Morphology and Morphometry of Skulls of Raccoon Dogs, *Nyctereutes procyonoides* and Badgers, *Meles meles*

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ABSTRACT. In order to obtain the basic data to identify the skeletal remains from the archaeological sites, morphological and morphometrical studies were carried out on skulls of living raccoon dogs (35 males and 45 females) and badgers (16 males and 8 females) from Kagoshima Prefecture. Macroscopically, the sexual differences were observed in badgers for the parts of the zygomatic process of the temporal bone and the occipital squama, but were not in raccoon dogs. Among 24 cranial measurements, significant sexual differences were found in five measurement items in raccoon dogs, while 12 items in badgers. Mandibles showed significant sexual differences in both species. Raccoon dogs had significantly larger values than badgers in most of the items concerning length of cranium and most mandibular measurements. The discrimination efficiencies of discriminant formulae between both sexes were lower in raccoon dogs, but higher in badgers, and the efficiencies between both species were obtained 100%. In the regression formulae for estimating skull length, some formulae showed high coefficients of determination in both species. These observations represented interspecific and sexual differences in the skulls of raccoon dogs and badgers. — KEY WORDS: badger, interspecific difference, raccoon dog, sexual dimorphism, skull measurement.

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Recently, the mammalian remains have been excavated from a lot of sites of the Jomon and Yayoi Periods in Japan, and also skeletal remains of the canid and mustelid species have been reported in Kyushu [9]. However, in many cases it is difficult to identify species, especially raccoon dogs (*Nyctereutes procyonoides*) and badgers (*Meles meles*), because of small fragments of the bones excavated and their similar sizes of both the species.

Although the raccoon dog belonging to Canidae is taxonomically different from the badger, a mustelid species, it has been often confused with the badger, because of the similar appearances such as body type or facial maculae [10]. Concerning the bones of these species, only a few studies on the measurements of the skulls of raccoon dogs from Japan have been reported [4, 8, 12, 16], and many measurements including various parts of the skulls have not been demonstrated in these studies. On the other hand, there are some studies using the measurements of the skulls of European badgers [3, 5, 7, 15], but in Japan, no morphometrical study has been carried out on the bones of badger.

Our purpose is to obtain the basic data necessary to identify skulls of raccoon dogs and badgers excavated from archaeological sites, and to obtain the real osteological data of both species from Kagoshima Prefecture. In the present study, the skulls of raccoon dogs and badgers from Kagoshima Prefecture were examined both macroscopically and morphometrically to clarify the interspecific and sexual differences of both species.

MATERIALS AND METHODS

Eighty skulls of adult raccoon dogs (35 males and 45 females) and 24 of adult badgers (16 males and 8 females) captured in Kagoshima Prefecture were used in this study. We regarded the animal with the closed epiphyseal lines of long bones as adult.

The sexual differences and interspecific differences in respective bones were investigated macroscopically and morphometrically. According to the method of Driesch [2], each part of the bones was measured with vernier calipers to the nearest 0.1 mm. The crania were measured for 24 items, while the mandibles were evaluated by 11 measurements (Table 1). The significant differences between sexes and between species were determined by Student's *t*-test. We also computed the linear discriminant functions between sexes and between species, and regression formulae to estimate the total length of crania or mandibles from the measurements of one piece of bone.

RESULTS

Macroscopical observations: Breadth of parietal bone was wider in badgers, and the external sagittal crest was well developed in raccoon dogs. The frontal bone protruded dorsally in badgers, while it slightly in raccoon dogs. The frontal zygomatic process was an angular shape in raccoon dogs, but was less developed in badgers (Fig. 1). The zygomatic process of the temporal bone protruded laterally in raccoon dogs, but it extended obliquely forward in badgers, whose process protruded more forward in females than in males (Fig. 1). The nasal bone and the maxilla were fairly long in raccoon dogs. The infraorbital foramen was considerably larger in badgers. The squamous part of the occipital bone was wider in badgers, and wider in males than in females. The shape of foramen magnum, which was

Table 1. List of the measurements and their abbreviations

Cranial measurements	
Total length	TL
Condylobasal length	CL
Basal length	BL
Upper neurocranium length	NL
Facial length	FL
Median palatal length	PL
Length of cheektooth row	LPM
Greatest diameter of the auditory bulla	DAB
Greatest mastoid breadth	MB
Breadth dorsal to the external auditory meatus	BAM
Greatest breadth of the occipital condyles	BOC
Greatest breadth of the bases of the jugular processes	BJP
Greatest breadth of the foramen magnum	BF
Height of the foramen magnum	HF
Greatest neurocranium breadth	NB
Zygomatic breadth	ZB
Least breadth of the skull	LBS
Frontal breadth	FB
Least breadth between the orbits	LBO
Greatest palatal breadth	GPB
Least palatal breadth	LPB
Breadth at the canine alveoli	BCA
Greatest inner height of the orbit	IHO
Height of the occipital triangle	HOT
Mandibular measurements	
Total length (length from the condyle process to infradentale)	TL
Length from the angular process to infradentale	LAI
Length from the indentation between the condyle process and the angular process to infradentale	LII
Length from the condyle process to aboral border of the canine alveolus	LCC
Length from the indentation between the condyle process and the angular process to aboral border of the canine alveolus	LIC
Length from the angular process to aboral border of the canine alveolus	LAC
Length of the cheektooth row	LPM
Greatest thickness of the body of jaw below M_1	TM
Height of the vertical ramus	HR
Height of the mandible behind M_1	HM
Height of the mandible between P_2 and P_3	HP

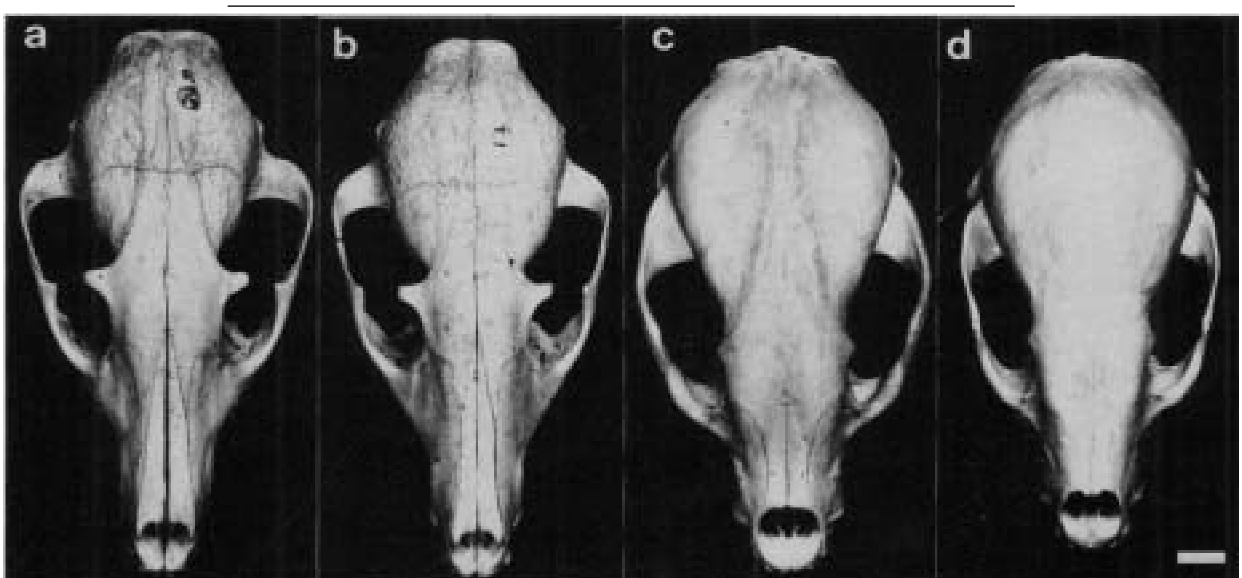

Fig. 1. Dorsal view of the cranium. a: male raccoon dog, b: female raccoon dog, c: male badger, d: female badger. Bar=1 cm.

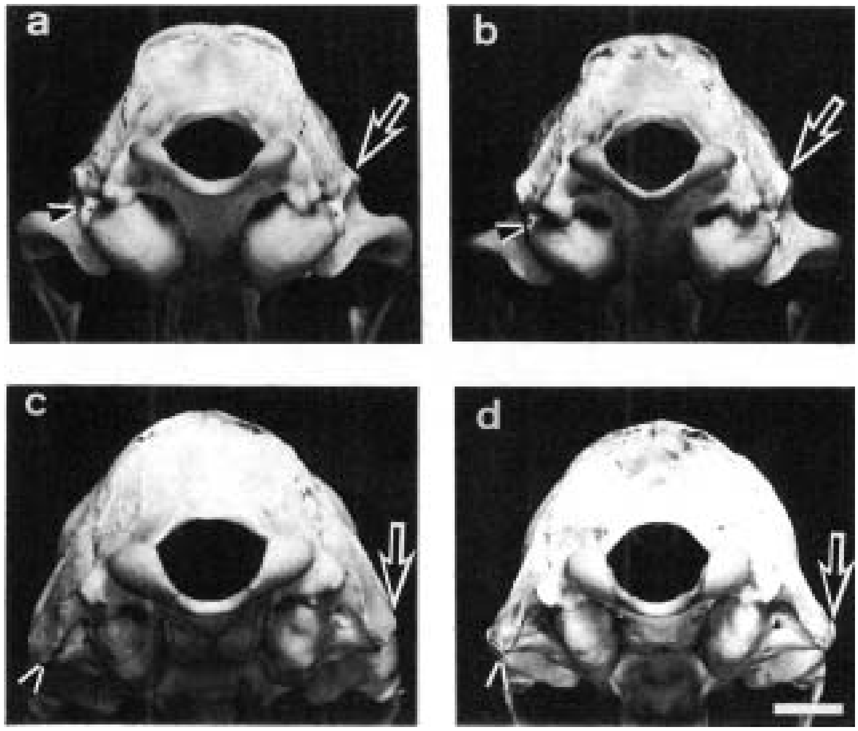

Fig. 2. Caudo-ventral view of the cranium. a: male raccoon dog, b: female raccoon dog, c: male badger, d: female badger, arrow: mastoid process, arrowhead: external acoustic pore. Bar=1 cm.

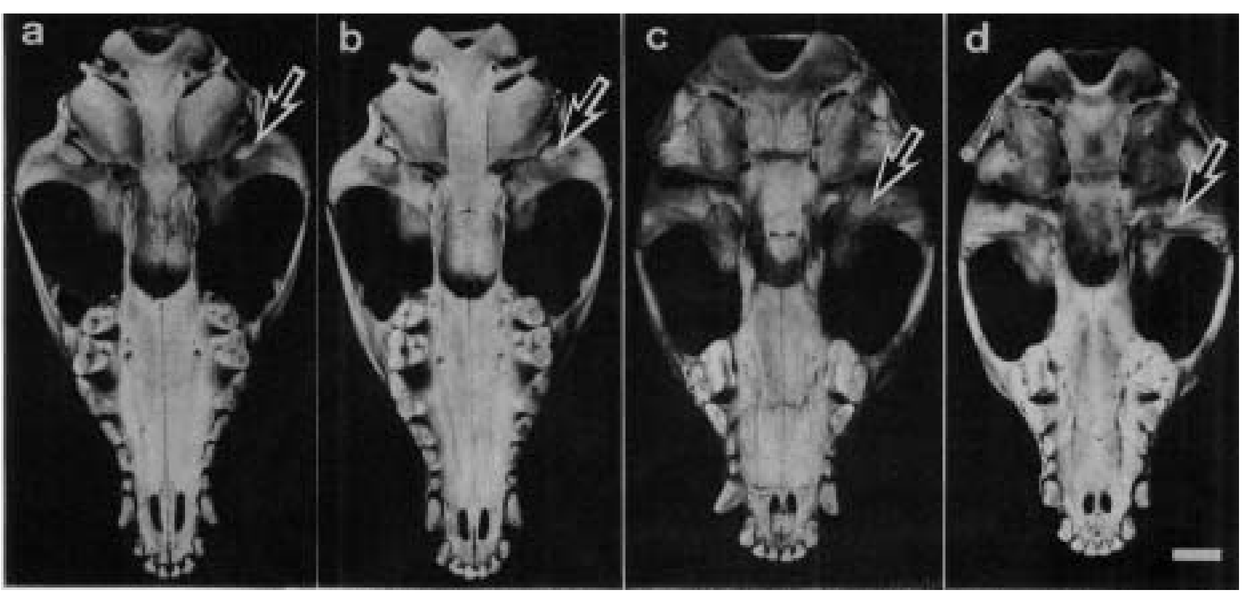

Fig. 3. Ventral view of the cranium. a: male raccoon dog, b: female raccoon dog, c: male badger, d: female badger, arrow: retroglenoid process. Bar=1 cm.

wider in badgers, was almost oval in both species (Fig. 2). The incisura on the upper margin of the foramen was observed in one male raccoon dog, and in one male and two female badgers. Although the mastoid process of the temporal bone was not formed in raccoon dogs, badgers had a remarkably protruded process (Fig. 2). The base of the occipital bone was wider in badgers. The external acoustic pore opened directly at the tympanic bulla in raccoon dogs, but badgers had a cylindrical process around the margin of the pore (Fig. 2). The retroglenoid process was well developed in badgers (Fig. 3).

The carnassial tooth, P^4 was longer and its palatal root

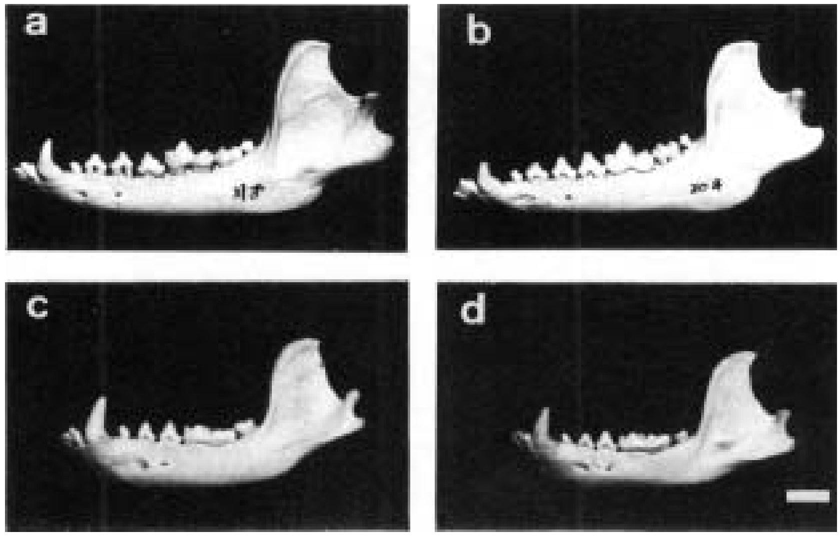

Fig. 4. Lateral view of the mandible. a: male raccoon dog, b: female raccoon dog, c: male badger, d: female badger. Bar=1 cm.

was situated more forward in raccoon dogs than in badgers. Badgers had the well developed first molar, whose palatal side was longer than the buccal side, while raccoon dogs had the M^1 whose palatal side was shorter than the buccal side (Fig. 3). Variations in the number of teeth were observed in raccoon dogs; the right P^1 was absent in one male and in two females, and the P^1 of both sides were absent in one female. The bilateral P^1 was absent in all badgers.

The mandible of raccoon dogs was larger than that of badgers. The ventral border of the mandibular body was linear in both species, but the hollow part of the angular process was deeper in raccoon dogs (Fig. 4). In badgers, the anterior border of the mandibular ramus markedly curved backwards (Fig. 4), and the condyloid process was wider. In the caudal view, the transit part from the condyloid process to the angular process slightly curved to the innerside and longer in raccoon dogs, while it was linear in badgers.

The protoconid of the M_1, the carnassial tooth, was higher in raccoon dogs than in badgers. Variations in the number of teeth were seen in seven raccoon dogs; absent was the left P_1 in one female, the right P_1 in two males, the P_1 of both sides in one female, the P_1 and P_2 of both sides in one female, the left M_3 in one female, and both the M_3 in one male. In badgers, absent was the bilateral P_1 in all animals, and the right P_2 in one male and one female.

Comparison by measurment values: The mean value and standard deviation of measurements in the crania and mandibles are shown in Table 2. In cranium of raccoon dogs, five measurement items in males, e.g., NB and ZB, showed significantly greater values than in females ($p<0.05$). In badgers, 12 measurement items of males were significantly larger than those of females; TL, BL, FB, etc. ($p<0.05$). In the comparison between the species, 19 out of 24 measurement items showed significant differeces in the both sexes ($p<0.05$). For the remaining five items, the significant differences were shown in one item in the male, and in three items in the female ($p<0.05$).

Significant sexual differences of the mandible were found in 9 measurement items of raccoon dogs and in 10 items of badgers ($p<0.05$). HP in badgers was significantly larger than that of raccoon dogs ($p<0.05$). Female raccoon dogs had a significantly larger HM than female badgers ($p<0.05$). For the other measurement items, raccoon dogs had significantly larger measurements in both sexes ($p<0.05$).

Discriminant analysis: The discriminant functions between sexes were computed using the two and three measurement items in crania and three in mandibles (Table 3). These items were related to the maxillary and occipital regions, and mandibular body, which were frequently excavated from archaeological sites. The discrimination efficiencies in raccoon dogs were low: 57.4% in the maxillary region, 69.1% in the occipital region, and 65.0% in the mandible. In badgers, on the other hand, they were high as 95.0% in the maxillary region, 80.0% in the occipital region, and 91.7% in the mandible.

In addition, discriminant formulae to distinguish raccoon dogs from badgers were computed using two and three items in crania and three in mandibles (Table 4). All discrimination efficiencies were 100%.

Estimation of greatest length from respective measurements: Regression formulae were calculated to estimate the total length of cranium or mandible from the measurable bone fragment. Simple, quadratic and exponent regression formulae for estimating the greatest length of the cranium and mandible were computed. The coefficients of determination were high, as shown in Table 5. The very high values (0.90–0.99) were obtained from the following items; CL, LII and LCC.

Table 2. The mean value (mm) and standard deviation of measurements of crania and mandibles

	Raccoon dog		Badger	
	male	female	male	female
Cranial measurements				
TL	110.04 ± 3.54 (34)b)	108.77 ± 3.79 (44)c)	107.31 ± 3.57 (14)a)	102.55 ± 3.66 (6)
CL	106.70 ± 3.62 (34)b)	105.68 ± 3.74 (44)c)	102.55 ± 3.43 (16)a)	98.33 ± 2.13 (7)
BL	101.49 ± 3.51 (34)b)	100.20 ± 3.48 (44)c)	95.22 ± 3.23 (16)a)	90.54 ± 2.20 (7)
NL	53.29 ± 2.15 (34)b)	52.48 ± 2.25 (42)c)	62.34 ± 3.01 (10)	60.33 ± 2.59 (6)
FL	62.67 ± 2.40 (34)b)	61.98 ± 2.65 (42)c)	52.86 ± 2.52 (12)a)	50.21 ± 1.57 (7)
PL	54.05 ± 2.02 (34)	53.50 ± 1.99 (44)c)	53.93 ± 2.16 (16)a)	51.56 ± 1.66 (8)
LPM	37.53 ± 1.19 (34)b)	36.98 ± 1.48 (44)c)	21.43 ± 0.76 (16)	21.03 ± 0.96 (8)
DAB	16.73 ± 0.84 (34)b)	16.59 ± 1.07 (44)c)	22.72 ± 1.27 (16)	22.17 ± 0.81 (7)
MB	38.49 ± 1.11 (31)b)	37.82 ± 1.67 (42)c)	53.71 ± 2.23 (14)	52.05 ± 1.66 (7)
BAM	40.53 ± 1.05 (32)	40.13 ± 1.42 (42)c)	41.14 ± 3.07 (15)a)	37.99 ± 1.62 (8)
BOC	22.91 ± 0.66 (34)b)	22.83 ± 0.80 (44)c)	28.41 ± 2.43 (16)	27.23 ± 0.80 (8)
BJP	29.64 ± 1.17 (34)b)	29.22 ± 1.28 (44)c)	37.19 ± 1.78 (16)a)	35.62 ± 0.79 (7)
BF	13.05 ± 0.42 (34)b)	13.02 ± 0.60 (44)c)	15.67 ± 1.05 (15)	15.03 ± 0.97 (8)
HF	9.32 ± 0.50 (34)b)	9.27 ± 0.58 (44)c)	12.76 ± 1.16 (12)	12.85 ± 1.19 (7)
NB	40.92 ± 1.61 (30)a)b)	39.98 ± 1.26 (41)c)	44.97 ± 1.63 (15)	44.34 ± 0.77 (6)
ZB	60.60 ± 1.99 (34)b)	59.06 ± 2.73 (43)c)	59.32 ± 3.16 (15)a)	56.73 ± 1.88 (8)
LBS	21.28 ± 1.06 (30)b)	21.52 ± 1.58 (42)c)	23.32 ± 1.70 (13)	22.79 ± 1.04 (7)
FB	34.01 ± 2.35 (25)b)	33.83 ± 2.41 (33)c)	26.57 ± 1.18 (15)a)	25.16 ± 0.79 (8)
LBO	22.23 ± 0.96 (32)b)	21.84 ± 1.12 (41)	23.65 ± 1.08 (16)a)	22.47 ± 1.05 (8)
GPB	34.54 ± 1.27 (34)a)	33.80 ± 1.10 (43)	34.78 ± 1.21 (16)	33.98 ± 1.05 (8)
LPB	18.45 ± 0.62 (34)b)	18.36 ± 0.65 (43)c)	22.89 ± 0.91 (16)a)	21.61 ± 0.71 (8)
BCA	19.58 ± 0.70 (33)b)	19.39 ± 0.78 (42)c)	24.36 ± 1.09 (16)a)	22.42 ± 0.71 (8)
IHO	17.49 ± 0.73 (34)a)b)	17.15 ± 0.72 (44)c)	15.77 ± 0.87 (16)	15.46 ± 0.81 (8)
HOT	29.25 ± 1.24 (34)a)b)	28.51 ± 1.31 (43)c)	32.71 ± 1.79 (14)	31.06 ± 1.17 (6)
Mandibular measurements				
TL	80.74 ± 2.88 (35)a)b)	79.37 ± 2.95 (45)c)	68.72 ± 2.66 (16)a)	65.18 ± 1.68 (8)
LAI	82.73 ± 3.05 (35)a)b)	81.12 ± 3.12 (45)c)	68.73 ± 2.94 (16)a)	65.83 ± 1.52 (8)
LII	78.85 ± 2.79 (35)a)b)	77.41 ± 2.87 (45)c)	66.69 ± 2.37 (15)a)	63.34 ± 1.62 (8)
LCC	70.88 ± 2.71 (35)a)b)	69.57 ± 2.78 (45)c)	57.61 ± 2.11 (15)a)	54.91 ± 1.24 (8)
LIC	69.16 ± 2.60 (35)a)b)	67.84 ± 2.71 (45)c)	56.02 ± 1.92 (15)a)	53.28 ± 1.11 (8)
LAC	73.19 ± 2.81 (35)a)b)	71.68 ± 3.05 (45)c)	58.14 ± 1.77 (15)a)	55.78 ± 1.05 (8)
LPM	41.84 ± 1.23 (34)a)b)	41.29 ± 1.12 (41)c)	31.33 ± 0.72 (15)a)	30.68 ± 0.59 (8)
TM	6.35 ± 0.41 (35)b)	6.17 ± 0.44 (45)c)	5.28 ± 0.32 (16)a)	4.93 ± 0.22 (8)
HR	33.07 ± 1.64 (35)a)b)	31.99 ± 1.66 (45)c)	28.63 ± 1.83 (16)	27.25 ± 1.13 (8)
HM	11.50 ± 0.59 (35)	11.23 ± 0.80 (45)c)	11.58 ± 0.96 (16)a)	10.41 ± 0.48 (8)
HP	9.13 ± 0.48 (35)a)b)	8.73 ± 0.65 (45)c)	11.14 ± 0.65 (16)a)	10.00 ± 0.53 (8)

( ): numbers. a): significant difference between male and female (p<0.05). b): significant difference between raccoon dogs and badgers in males (p<0.05). c): significant difference between raccoon dogs and badgers in females (p<0.05).

DISCUSSION

In Kagoshima Prefecture, bone remains of raccoon dogs and badgers have been excavated in several archaeological sites such as Katano and Kurokawa cave sites, and Kusano and Ichiki shell-mounds [9]. In general, the animal remains are mostly found as bone fragments, and it is difficult to distinguish between the bones of raccoon dogs and badgers. Therefore, it is very important to obtain the basic data on the skeleton of the both living species.

Macroscopically, the interspecific differences were found in the nasal, the occipital and the temporal bones, and the maxilla and the mandible. Sexual dimorphisms were also detected in badgers for the temporal and the occipital bones, but were not in raccoon dogs. The conspicuous protrution of mastoid process of the temporal bone in badgers may be referable to their strong cervical muscles inserted on the process, e. g. sternocephalic, atlanto-occipital, sternocleidomastoid muscles, which may be reflected in the behavioral differences between badgers, which dig their deep and long burrows very well [11], and raccoon dogs, which do poorly [10].

In general, the dental formulae of raccoon dogs and badgers are I 3/3 C 1/1 P 4/4 M 2/3 and I 3/3 C 1/1 P 4/4 M 1/2 [13], respectively. In raccoon dogs, many variations in the number of teeth have been reported. Asahi and Mori [1] described that 80 raccoon dogs out of 308 individuals (26%) had variations in the number of teeth, such as defects and excess. Such variations were also reported by other researchers [6, 14]. In the present study, similar variations

Table 3. Discriminant formulae between male and female in both raccoon dogs and badgers

Crania in raccoon dogs

Maxilla region

$Z = -0.2789\ X_1 - 0.1092\ X_2 + 7.2690$ (Z<0: male, Z>0: female)

X_1: LPB, X_2: BCA

Occipital region

$Z = 0.9642\ X_1 - 0.5226\ X_2 - 0.6574\ X_3 + 11.3181$ (Z<0: male, Z>0: female)

X_1: BF, X_2: HF, X_3: HOT

Mandibles in raccoon dogs

$Z = -0.7325\ X_1 + 0.4056\ X_2 - 1.4699\ X_3 + 13.1013$ (Z<0: male, Z>0: female)

X_1: TM, X_2: HM, X_3: HP

Crania in badgers

Maxilla region

$Z = 0.3427\ X_1 + 2.1046\ X_2 - 57.3006$ (Z>0: male, Z<0: female)

X_1: LPB, X_2: BCA

Occipital region

$Z = -1.5295\ X_1 + 1.9730\ X_2 + 1.1544\ X_3 - 46.8039$ (Z>0: male, Z<0: female)

X_1: BOC, X_2: BJP, X_3: BF

Mandibles in badgers

$Z = 3.3300\ X_1 - 0.4544\ X_2 + 3.2355\ X_3 - 46.2032$ (Z>0: male, Z<0: female)

X_1: TM, X_2: HM, X_3: HP

Table 4. Discriminant formulae between raccoon dogs and badgers

Crania

Maxilla region

$Z = -5.8235\ X_1 - 1.4274\ X_2 + 150.2506$ (Z>0: raccoon dog, Z<0: badger)

X_1: LPB, X_2: BCA

Occipital region

$Z = -8.3197\ X_1 + 2.8244\ X_2 + 0.0123\ X_3 + 171.5925$ (Z>0: raccoon dog, Z<0: badger)

X_1: BOC, X_2: BF, X_3: HF

Mandibles in raccoon dogs

$Z = 12.0043\ X_1 - 23.0876\ X_2 + 15.3410\ X_3 + 236.0165$(Z>0: raccoon dog, Z<0: badger)

X_1: TM, X_2: HM, X_3: HP

were observed in 11 individuals (13.8%) consisting of five males and six females. In one female, five premolars consisting of the right P^1, and the P_1 and P_2 on both sides were absent. Excess of teeth was not detected in the present study. In badgers, two (8.3%) missed the P_2. Further, it is said that the both P^1 and P_1 of mustelid animals show a tendency to degenerate [13], in badgers in this study, all (100%) missed the both P^1 and P_1.

The comparison between our measurements of raccoon dogs and those of Miyao and Koike [8], demonstrated that our specimens from Kagoshima Prefecture were significantly smaller than those from Oita Prefecture in TL, ZB and NB ($p<0.05$). Additionally, TL of our specimens appeared to be significantly smaller than that of raccoon dogs from Yashiro Island, Yamaguchi Prefecture ($p<0.05$). These results might be reflected the differences of geographic latitude.

Miyao and Koike [8] reported no sexual differences in the size of skulls and teeth of raccoon dogs. Hell and Paule [5] described that male skulls were slightly greater than those of female in European bager, so according to the skull characteristics it was not possible to determine the sex of individual. The present study, however, found significant sexual differences in five of 24 measurement items of cranium and nine of 11 items of mandible of raccoon dogs (Table 2). On the other hand, 12 of 24 items of cranium and 10 of 11 items of mandible of badgers showed sexual dimorphism (Table 2). These differences might be useful in differentiating sexes in both species.

The discrimination efficiencies of discriminant formulae between both sexes were lower in raccoon dogs, but higher in badgers, and which might be referable to more remarkable sexual differences in badgers. The fact that the efficiencies of those between both species have been 100% will be useful for distinguishing raccoon dogs from badgers. Further, in the present study, it was assumed that the greatest length of the cranium and mandible can be estimated from one measurement item by the regression formulae, which might

Table 5. The estimated formulae of the greatest length from the length, breadth and height of the crania and mandibles

	Raccoon dog		Badger	
	Estimated formulae	coefficient of determination	Estimated formulae	coefficient of determination
Basal length of cranium				
TL	$Y=-0.0291348X^2+7.26256X-344.567$	0.91	$Y=0.0455274X^2-8.67694X+501.08$	0.87
CL	$Y=-0.0043552X^2+1.86395X-47.9335$	0.98	$Y=-0.00252677X^2+1.51299X-33.6164$	0.99
NL	$Y=-0.0440596X^2+5.68464X-76.3079$	0.41	$Y=0.10359X^2-11.4215X+402.754$	0.67
FL	$Y=-0.0446443X^2+6.66412X-140.764$	0.66	$Y=0.112877X^2-10.3102X+323.992$	0.80
PL	$Y=0.0391574X^2-2.83342X+139.814$	0.61	$Y=0.0195486X^2-0.356394X+57.6376$	0.86
LPM	$Y=0.267733X^2-18.0555X+401.455$	0.45	$Y=0.0185639X^2+2.49231X+31.7053$	0.54
DAB	$Y=-0.126418X^2+6.87473X+21.5264$	0.57	$Y=1.30632X^2-57.2148X+717.505$	0.60
MB	$Y=0.253753X^2-17.7637X+408.798$	0.38	$Y=-0.117984X^2+13.7981X-306.407$	0.44
BAM	$Y=-0.11181X^2+10.7804X-151.757$	0.40	$Y=0.0244858X^2-1.26523X+104.503$	0.42
BOC	$Y=-1.08328X^2+52.0206X-521.752$	0.25	$Y=0.013719X^2+1.27809X+46.8946$	0.53
BJP	$Y=-0.276847X^2+18.1137X-191.984$	0.51	$Y=0.00843629X^2+1.44319X+29.0229$	0.54
HOT	$Y=0.0573762X^2-1.53007X+97.1214$	0.44	$Y=-0.536337X^2+36.6118X-527.547$	0.52
Total length of mandible				
LAI	$Y=-0.000864611X^2+1.05268X-0.343985$	0.96	$Y=0.0949605X^2-11.9041X+437.481$	0.90
LII	$Y=-0.00210235X^2+1.34066X-11.8469$	0.97	$Y=0.00868198X^2-0.113343X+37.419$	0.98
LCC	$Y=-0.00378739X^2+1.57295X-11.6972$	0.97	$Y=0.000703937X^2+1.11783X+1.7104$	0.95
LIC	$Y=-0.00652174X^2+1.9511X-22.9405$	0.94	$Y=-0.000171866X^2+1.2748X-2.35114$	0.93
LAC	$Y=0.00358899X^2+0.427465X+30.257$	0.93	$Y=0.0383454X^2-3.13652X+121.207$	0.82
LPM	$Y=0.0352522X^2-0.907475X+56.909$	0.70	$Y=0.547801X^2-31.23X+508.657$	0.57
HR	$Y=-0.0217529X^2+2.72692X+14.4368$	0.57	$Y=0.00200249X^2+1.0328X+36.9608$	0.52
HM	$Y=0.00155191X^2+2.5617X+50.6923$	0.40	$Y=-0.19571X^2+6.59273X+18.5023$	0.58
HP	$Y=0.485205X^2-5.48885X+90.196$	0.41	$Y=0.454256X^2-7.81925X+98.8572$	0.38

be applicable to the mammalian skeletal remains.

We will use the macroscopical observations and statistic differences at various measurement items in this study to identify excavated bones, and confirm their usefulness.

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