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ENGLISH SUMMARY

I. Systematic status of the domestic dog in the Family Canidae

Yoshinori IMAIZUMI

The domestic dog, *Canis familiaris*, has been supposed by many authorities to be a descendant of one or more particular races of *Canis lupus*. But the dogs, even the most wolf-like races such as Eskimo dogs, sheep dogs and dingos, differ clearly not only from the races of *lupus* but also from any other species belonging to the genus *Canis* in several measurements of skulls and teeth.

The mean values of the condylobasal length of skull in fairly good samples of ten subspecies of *lupus* from Eurasia and North America and temperature classes which correspond to average temperatures of the coldest month of the year in the respective habitats of the sample, correlate linearly and the regression line is shown by the form: $Yc=-27.23+0.15X$, $Sys=1.34$. Here, the region of $Yc\pm2$ sys in scatter diagram is provisionally considered a cline of *lupus*. Quite similar correlations are seen in several other cranial and dental measurements in the samples of *lupus*.

On the other hand, the points of the dog, represented by mean values and temperature classes of samples of the Eskimo dog, sheep dog, dingo, and large dog, which is a complex of the largest dogs, show a quadrilateral in their respective scatter diagrams. These quadrilaterals of the dog, when observed one after another, strongly fluctuate against the clines of *lupus* and there are no correlations between them (Figs. 2~8). Such fluctuation of the dog quadrilateral also has no connection with the points of any forms examined of the genus *Canis* in scatter diagrams. The amplitude of the dog fluctuation is decidedly larger than those of the races of *lupus* which are nearly always confined within the range of the cline of the species ($Yc\pm2$ sys).

Therefore, it is evident that the dog cannot be a domesticated form of *lupus* but a fully distinct species, though wild populations of it are unknown. The high ratios of cranial and dental features in the primitive phase which are dominent in *Speothos-Dusicyon* group probably indicate that the dog is more primitive than any races of *lupus*, *hodophilax*, or *niger* of the subgenus *Canis* and that it is only slightly higher than *latrans* of the subgenus *Thos* in systematic status.

II. The dog, its domestication and development, with special reference to the origin and the history of the Japanese native dog (A review)

Katuaki ŌTA

The present review consists of two parts. In the first part, current concepts on the ancestor of domesticated dogs, time, place and process of domestication and processes of differentiation and development of various breeds are reviewed and discussed. Recent evidences obtained from the osteological, serological and behavioral studies of various species of Canids exclude almost conclusively the species other than the wolf and the wild dingo (wild animal like dingo) from the list of candidates for the ancestor of dogs. A race or races of the small wolf and/or the wild dingo are the most probable ancestor of modern dogs, though further conclusion can not be drawn yet. The possibilities of interbreeding of dogs with northern large wolf, jackal and coyote also still remain. Archaeological evidences so far available suggest that domestication of dogs began at late Paleolithic (around 15,000 years B. P.) in Western Asia and/or other areas (Table 5). Although the question whether domestication was achieved in only one place or in several independently has been still unsolved, the presence of some genetical characters such as tail carriage and non-seasonal type of breeding, not observed in wild species but very common in most breeds of dogs, may make difficult to suppose so many places as domestication centers or so many geographical races of wolf as the origin of modern dogs.

There is no firm basis for assuming the process of domestication at present and, therefore, discussions on the problem must be inevitably speculative. However, the most convincing interpretation is that the domestication was initiated through the feeding of wild animals as a pet or the like without any special practical purpose for human life. Rapid and wide spreading of dogs in the ancient world and wide variety of body size already observed in ancient dogs, which may be a result of selection of a primitive form, can be understood only when tight mental bond between man and dog is assumed to be estiablished in the most initial stage of domestication. In combination with the discussion on the method for the study of the evolution or the history of dogs, participation of natural and artificial selections and of possible interbreeding with wild species in the processes of differentiation and development of various breeds or local populations are discussed in the last two sections of the first part. Considering the intensiveness of the selection pressure put upon the dog for a long historical period, it may be essential for the studies of genealogical relations of dog breeds to evaluate properly the effect of selection on the character to be investigated. In this sense, studies based on the population

genetics using the data of characters being neutral to selection may offer the most useful informations on the origin and the history of dogs.

Results of previous workers on the origin and the history of Japanese native dogs are reviewed in the second part, together with the brief summary of the studies on wolves in Japan, including *Canis hodophylax* Temminck, and also with some descriptions of native dogs in East Asian countries in old and recent ages. Archaeological studies on the pre-historic sites of the Jomon period (Neolithic age in Japan) reveals that there were at least three types of domesticated dogs in old Japan; being comparable in their size to *Canis familiaris palustris* (small), *C. f. intermedius* (medium) and *C. f. matris optimae* (large). The most popular dog in old Japan throughout the whole period of stone ages (the Jomon and the Yayoi periods) was the small-sized. They had already appeared from the earliest stage of Jomon period (around 9,000 years B. P.) (Table 5, Fig. 10). Although the origin of the old Japanese dog is still obscure and just the subject of our future studies, evidences available at present imply, in the most probability, that the small ones were introduced into our country from the southern part of Eastern Asia and dogs of large size, on the contrary, entered to the northern district of Japan from Sakhalin or other neighbouring area of North Eastern Asia. Appearance of the medium-sized dog, which was somewhat later than that of others, may relate to the transfer of culture into our country from the continent through Korean penninsula, though other interpretations are also possible on the origin of dogs of this type. Dogs in old days seemed to be raised mainly for the use for hunting. Frequent findings of dog skeltons courteously buried indicate the importance of dogs for the life of hunting-gathering people in prehistoric ages. Shape of dogs, imagined from clay figurines unearthed from remains of stone ages or pictorial representation on the metalware in later ages, was almost the same as that seen in current breeds, having errect ears and curled tail.

History of Japanese native dogs during ages after the enterance of Yayoi culture (rice crop culture) is not so clear except for that in modern ages. However, it is certain that blood of stone age dogs was descended to the modern dogs throughout the most of historical ages without large contamination of the blood of foreign breeds, through interbreeding between local populations must occur quite intensively within the country. There were no documents indicating the influx of a large number of dogs from foreign countries and no severe alteration of the shape of dogs was found in literature or works of art.

Accompanying with an introduction of European civilization started from the 16th

century and accelerated greatly after the final stage of the Edo period (later half of the 19th century), a large number of dogs of various breeds were imported from wide areas of the world. This new current brought about the establishment of new breeds such as Japanese spaniel (Chin) in the Edo period and Japanese terrier and Tosa-inu (a breed for dog-fighting, cross-bred between the native dog and mastiff, bull dog, pointer and others) in the Meiji-Taisho period on one hand, but resulted in a rapid hybridization of native dogs, especially in the urban areas, on the other. During this chaotic period, many local populations of the native dog lost their purity in blood and extinguished (Table 6). In 1930's when activities for the preservation of native dogs were initiated, only a small number of dogs could be found with satisfactory purity even in the villages (Fig. 11). Although the work for the preservation and the revival of Japanese native dogs was severely damaged again during the World War II, it was re-initiated after the war and has been proceeded without severe troubles until now.

Japanese native dogs are now divided into the following 6 breeds and 3 local populations according to their body size and their main localities of distribution at the time of re-finding in 1930's. Standards for the body size and allowances for the variation in coat colour and other external characters for each breeds were first settled in 1930's and have been succeeded thereafter by various associations or kennel clubs with or without modification.

Akita-inu: Large-sized, north eastern part of Honshu-island (Colour photograph, 1).

Hokkaido-ken (Ainu-ken): Medium-sized, Hokkaido-island (Colour photograph, 2).

Kishu-ken: Medium-sized, Wakayama and Mie prefectures, the central part of Honshu-island (Colour photograph, 3).

Shikoku-ken (Tosa-ken): Medium sized, Shikoku-island. Mother breed of Tosa-inu for dog fighting (Colour photograph, 4).

Kai-ken: Small-medium-sized, Yamanashi prefecture, the central part of Honshu-island. Fixed in their coat colour to tiger-brindle (Colour photograph, 5).

Shiba-inu: Small-sized (Colour photograph, 6).

Shinshu-breed: Nagano prefecture, the central part of Honshu-island.

San'in-breed: Tottori and Shimane prefectures, the western part and the side of Japan sea of Honshu-island.

Mino-breed: Gifu prefecture, the central part of Honshu-island, almost extinguished during the last world war and now in the process of re-construction.

Of the breeds mentioned above, Akita-inu has a patent history of hybridization in

recent years mainly through the interbreeding with Tosa-inu. Most of the Akitas lost once the original form as native dogs, changing in their shape to mastiff type with drooped ears, but the breed has been reconstructed during the last several decades.

III. Morphological studies of Japanese native dogs

Katuaki ŌTA

1. Studies on the external characters.

Body size, coat colour and other external characters and their variation or distribution within breeds were investigated in all of current 6 breeds of Japanese native dogs. Regions surveyed and number of dogs examined are summarized in Table 7. Results were discussed in relation to the standards or allowances for each characters settled by kennel clubs. Attempts were also made to clarify the mode of inheritance of coat colour and other characters by investigating the parental relation of dogs recorded in the registration card. Size of litters and sex ratio of new born pups in Japanese native dogs were also studied by the use of the record of littermates in the registration card.

1) Body size: Prior to obtain the body size of adult male and female dogs, the age when body growth of dogs almost or completely ceased was assessed in each breeds by using the data obtained by measurements of withers height, body length and chest girth in all dogs examined (for esample, Fig. 12). Size and conformation of body of dogs were considered to attain those of adults before 18 months of age in male Akitas, 12 months in female Akitas and male and female Hokkaido-kens and 8 months in dogs of all other breeds. Therefore, following analyses of the result on body size were carried out by using only the data of dogs over these ages (Tables 8 and 9).

Distribution of withers height within breeds was shown in a form of histogram in Fig. 13, together with the mean value and range of standard for the height in each breeds. In the breeds excepting Kai-ken and Mino-breed of Shiba-inu, the body size distributed closely around the mean value in either male or female dogs, showing the effect of selection in accordance with the settlement of the standard. Wide variation of body size in Kai-ken and Mino-Shiba-inu might be reflexions of wide range and absence of standard for the body size in these breeds, respectively. Withers height of most of Akita-inu was less even than the lower limit of the standard of the breed. In order to compare the body conformation between breeds, ratios of body length and chest girth to withers height, expressed in terms of %, were calculated. Graphic analysis was also carried out for the same purpose by using mean values of the height, the length and the chest girth of each breeds (Fig. 14). These treatments revealed that the Akitas were slightly different in

their body conformation from other native breeds: shorther body length and narrower chest girth in proportion to their withers height or, inversely stated, longer extremities in proportion to their size of body trunks. These results are discussed in relation to the history of the Akita-breed and also to the effect of selection performed in recent years.

2) Coat colour: Coat colour observed in Japanese native dogs are usually classified into the following 5 categories;

White: From pure white to white with brownish shade. Adult dogs with pure white coat are very rare.

Brown ("Red"): From cream or pale brown to dense red brown with or without black shade. Chocolate brown is observed rarely in the Akita, but not in other breeds.

"Goma": Black hairs intermingle with brown hairs of various colour intensities and distribute uniformly over the whole body. Coat colour like that of wolf is also seen, but not frequently, and this colour is classified into either "Goma" or "Red" in usual cases.

Black: Solid black or black and tan. Solid black is hardly seen in current Japanese dogs.

Tiger-brindle: Black striped. Ground colour varies from pale to red brown.

Regardless of the coat colour, white markings of various sizes are seen very frequently in Japanese native dogs. Distribution pattern of white area and grading of its size are illustrated in Fig. 16. Only the marking larger than grade 3 or 4 is recorded in the registration card.

According to this classification principally, distribution of coat color and of white marking in each breeds are summarized in Tables 11 and 12, respectively. Although breeds other than Kai-ken had a variety of coat colour, inclines of considerable degree were seen to white in Kishu-ken, to "Goma" in Shikoku-ken and to "Red" in Shiba-inu.

Possible gene combinations for each coat colours were assumed (Table 18) by investigating their mode of inheritance (Tables 16-17) in reference to the present knowledge on the gene control of coat colour in dogs. Of all colours observed in the present survey, "Goma" was the most difficult to explain, of which mode of inheritance was not consistent with any combinations of known genes in *A* and *E* loci. There were no or little evidences implying the existence of genes *M*, *P* and *Int* and *W* of Iljin, and gene frequencies of A^s, E^m and s^w were considered to be low at least in the current populations of Japanese native dogs. White markings in Japanese dogs seemed to be largely due to

the action of gene s^i, though the amount of the Irish spotting varied considerably between breeds (Table 12).

3) Other external characters: Percentages of the occurrence of dew claws, pigmented spots on the tongue and missing teeth and distribution of types of tail were investigated. All of dew claws observed were of single type and found in hind legs of both sides. Almost all reduction of teeth number was due to the congenital loss of one or more premolar teeth. Type of tail was classified into two categories, according to the usual classification used in kennel clubs: tightly coiled or curled tail and upright and loosely curled (sickle-shaped) tail. There were quite large differences in the frequency of the occurrence of these characters between breeds (Table 19), corresponding to the differences in the extent of allowances or the prefernce for the character between kennel clubs or dog-owners. Although trials to clarify the mode of inheritance of these characters by invetigating the parental relation of the dog examined were unsuccessful, data will offer some basis for the future studies on the genetical control of the characters (Tables 20–23).

4) Litter size and sex ratio: Results are summarized in Table 24. It is quite noteworthy that mean litter sizes in various breeds of Japanese native dogs obtained in the present study are much smaller than those reported in foreign breeds. Further studies will be needed.

IV. Comparison of body conformation between six breeds of the Japanese native dogs by principal component analysis (PCA).

Shin-ichi Ito

The principal component analysis was applied to the data on three body measurements (withers height, body length and chest girth) in six breeds of the Japanese native dogs. In the six breeds examined, the 1st, the 2nd and the 3rd principal components included amount of information of about 94.5%, 4.0% and 1.5%, and represent size factor (body size), shape factor (slender versus massive) and shape factor (long-legged versus long-torsoed), respectively. The native breeds were classified based on the result of PCA as follows:

Large size and slender type·····Akita-inu,
Medium-large size and slender type·····Shikoku-ken,
Medium-large size and middle type·····Kishu-ken,
Medium-large size and massive type·····Hokkaido-ken,
Medium-small size and massive type·····Kai-ken,
Small size and slender type·····Shiba-inu (Mino-kei),

Small size and middle type ·····Shiba-inu (San'in-kei),

Small size and massive type·····Shiba-inu (Shinshu-kei).

In all of the breeds examined, male dogs were classified into long-legged and the females into long-torsoed type.

V. Cranial and dental characters of the Japanese native dogs.

Iwao OBARA and Yoshinori IMAIZUMI

Although several distinct breeds of native dogs are kept in Japan, only a few papers dealing their cranial and dental features have been known.

It was difficult to find out distinguishing characters in the cranial and dental features of each breed, but several racial peculiarities were scarcely recognized. The followings are diagnostic descriptions for respective breeds of Japanese native dogs.

Akita-inu—A large-sized breed originally from Akita Prefecture. Skull large and massive with well developed frontal shield. Condylobasal length 206.7 (195.3–212.8) mm in 5 males. Sagittal crest high. Exposed portion of presphenoid slender entirely and without prominent alae.

Shikoku-ken—A medium-sized breed originally mainly from Shikoku. Skull rather large but evidently smaller than that of Akita-inu. Condylobasal length 183.8 (178.8–188.4) mm in 9 males, 171.0 (162.0–178.2) mm in 6 females. Skull massive, heavy with high frontal shield. Sagittal crest well developed, front-nasal region only weakly depressed. Exposed portion of presphenoid generally slender entirely and without alae.

Kishu-ken—A medium-sized breed originally mainly from Wakayama and Mie Prefectures. A single male was examined. Condylobasal length 181.0 mm. General appearance similar to that of Shikoku-ken, but exposed portion of presphenoid remarkably widened in posterior half. Teeth relatively large. Cingulum on inner surface around the protocone of M1 rather well developed as in some of *Canis lupus* and *C. hodophilax*.

Shiba-inu (Shinshu-kei)—Small-sized breed originally from the Nagano district. Condylobasal length 150.7 (135.7–161.6) mm in 8 males and 139.2 (137.0–141.4) mm in 2 females. Front-nasal region rather flat, only slightly concave. Frontal shield swollen prominently. Temporal ridges evident. Anterior border of mesopterygoid fossa with prominent projection at middle. Exposed portion of presphenoid mostly with prominent alae at middle. In two specimens out of 12, when put the skulls on a horizontal plane, they well balanced and angular processes of mandibles free from the plane as in *Canis hodophilax*. Teeth rather large.

Shiba-inu (San'in-kei)—Small-sized breed originally from the San-in district, west-

ern Honshu. Condylobasal length 146.3(142.2–150.4) mm in 2 males, 138.6 (131.2–148.8) mm in 4 females. Size similar to Shinshu-kei of Shiba-inu but generally front-nasal region more depressed, anterior border of mesopteryoid fossa emarginated at middle, and exposed portion of presphenoid without prominent alae. Temporal ridges conspicuous.

Hokkaido-ken—Intermediate type of small and medium breeds, originally from Hokkaido. Size of skull variable, condylobasal length 166.4 (140.7–176.2) mm in 5 males, 157.0 (155.0–159.0) mm in 2 females. Front-nasal region generally rather flat, but some times rather strongly dished. In some skulls, exposed protion of presphenoid widened in the posterior half or has prominent alae at middle.

Kai-ken—Intermediate type of small and medium breeds, originally from Yamanashi Prefecture. Size variable, condylobasal length 160.9 (147.7–170.3) mm in 5 males and 141.8 (128.0–162.7) mm in 4 females. Front-nasal region generally strongly dished. Sagittal crest poorly developed. Rostrum rather broad and short. Missing teeth, probably congenital, not uncommon (observed in 6 specimens out of 10 examined).

VI. Pedigree analyses of Japanese native dog breeds

Ken NOZAWA

Applying the techniques of pedigree analysis (WRIGHT & MCPHEE, 1925; NOZAWA, 1961) the author tried to elucidate the characteristics of the breeding populations of the 6 Japanese native dog breeds, that is, Hokkaido-ken, Akita-inu, Kai-ken, Kishu-ken, Shikoku-ken and Shiba-inu, and the following informations were obtained. Here, the proband individuals were obtained by random sampling from the pedigree-registered dogs born in 1973.

(1) Mean generation interval of the Japanese native dogs was 3~4 years, and the interval from sire to offspring was generally longer than that from dam to offspring (Table 36).

(2) Breeding population number could be estimated by the product of the number of newly registered individuals per year by the mean generation interval. This number was considered as a lower limit of the total number of pure-bred individuals in each breed. The breeding population number of the breeds were estimated as follows: about 120,000 in the Akita-inu and Shiba-inu, 10,000~20,000 in the Hokkaido-ken, Kishu-ken and Shikoku-ken, and about 2,600 in the Kai-ken (Table 37).

(3) The breeding population numbers in different prefectures were estimated as shown in Figs. 23~28. From these figures we can postulate that the Akitas and Shibas are the breeds being raised universally in whole Japan and the distribution patterns of

the other 4 breeds are of localized nature in some restricted areas of the country. That could be confirmed by calculating the correlation coefficient between the human population size and the breeding population number of dogs in different prefectures: thus, significant positive correlations were obtained in the former two breeds, and the correlations were regarded as non-significant in the latter four breeds (Table 38).

(4) Distance between two geographical points can be measured by the minimum number of prefectural boundaries existing between these points. The mean distances between the birth places of parent and offspring were generally in the range of 1~2 except in the Hokkaido-ken whose mean distance was less than 1. The mean distance between birth places of sire and offspring was observed to be longer than that of dam and offspring in every breed (Table 39). Proportion of the zero distance was in the range 50~60% except in the Hokkaido-ken in which the proportion was 88% (Table 40).

(5) The mean distance between birth places of parents was in the range of 1~2 (Table 41a). The proportion of zero values of this distance which could be regarded as the prefectural endogamy rate was generally in the range of 1/4~1/2, the Hokkaido-ken giving an exceptionally high estimate as 88% (Table 41b).

(6) Table 42 shows the results of analyses on inbreeding and population structure of the Japanese native dog breeds. Variation among breeds in increment of the total inbreeding coefficient in the last four generations was comparatively small, ranging between 2% in the Akita-inu (AK) and 7.5% in the Kai-ken. Most of this variation could be attributed to the variation in incidence of current inbreeding between breeds. Contribution of interse relationship to the total inbreeding was variable among breeds, the minimum being 0.4% in the Shiba-inu and the maximum 3.9% in the Kai-ken. These estimates were observed to correlate negatively with the breeding population number (Table 37). The amount of genetic differentiation within breed which could be measured by the index of subdivision were generally observed to correlate positively with it. The average effective population size calculated in the last four generations were observed to constrict remarkably from the breeding population number; this gives a support to the inference that the selection of breeding sires have been practiced fairly rigorously in each dog breed.

(7) The results of the similar pedigree analyses on the individuals bled for electrophoreic screenings of blood protein variations are presented in Table 43. Comparison of these with the results shown in Table 44 suggests that the bled individuals in the Shikoku-ken and Shiba-inu have represented only a part of whole pedigree of these dog breeds. Furthermore, a significant difference was observed in the Kai-ken between the

mean coefficient of relationship within random samples for pedigree analysis on the one hand and that between the random samples for pedigree analysis and the individuals bled for electrophoretic screening on the other; the reason of it was remained yet to be analyzed.

VII. Phylogenetic relationships of dog breeds especially of Japanese native dog breeds determined by the blood protein polymorphisms

Yuichi TANABE

The horizontal starch gel electrophoresis and the horizontal polyacrylamide gradient gel electrophoresis were employed to clarify the phylogenetic relationships of dog breeds especially of Japanese native dog breeds by using the polymorphic variation of the blood protein components as the genetic markers. Blood samples were collected from 1975 individual dogs of 55 breeds including 8 Japanese native breeds.

Protein polymorphisms are observed in 13 loci such as plasma albumin (*Alb*), plasma postalbumin (*Poa*), plasma transferrin (*Tf*), plasma eserine resistant esterase (*Es*), plasma leucine aminopeptidase (*Lap*), plasma alkaline phsphatase (*Akp*), erythrocyte hemoglobin (*Hb*), erythrocyte esterase-2 (*Es-2*), erythrocyte esterase-3 (*Es-3*), erythrocyte acid phosphatase (*Pac*), erythrocyte tetrazolium oxydase (*To*), erythrocyte glucose phosphate isomerase (*GPI*) and erythrocyte catalase (*Ct*), whereas 10 loci such as plasma postalbumin-2 (*Poa-2*), plasma slow-α_2-macroglobulin (*Slow-α_2*), plasma eserine resistant esterase-fast (*Es-f*), plasma amylase (*Amy*), erythrocyte esterase-fast (*cell-Es-f*), erythrocyte glucose phosphate dehydrogenase (*G-6-PD*), erythrocyte lactate dehydrogenases (*LDH-A* and *LDH-B*), erythrocyte adenylate kinase (*AK*) and erythrocyte leucine aminopeptidase (*cell-Lap*) are monomorphic.

The present study reveals that the phenotypic variations of plasma postalbumins, plasma tranferrins, plasma eserine resistant esterases, plasma leucine aminopeptidases, plasma alkaline phosphatases, erythrocyte hemoglobins, erythrocyte esterases-2, erythrocyte esterases-3, erythrocyte glucose phosphate isomerases and erythrocyte catalases are controlled, respectively, by the autosomal loci of *Poa* with three codominant alleles, Poa^A, Poa^B and Poa^C; *Tf* with five codominat alleles, Tf^A, Tf^B, Tf^C, Tf^D and Tf^F; *Es* with three codominant alleles, Es^A, Es^B and Es^C; *Lap* with two codominant alleles, Lap^A and Lap^B; *Akp* with three codominant alleles, Akp^A, Akp^B and Akp^C; *Hb* with two codominant alleles, Hb^A and Hb^B; *Es-2* with a dominant alleles, $Es\text{-}2^S$ and a recessive allele, $Es\text{-}2^F$; *Es-3* with two codominant alleles, $Es\text{-}3^A$ and $Es\text{-}3^B$; *GPI* with two codominant alleles,

GPI^A and GPI^B; and *Ct* with two codominant alleles, Ct^A and Ct^B, and a recessive allele, Ct^O.

Mean genetic distance between the dog breeds was calculated by method of ROGERS (1972) using the data of 13 polymorphic loci and of NEI (1975) using the data of 13 polymorphic and 10 monomorphic loci. From the matrix of the two kinds of genetic distance values, the dendrograms of the dog breeds were drawn by the unweighted pair-group method of clustering in numerical taxonomy (SNEATH and SOKAL, 1973).

A close relationship was observed among most ot Japanese native dog breeds, *i.e.* Hokkaido, Akita, Kai, Shikoku, Shinshu-Shiba, Mino-Shiba, except San'in-Shiba. Further, a marked difference of genetic constitution ot Japanese native dog breeds and of European dog breeds was observed. No significant difference was observed in average heterozygosity ($\bar{H}$) between Japanese native dog breeds and European dog breeds.

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