (1939). Other authors incline to the opposite point of view viz. BEAUFORT (Zoögeographie Ind. Arch. pp. 169-170, 1926) and E. MOHR (1920). Personally I am convinced that *R.t. macassaricus* should be considered as an autochone form, which perhaps originally was not spread over the whole of Celebes. Its very peculiar characters do support this opinion. Another point is that *R.t. russa* seems to have been imported several times in Celebes. It is rather certain that this has been the case in Minahassa, N. Celebes. GRAAFLAND (1898) stated that deer from Java were imported in Minahassa, "where deer at that moment did not occur". I am sure that at present Minahassa-deer are not pure-bred *russa.* The only specimen I saw (Btzg. Mus. Cat. Nr. 3752) inclines to *R.t. macassaricus* but is somewhat larger, has a very heavy mane (which is the more remarkable because it is only 3 years old and is carrying his first three-tined antlers) and is somewhat lighter on the belly than average *macassaricus.*

Other examples of cross-breds are HEUDE's type of *menadensis* and part of A. B. MEYER's material (1898-1899). The type of *celebensis* RÖRIG is said to have been collected in N. Celebes. This certainly is not *russa.*

Not only in Minahassa cross-breds occur. The paratype of *menadensis* HEUDE, a single-tined young stag, may prove it. This specimen has been collected in the vicinity of Makassar. Several experienced hunters in South-Celebes assured that in this region two "kinds" of deer occurred. The same opinion has been uttered by RAVEN. All material from S. and C. Celebes at my disposal however, belongs to typical *macassaricus*.

Biology. Ecological data scarcely available. In the Northern part of Celebes hunting is unimportant. In 1939 only permits for killing of 400 deer were given. In S.W. Celebes stock of deer is still large. Just as in the Lesser Sunda Islands hunting grounds are preserved according to old adat rights. These are the so-called "ongko's". Beats are held on horseback with snares; grass-fires are used also. In S.E. Celebes the situation is less favourable. In 1939 over-hunting was serious, more than a hundred of deer being killed daily. At Bonebay (S.E. Celebes) deer are hunted on foot, by moonlight, with a spear and with a domestic buffalo as cover! Hunting now is limited to certain seasons of the year, but there is much disagreement about the right seasons. In W. Central Celebes deer are hunted on horseback with a spear.

Birth-season is spread over a large part of the year. SODY has recorded: January (2 ×), February (1 ×), June (1 ×), July (3 ×), August (3 ×), September (1 ×), October (3 ×). In our collection material is present born about August. Nothing has been recorded concerning rutting-season.

I already mentioned the disagreement of authors about importation of deer in Celebes. Most probably import from elsewhere has taken place in the Northern part of the island (MÜLLER & SCHLEGEL p. 221, 1839-1844; E. MOHR 1920; GRAAFLAND 1898; DAMMERMAN 1939; SARASIN 1905). Most remarkable is the contradiction between the absence of deer in prehistoric times and the very pronounced characters of the subspecies in Celebes.

Geographical distribution. Celebes, Banggai (?) Saleyer (?).

Rusa timorensis djonga nov. subspec.

Definition. The new race belongs to the smallest representatives of the species. Total length 1600 mm in adult males, 1410 in females. Mane in stags slightly developed. Colour rather light grayish-brown in autumn-coat. Faint dorsal stripe in males, somewhat more distinct in females. Light-coloured parts yellowish-white to dirty white. Dark pectoral spot large, in stags covering the whole breast, belly always light-coloured. Chin grayish white, without chin-spots. Throat and upper breast grayish-white. Forehead nearly the same colour as rest of head. Stags with larger pectoral spot than hinds and with less distinct dorsal stripe, a trifle darker than hinds. Young animals of both sexes somewhat

Table 21. *Rusa timo*

Collection number	Locality	Collector	Date	Sex	Age in years or months (m.)	Condylo-basal length	Condylo-basal length from orai border for. magn.	Occipito-nasal length	Total length of skull	Zygomatic breadth	Greatest width of
3191	Buton.	MOHARI	1910	♂	18 m.	252	237	224	267	112	7
3260	id.	id.	—	♀	4 m.	160	—	139	168	79	6
3673	Bolobo, Buton.	id.	X.09	♀	16 m.	233	218	—	243	100	6
3767	Labasa, Muna.	G. A. L. DE HAAN	7.X.48	♂	20 m.	247	223	227	258	108	6
3766	id.	id.	8.X.48	♂	6	266	250	244	274	111	7
3768	id.	id.	7.X.48	♀	26 m.	232	211	216	243	98	5
3769	id.	id.	6.X.48	♀	5	243	226	222	259	104	6

warmer coloured than older animals. Fawns distinctly yellowish. Coat thick-set but rather short and smooth. Tail long and thin. Total measured length of skull in stags 274 mm, in hinds 259 mm. Measurements: Table 21. Antlers short and light.

Terra typica. Muna Island, off S.E. Celebes.

Type of subspecies. Buitenzorg Museum. Skin and skull, ♂, Labasa, Muna I., 8.X.48, leg. G.A.L. DE HAAN, Cat. Nr. 3766.

Material. 3 ♂ (3 skulls, 2 skins), 4 ♀ (3 skulls, 4 skins), 1 fawn (skin and skull).

Diagnosis. In size similar to *floresiensis* but immediately distinghuished by the light throat. Smaller than *macassaricus* and distinguished by much more grayish colour, smaller pectoral spot, less developed mane and light throat. Distinguished from *moluccensis* by smaller size, less developed mane in stags and larger pectoral spot.

Biology. Only little known. There seems to be a preference for savannah. Of 4 specimens collected by Mr DE HAAN 3 were collected in savannah, one in a coconut plantation. Rutting-season unknown. One birth-record in June (Buton), one in February (Muna).

Geographical distribution. Buton I., Muna I. (off S.E. Celebes).

ga nov. subspec.

Length of frontal suture	Lacrimal notch to the tip of premaxillaries	Interorbital breadth	Width of palatinum between M^3	Length of mandibel	Maxillary toothrow	Mandibular toothrow	Length of pedicles from caudal border of orbit	Greatest length of antlers	Distance tip to tip of antlers	Greatest width of antlers	Length of glandular pit	Depth of glandular pit	Total length of body	Length of tail	Length of ear	Points (total number)	Remarks
6	151	69	(39)	197	(80)	(90)	73	217	170	235	32	—	—	—	—	3+3	Very young animal with complete antlers!
8	85	46	(30)	132	—	—	—	—	—	—	11	1.5	—	—	—	—	
8	140	77	(37)	182	(73.5)	82	—	—	—	—	26	4.5	—	—	—	—	
8	141	66	(39)	197	(75)	(79)	66	75	80	80	29	9	1490	180	115	1+1	
7	152	80	42	211	72.5	80	57	346	(200)	282	32	11	1600	170	120	3+3	Type of subspecies
5	139	56	37	188	(72.5)	(79)	—	—	—	—	24	4	1410	160	110	—	
7	147	61	38	199	72	81	—	—	—	—	26	4	1390	160	110	—	

Rusa timorensis moluccensis (QUOI et GAIMARD).

Cervus moluccensis (Cerf des Moluques) QUOI & GAIMARD: Voy. de l'Astrolabe, Zoologie, 1, pp. 133-134, Pl. 24 (1830); S. MÜLLER: Verh. Nat. Gesch. Ned. Overz. Bez. Zoöl. p. 5, p. 45 (1839-1844); BLYTH (in SWINHOE); P.Z.S. 1869, p. 659 (1869); v. BROOKE: P.Z.S. 1878, p. 904 (1878); A. VON ROSENBERG: "Der Malayische Archipel" (1878); A. B. MEYER: Abh. u. Ber. K. Mus. Dresden 7, Nr. 7, pp. 29-30 (1898-1899); J. H. VAN BALEN: Dierenwereld van Insulinde, Zoogd. p. 193, p. 195 (1914).

Cervus russa BERNSTEIN: Ned. Tijdschr. Dierk. 2, p. 373 (1865).

Cervus russa moluccensis MÜLLER & SCHLEGEL: Verh. Nat. Gesch. Ned. Overz. Bez., Zoöl. p. 211, p. 220, Pl. 45, f. 5 (1839-1844); J. H. VAN BALEN: Album der Natuur, p. 119 (1906).

Cervus hippelaphus moluccensis R. LYDEKKER: "Deer of all Lands", London, pp. 166-170 (1898); K. W. DAMMERMAN: Treubia 7, Suppl., p. 149 (1929); H. C. RAVEN: Bull. Am. Mus. N. H. 68, p. 264 (1935); J. H. WESTERMANN: Fauna & Natuurbesch. Ned. Nw. Guinea, Amsterdam, pp. 56-58, p. 87 (1947).

Cervus (Rusa) hippelaphus moluccensis L. F. DE BEAUFORT: Abh. Senckenb. Naturf. Ges. 34, p. 110 (1911).

Cervus timoriensis moluccensis R. LYDEKKER: Cat. Ung. Mamm. B.M. 4, pp. 65-66 (1915).

Hippelaphus buruensis P. M. HEUDE: Mém. conc. l'Hist. Nat. Emp. Chin. III, pp. 93-94, Pl. XVI, f. 1-5 (1896).

Hippelaphus hoevellianus P. M. HEUDE: Mém. conc. l' Hist. Nat. Emp. Chin. III, p. 94, Pl. XVI, f. 6-10 (1896).

Hippelaphus moluccensis P. M. HEUDE: Mém. conc. l'Hist. Nat. Emp. Chin. 3, pp. 95-97, Pl. XVII, f. 1-5, Pl. XVI, f. 11 (1896).

Rusa Peronii (The smaller *Rusa*) J. E. GRAY: Cat. Rumin. Mamm. B.M. pp. 78-79 (1872).

Rusa hippelaphus var. A. R. WALLAGE: "The Malay Archipelago", London, 2nd ed., 2, p. 80 (1869).

Rusa hippelaphus moluccensis HILZHEIMER & HECK: BREHMS Tierleben, Säugetiere, 4, p. 125 (1916); E. MOHR: Arch. f. Naturgesch. 84, 1918, pp. 137 & 140 (1920) (List of literature).

Rusa moluccensis J. E. GRAY: Cat. Rumin. Mamm. B.M. p. 77 (1872) (List of literature); L. J. FITZINGER: Sitzungsb. Math. Naturw. Cl. Kais. Ak. Wiss. Wien 70, I, Hf. 1-5, 1874, pp. 320-323 (1875) (List of literature); J. C. KONINGSBERGER: (in HULSTIJN) Med. Encyclop. Bur. 15, p. 26 (1918); R. I. POCOCK: P.Z.S. 1935, p. 183, fig. 3 A (1935).

Rusa timoriensis moluccensis ROWLAND WARD: Records of big Game, 10th ed. p. 27 (1935).

——— F. H. H. GUILLEMARD: Marchesa, p. 357 (1886); C. LULOFS: Tijdschr. B.B. 45, p. 232 (1913); id. 53, p. 512 (1917); L. F. DE BEAUFORT: "Zoögeographie Ind. Arch.". Haarlem, pp. 169-170 (1926); ANON.: 3 Jaren Ind. Natuurleven, Batavia, p. 154 (1939); E. K. A. HEISE: Ned. Ind. Jager 9, pt. 12, pp. 328-330; S. BLOEMBERGEN: Verslag Exploratietocht Soela-eil., Juli-Oct. 1939, p. 36 (1940); H. BARTSTRA: Ned. Ind. Jager 11, Nr. 8, p. 186 (1941).

Descendants of imported stock from elsewhere in Moluccas:

Cervus moluccensis QUOI & GAIMARD: Voy. de l'Astrolabe, Zoologie, I, 1830, pp. 134-135, Pl. 25 (1830); S. MÜLLER: Verh. Nat. Gesch. Ned. Overz. Bez. Zoöl. p. 5, p. 45 (1839-1844).

——— FRANÇOIS VALENTIJN: Oud & Nieu-Oost Indien, 3, p. 267 (1726).

Discussion. Material from the Moluccan region including Sula Islands, Aru Islands and New Guinea (in both last-named localities recently imported) is not to be considered as really homogeneous. Topotypical material from Buru was not available to me. As the material from Halmahera does correspond to the first part of the original description by QUOI & GAIMARD, the definition given here has mainly been based on this material. As has been discussed on p. 206 the population from Ambon is not *Rusa timorensis moluccensis*, but does consist of hybrids between *russa* and *macassaricus*. Most typical is the absence of the white throat in this mixed population, which also presents a very heterogeneous appearance. Among all material, treated here as *moluccensis*, maybe one or more races should be distinguished. Especially Sula deer perhaps represent a separate race. At the moment I think it best to treat this material as aberrant populations of *moluccensis*.

Definition. The race belongs to the larger representatives of the species. Greatest measured total length of body in stags, 1930 mm, height 980 mm, in hinds 1720 mm, height 860 mm. General colour grayish-brown in autumn-coat, warmer yellowish-brown in springcoat. Forehead slightly darker than rest of head, a dark line from forehead to tip of nose. Chin grayish white, without chin-spots. Throat grayish white, this colour also tingeing upper breast. Inner side of legs, arm-pits, groins, belly and posterior part of breast the same very light grayish colour, somewhat

tinged with ochreous on belly. Age variation slight, young animals somewhat darker than old ones and with smaller pectoral spot. Stags darker and more gray than hinds. Dorsal stripe indistinct or absent. Dark pectoral spot rather large, covering nearly half of the breast in old specimens. Coat thick-set and long, rather soft. Tail long, thick and bushy, very dark. Total length of skull in adult stags over 300 mm. Greatest measured length 322 mm, in hinds 270-290 mm. Measurements: Table 22. Antlers well developed, wide. Greatest measured length 810 mm (ROWLAND WARD: 914 mm, without locality).

Terra typica. Buru I.

Type of subspecies. ♂, Buru, leg. QUOI & GAIMARD, present whereabouts unknown. Figured: Voy. de l' Astrolabe, Zoologie, I, 1830, Pl. 24.

Material. 19 ♂ (19 skulls, 3 skins), 7 ♀ (7 skulls, 4 skins).

Diagnosis. Only slightly smaller than *russa*, distinguished by the light throat and upper breast and the somewhat larger pectoral spot. Distinguished from *djonga* by larger size and lighter colour, from *macassaricus* by somewhat larger size, light throat and smaller pectoral spot, from *floresianus* and *timorensis* by larger size and colour-characters.

Variation of populations.

Halmahera. Large; well developed antlers, a^1 long and strong.

Ceram. Perhaps somewhat smaller than the preceding population. Typical accessorial points on a^1 in old animals.

Banda. Provisionally treated under this race. Only one skull of a juvenile hind was available to me.

Sula Is. Darker than the Halmahera-population, with somewhat larger pectoral spot, less whitish throat. Hinds in autumn-coat are generally dark grayish brown, changing to deep dark oakwood-brown in spring-coat. This population probably represents a separate race.

Aru Is. This stock originally came from Ceram. There is no difference between both populations, but antlers are heavier in the Aru-islands. Accessorial points not only in a^1, as mostly the case in Ceram but also development of "surroyals". Largest measured length of antlers: 690—730 mm (HEISE in litt.).

Biology. In the Northern Moluccas deer are known to inhabit forest, perhaps mostly used for cover. Feeding, they often prefer coconut-plantations, especially those which have been neglected for a long time, and where shrubs and herbs offer plenty of food. In other regions there is a preference for open plains (Aru Islands). Deer have been observed swimming in open sea (VAN BALEN 1914). In the Northern Moluccas, Ceram, Aru Islands, Batjan, Belang-Belang, Parapottan and Momi (New Guinea) the stock of deer is large. In Buru, deer seem to be rather scarce and in the Sula Islands they are not numerous. In the Obi Group deer do not occur, except in Belang-Belang where they have been imported.

Table 22. *Rusa timore*

Collection number	Locality	Collector	Date	Sex	Age in years or months (m.)	Condylo-basal length	Condylo-basal length from oral border for. magn.	Occipito-nasal length	Total length of skull	Zygomatic breadth	Greatest width of braincase	Greatest width of 2 nasals
3754	Taliabu, Sula Is.	J. J. MENDEN	20.IX.38	♀	4	268	245	241	282	106	69	32
3755	id.	id.	23.IX.38	♀	9	265	241	236	275	109	69	32
3674	Sasana, Sula Is.	id.	1914	♀	10	257	238	231	270	105	70	32
3192	Banda Is.	P. OUWENS	—	♀	1	202	191	187	220	92	65	21
612	Ceram	H.H. the Duke ADOLF VON MECKLENBURG	X.23	♂	± 3	—	—	—	—	—	—	—
613	id.	id.	—	♂	± 3	—	—	—	—	—	—	—
609	id.	id.	X.23	♂	—	—	—	—	—	—	—	—
3746	id.	Dr P. J. EYMA	—	♂	—	—	—	—	—	—	—	—
611	id.	H. H. the Duke ADOLF VON MECKLENBURG	—	♂	—	—	—	—	—	—	—	—
614	id.	id.	—	♂	—	—	—	—	—	—	—	—
610	id.	id.	X.23	♂	—	—	—	—	—	—	—	—
3745	Gng. Binaija, Ceram 3000 m.	Dr P. J. EYMA	—	♂	9	—	—	256	—	133	78	37
607	Wokam, Aru Is.	H. H. the Duke ADOLF VON MECKLENBURG	21.X.23	♂	17 m.	257	241	226	266	113	71	29
608	Aru Is.	id.	X.23	♂	± 3	—	—	—	—	—	—	—
606	Wokam, Aru Is.	id.	21.X.23	♂	4	293	276	254	303	120	75	31
605	id.	id.	21.X.23	♂	5	288	268	260	300	126	76	35
3775	Dobo, Aru Is.	id.	XI.23	♂	—	—	—	—	—	—	—	—
3774	Tiloppe, Weda, Halmahera.	G. A. L. DE HAAN	27.XII.48	♂	8 m.	202	178	180	210	93	67	24
3787	Kobe, „ „	id.	5.III.49	♂	14 m.	250	225	223	262	110	72	27
3788	„ „ „	id.	25.II.49	♂	17 m.	272	244	246	282	121	74	32
3781	Tiloppe, „ „	id.	25.I.49	♂	5	—	—	272	312	132	80	38
3780	id.	id.	6.II.49	♂	5	307	285	276	318	134	80	44
3771	id.	id.	24.XII.48	♂	7	306	285	273	322	130	80	36
3782	id.	id.	2.II.49	♂	7	311	293	277	321	128	79	34
3779	id.	id.	4.XII.48	♀	10 m.	222	202	199	232	100	57	28
3778	id.	id.	4.XII.48	♀	13 m.	248	224	225	260	103	67	27
3777	id.	id.	3.XII.48	♀	2	268	242	241	280	107	74	28
3772	id.	id.	29.XII.48	♀	4	272	251	250	290	112	72	27
3773	id.	id.	20.XII.48	♀	6	—	—	245	284	112	72	27
3776	id.	id.	1.XII.48	♀	7	280	256	246	289	111	76	32

ccensis (Q. & G.).

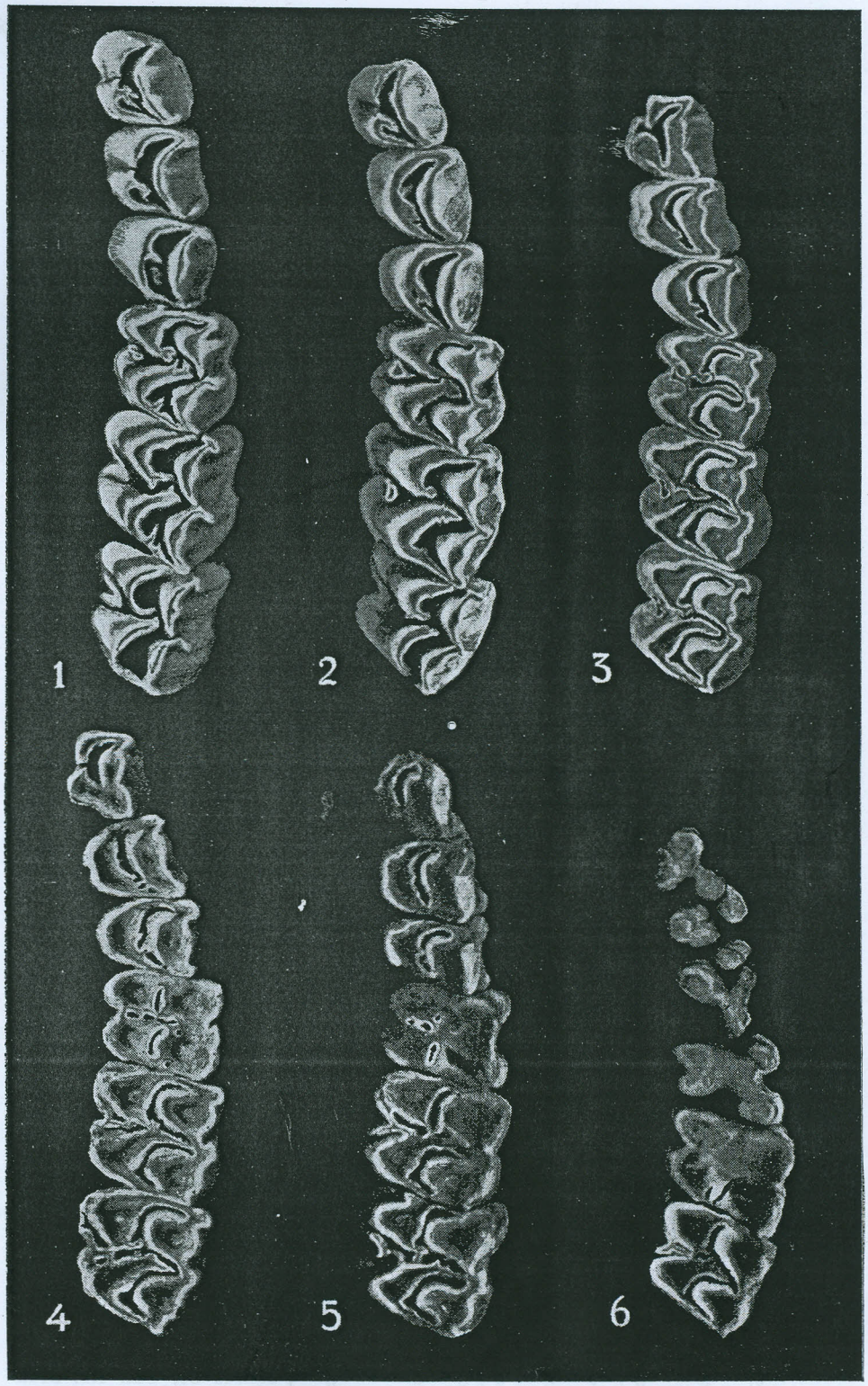
Lacrimal notch to the tip of premaxillaries	Interorbital breadth	Width of palatinum between M^3	Length of mandibel	Maxillary toothrow	Mandibular toothrow	Length of pedicles from caudal border of orbit	Greatest length of antlers	Distance tip to tip of antlers	Greatest width of antlers	Length of glandular pit	Depth of glandular pit	Total length of body	Length of tail	Length of ear	Points (total number)	Remarks
164	68	37	216	84	95	—	—	—	—	32	6	1730	180	150	—	Perhaps a separate race
158	71	41	214	79	91	—	—	—	—	30	8	—	—	—	—	
158	69	43	204	77	88	—	—	—	—	31	8	—	—	—	—	
119	53.5	(35)	169	(63)	(69)	—	—	—	—	22	5	—	—	—	—	Subspecific status uncertain.
—	—	—	—	—	—	—	225	215	278	—	—	—	—	—	7	—
—	—	—	—	—	—	± 75	310	180	288	—	—	—	—	—	6	—
—	—	—	—	—	—	—	520	145	410	—	—	—	—	—	6	—
—	—	—	—	—	—	49	530	335	—	—	—	—	—	—	6	—
—	—	—	—	—	—	± 67	530	388	490	—	—	—	—	—	6	—
—	—	—	—	—	—	—	580	370	460	—	—	—	—	—	7	—
—	—	—	—	—	—	—	640	315	505	—	—	—	—	—	6	—
—	95	45	—	79	—	57	(665)	(325)	—	38	15	—	—	—	9	Abnormal antlers
145	78	(38)	199	(84)	(88)	79	229	—	—	31	11.5	—	—	—	3+1	Right antler abnormal
—	—	—	—	—	—	72	325	250	315	—	—	—	—	—	3+3	—
173	84	39	219	86	97	65	414	(155)	390	—	—	—	—	—	3+3	—
166	87	45	233	84	96	75	570	250	550	37.5	16	—	—	—	3+3	—
—	—	—	—	—	—	63	640	345	560	—	—	—	—	—	4+4	—
112	55	(37)	158	(57)	(58)	(19)	—	—	—	21	4.5	1280	180	140	—	—
148	69	(42)	201	(77)	(74)	84	262	—	(113)	30	10	1310	210	145	1+1	—
160	75	(41)	218	(87)	(89)	89	285	—	180	—	—	1460	220	150	3+3	Six tines in the first antlers!
180	93	42	246	86	98	75	445	435	595	36	13	1920	200	160	4+3	Accessorial tine small.
181	98	44	240	88	99	77	582	345	535	38	15	1900	220	160	3+3	—
181	96	47	241	87	98	74	770	510	655	41	12	1870	220	160	3+3	—
185	87	46	248	85	96	68	810	390	610	35	16	1930	210	150	3+3	in velvet
130	60	(36)	178	(57)	(57)	—	—	—	—	24	6	1310	145	135	—	—
148	81	(38)	197	(72)	(73.5)	—	—	—	—	28	6	1520	180	130	—	—
166	68	(42)	219	86.5	94	—	—	—	—	31	9	1540	180	150	—	Pregnant
167	69	38	225	85	92.5	—	—	—	—	35	10	1670	220	145	—	—
167	70	40	230	84	97	—	—	—	—	33	8	1620	180	135	—	—
171	76	(41)	228	88	100	—	—	—	—	36	11	1720	200	160	—	—

In the Banda Group only six specimens were left in 1949 on the island Gng. Api (FRANSSEN in litt.).

In Halmahera deer are mostly hunted with spears, dogs and with snares.

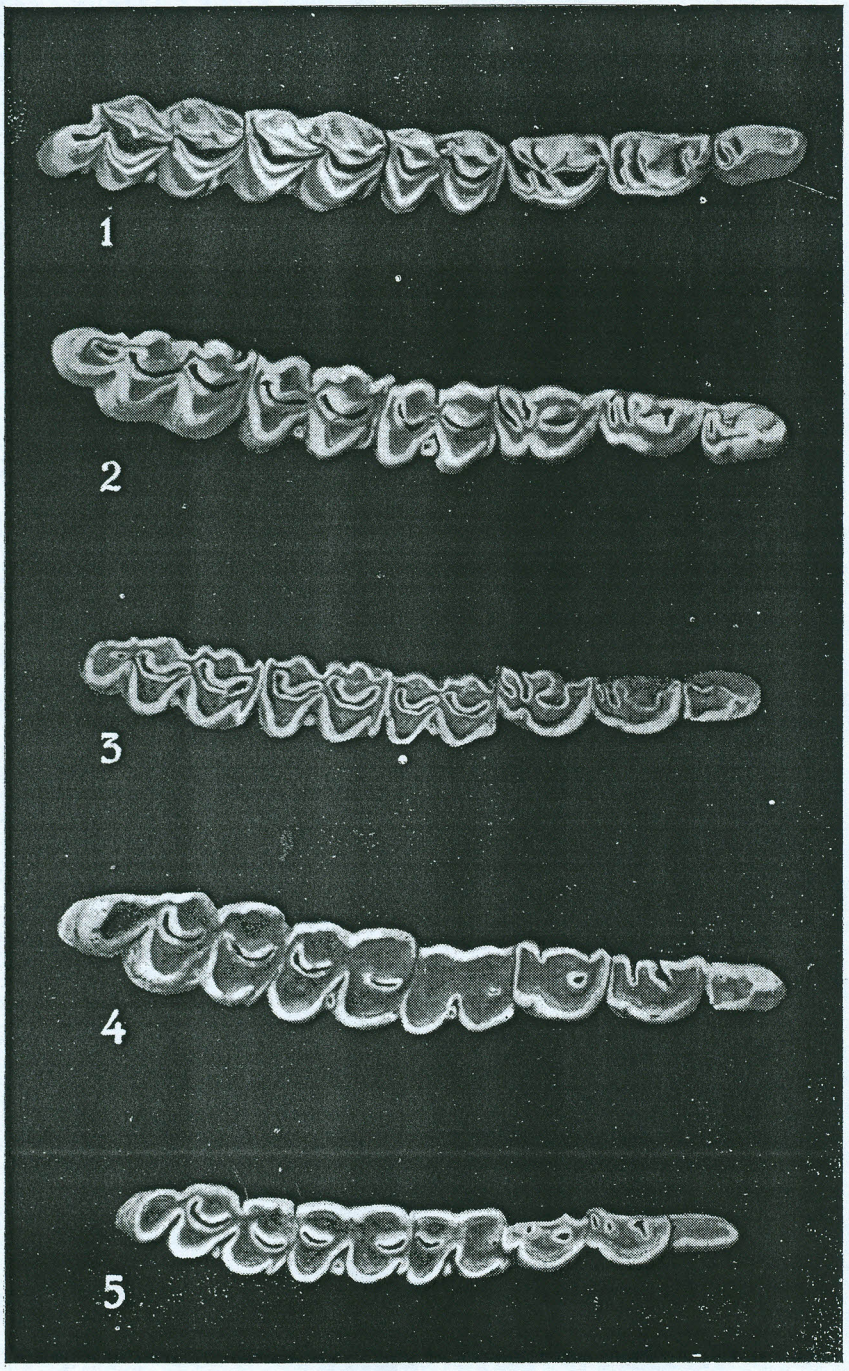
Birth-dates Halmahera: November, December, January, February. Rutting-season in Batjan seems to be September-October (BARTSTRA 1941), in Momi, W. Coast of Geelvink Bay, New Guinea in July (BARTSTRA in litt.) August-September (KOSTERMANS in litt.). On Halmahera DE HAAN recorded roaring and fighting stags in February (in litt.), but other stags were in velvet. BARTSTRA (1941) recorded stags in velvet from Batjan in March. Hair-moult recorded from Sula Islands in September, from Halmahera in December. Closed season for deer hunting was proclaimed in Ambon, Saparua, Banda, Buru and Ceram for June-July, in Aru Islands for January, and from April till September in New Guinea. Closed season in the southern Moluccas coincides with the dry monsoon, to prevent grass fires lighted to get deer out of cover. "Sore-throat" has been recorded in this subspecies (DE HAAN in litt.).

Geographical distribution. Sula Is. (Sanana, Taliabu and Sula Mangoli), Ternate, Mareh, Moti, Halmahera, Batjan, Parapottan (Batjan group), Belang-Belang (Obi group, imported by DIEPENHEIM about 1930), Buru, Ceram, (Ambon?, perhaps only imported stock from Java and Celebes), Saparua, Banda, Aru Is. (imported from Ceram in Wasior and Wammer in 1855 by CLEERENS. Present stock all descendants from the Wasior-pair), Western part of Onin Peninsula (imported from Ceram in 1913 by RAEDT VAN OLDEBARNEVELT), Momi, Manokwari, Muturi River and Rumberpon Island (New Guinea, W.-coast of Geelvink Bay) and Hollandia (N. New Guinea). Both last stocks imported by LULOFS from Halmahera in 1920.



A. C. V. VAN BEMMEL: *Revision of Rusine Deer.*
Rusa timorensis subspec.

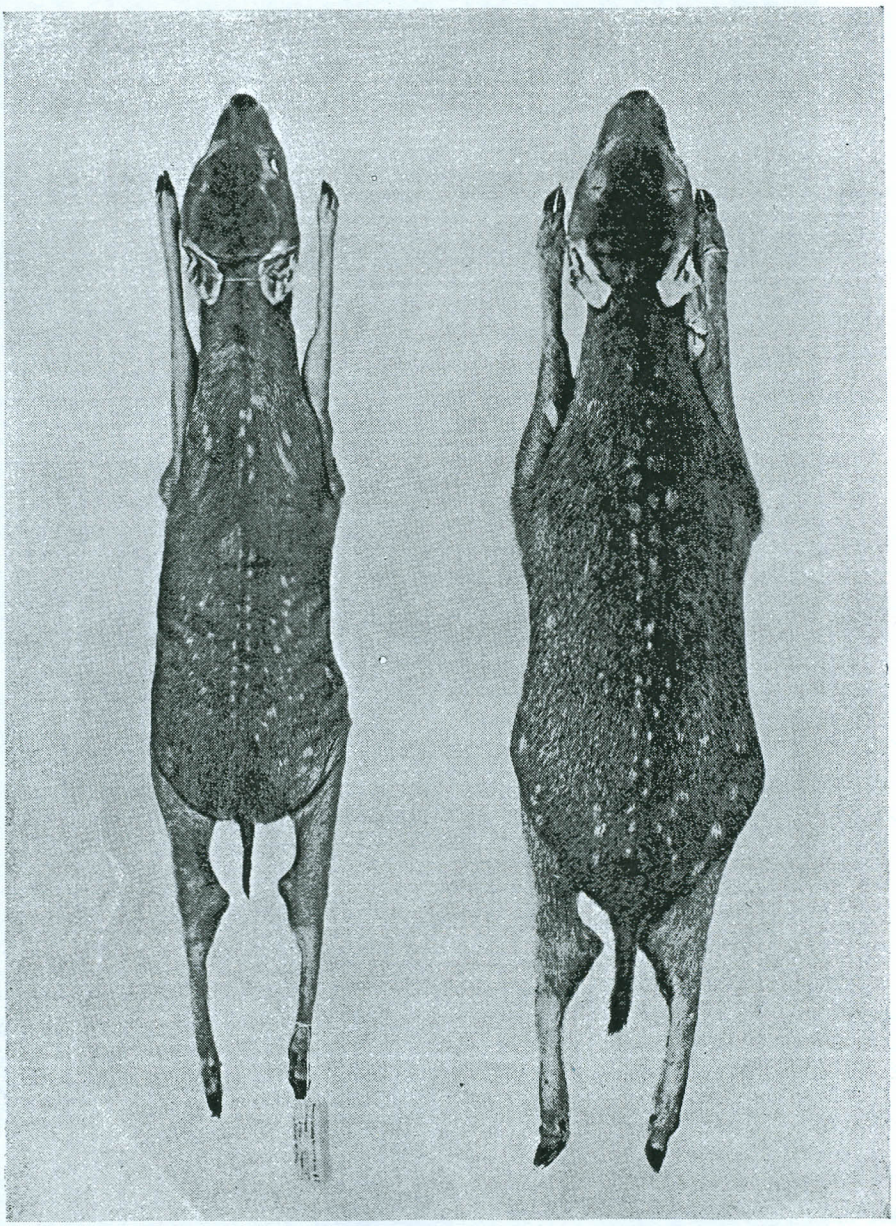
fig. 1. Upper Jaw, 3 years old, ♂ Tjibarusa 21-II-1932, Nr. 3285.
2. „ „ „ 5 „ „ „ ♀ Jang Highland, 17-XI-1928, Nr. 1921
3. „ „ „ 9 „ „ „ ♂ „ „ „ 10-VIII-'33, Nr. 3712
4. „ „ „ 12 „ „ „ ♂ „ „ „ 16-VII-1935, Nr. 3713
5. „ „ „ 15 „ „ „ ♂ Udjon Kulon, —, Coll. ROY. BOT. GARDENS
6. „ „ „ 20 „ „ „ ♂ Karimon Djawa, 6-V-1926, Nr. 1452



A. C. V. VAN BEMMEL: *Revision of Rusine Deer.*
Rusa timorensis subspec.

fig. 1. Lower Jaw, 3 years old, ♂ Tjibarusa,21-II-1932, Cat. Nr. 3285
2. „ „ , 6 „ „ , ? Jang Highland, coll. LEDEBOER
3. „ „ , 9 „ „ , ♂ „ „ , 10-VII-'33, Cat. Nr. 3712
4. „ „ , 12 „ „ , ? „ „ , coll. LEDEBOER
5. „ „ , 20 „ „ , ♂ Karimon Djawa, 6-V-1926, Cat. Nr. 1452

A. C. V. VAN BEMMEL: *Revision of Rusine Deer.*
Best head of *Rusa timorensis russa* (MÜLL. & SCHL.) ever recorded. Greatest length of antlers 1115 mm. Typically widened antlers of old stag.



A. C. V. VAN BEMMEL: *Revision of Rusine Deer.*
Left: *Rusa timorensis russa* (MÜLL. & SCHL.), fetus, Cat. Nr. 1694a, Tegalwaru Est., W. Java. Right: *Rusa timorensis macassaricus* (HEUDE), fetus, Cat. Nr. 3753, Makassar, Celebes.