

Taxonomic Status of the Japanese Otter (Carnivora, Mustelidae), with a Description of a New Species

By

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Abstract A new species of the subgenus *Lutra* BRISSON, 1762, of the genus *Lutra* is described from Shikoku in Japan under the name of *L. nippon*. It is a primitive species with relatively long tail and long facial portion of cranium among the Eurasian species of the subgenus *Lutra*.

Since the otters in Japan were nearly exterminated during the Meiji Era (1867–1911) except for those in Shikoku, only a few specimens of the population for study have been preserved in the collection of the National Science Museum, Tokyo, Japan. Formerly, the senior author, IMAIZUMI (1949), had an opportunity to examine three fresh skins and two male skulls which were accidentally captured by fishing net of a fisherman in the Sea of Setonai-kai, off Kagawa Prefecture, and sent to the Institute for Ornithology and Mammalogy, Ministry of Agriculture and Forestry, Japan. He tentatively identified them with *Lutra lutra whiteleyi* (GRAY, 1867) described from Hokkaido, because they were different from any other forms occurring in eastern Asia, such as *L. l. lutra* (LINNAEUS, 1758) from Ussuri, *L. l. chinensis* GRAY, 1837, from southern China and *L. l. stejnegeri* GOLDMAN, 1936, from Kamchatka.

Unfortunately, the type specimens of *Lutronectes whiteleyi* were juveniles, so that IMAIZUMI considered that the differences in the sizes of postorbital process and others between GRAY'S description and the data of the newly obtained specimens were taxonomically not important. He strongly desired to examine adult skulls from Hokkaido, but was unable to find them in any collection in Tokyo. After that, he found a skull of otter (NSMT-M 872) which was registered without record of its locality in the early years of the Meiji Era in the collection of the National Science Museum, Tokyo. As this skull seems to be considerably different from the skulls of the Kagawa specimens and from those of *L. lutra lutra* from Ussuri and Sakhalin, he supposed that it might be *whiteleyi* obtained from Hokkaido (IMAIZUMI, 1975).

Meanwhile, the junior author, YOSHIYUKI, has examined, not only some newly obtained specimens of the otter in the collection of the National Science Museum, including several skulls from Shikoku, Tokyo, Kanagawa, Sakhalin and China, but also several specimens from Shikoku in the collection of the Ehime Prefectural Museum, many subfossil skulls excavated from the remains in Hokkaido, Miyagi, Chiba and Saitama Prefectures of Honshu in the collection of Professor Hiromasa

KANEKO, and similar subfossil specimens excavated from the Torihama Shell Mound in the collection of Wakasa History and Folklore Museum, Fukui (Table 1).

Professor Hayao NISHINAKAGAWA allowed us to use his original measurements of a mandible which was excavated from the Muginoura Shell Mound of Kagoshima Prefecture, and Professor Hiromasa KANEKO lent us his original data of measurements of materials from Kabukai Remains of Rebun Island off northern Hokkaido.

The authors carefully examined these specimens including two adult skulls of *whiteleyi* from Hokkaido, and came to the conclusion that the otters from Shikoku, Honshu and Kyushu are specifically different from *L. lutra* which contains *whiteleyi* as a subspecies, because they have several primitive characters in common and are not contained in the range of linear cline formed by subspecies of *Lutra lutra*. The unnamed species is described and discussed in the present paper.

We wish to express our hearty thanks to Professor Hiromasa KANEKO of Waseda University, Mr. Yasuhiro MITSUNAGA, Vice-director of Ehime Prefectural Museum, Mr. Katsuhiko AMITANI, Curator of Fukui Prefectural Wakasa History and Folklore Museum, Mr. Sadao KOIKE, and Professor Hayao NISHINAKAGAWA, who kindly gave us opportunities of studying the invaluable materials of the Japanese otters.

Lutra nippon sp. nov.

[Japanese name: Nihon-Kawauso]

(Figs. 1-6)

Lutra lutra lutra (in part, not of LINNAEUS, 1758): KISHIDA, 1924, Monogr. Jpn. Mamm., 259. — MATSUMOTO, 1930, Sci. Rept. Tôhoku imp. Univ., Ser. 2, 13, 78.

Lutra lutra whiteleyi: IMAIZUMI, 1949, Nat. Hist. Jpn. Mamm., 182.

Holotype. NSMT-M16201, adult female, mounted skin and skull, obtained from the Nenokubi Seaside, Shimoda, Nakamura City, Kôchi Prefecture, by the late Mr. Yasuo TSUJI, on 30th March 1972. The holotype is preserved in the Mammal Section, Department of Zoology, National Science Museum, Tokyo.

Measurements of the holotype (in mm). Head and body 665, tail 452, hind foot sine unguis 117.5, ear 21 (from crown 12), manus cum unguis 84, body weight 5.7 kg, codylobasal length 113.4, zygomatic width 73.1, mastoid width 64.3, interorbital constriction 21.8, width across postorbital processes 27.6, postorbital constriction 14.6, canine width 28.8, palatal length 48.3, greatest length of bulla with paroccipital process 28.2, width across M1-M1 (alveoli) 36.6, length of C-M1 (crown) 34.2, length of I3-M1 (crown) 41.7, length of mandible 73.2, length of c-m1 (crown) 41.8, length of lower i3-m1 (crown) 43.2.

Specimens examined. See Table 1 and Fig. 1.

Diagnosis. Large and less advanced otter of the subgenus *Lutra*, as large as or larger than the largest subspecies of *Lutra lutra* both in head and body length and codylobasal length of skull in females, with relatively long tail. Skull similar to

Table 1. Examined materials of *Lutra nippon* sp. nov. and *L. l. whiteleyi* (GRAY, 1867).

| Collection no. | Sex | Age | Collecting site |
|--|-----|--------|---|
| <i>Lutra nippon</i> | | | |
| NSMT-M16201 (type specimen) | ♀ | adult | The Nenokubi Seaside, Shimoda, Nakamura City, Kôchi Prefecture (mounted skin and skull) |
| NSMT-M303 | ?♀ | subad. | Tokyo (skull) |
| NSMT-M5270 | ♀ | adult | Matsuyama City, Ehime Prefecture (skull) |
| NSMT-M17323 | ♀ | adult | Ofujishima, Sukumo City, Kôchi Prefecture (skull and skin of head) |
| KOIKE's Coll. | ?♀ | adult | Hatano City, Kanagawa Prefecture (cranium) |
| KANEKO's Coll. | ?♀ | adult | Ôtubo, Futtsu City, Chiba Prefecture (cranium) (early Jômon, about 6,000 years ago) |
| Ditto | ? | adult | The Ohi Shell Mound, Shiogama City, Miyagi Prefecture (mandible) (early Jômon, about 6,000 years ago) |
| Ditto | ? | adult | The Hebikiri Shrine Cave, Tateyama City, Chiba Prefecture (mandible) (latest Jômon, about 3,500 years ago) |
| Ditto | ? | adult | The Ishigaki Shell Mound, Kawaguchi City, Saitama Prefecture (cranium) (latest Jômon, about 3,000 years ago) |
| Collection of Ehime Prefectural Museum | ? | subad. | Uchiumi-mura, Ninamiuwa-gun, Ehime Prefecture (mounted skin) |
| Ditto | ♂ | adult | Kushu, Kita-gun, Ehime Prefecture (skeleton) |
| Ditto | ♂ | juv. | Ehime Prefecture (skull) |
| Collection of Wakasa History and Forklore Museum | ? | ? | Torihama remains, Torihama, Mikata-machi, Mikata-gun, Fukui Prefecture (fragments of five crania and six mandibles) (early Jômon) |
| <i>Lutra l. whiteleyi</i> | | | |
| NSMT-M872 | ? | adult | Hokkaido (skull) |
| KANEKO's coll. | ? | adult | Tokoro Remains, Tokoro-chô, Tokoro-gun, Hokkaido (cranium) (Okhotsk culture, about the Heian Era) |

Lutra lutra in general aspect but massive and with long facial portion, about 56.5 mm, long interorbital region, strongly developed postorbital process, short free portion of palate, and small auditory bullae combined with paroccipital process. Foramen ovale posterior in position, and posterior lacerated foramina widely separated. Inner lobe of P4, protocone, relatively small, with its anterior border extending to posterior base of anterior cusp of the outer blade.

Description. External characters. General form similar to that of *Lutra lutra*, but tail longer than in *L. l. lutra*, *chinensis*, *kutab*, *hainana*, and *whiteleyi*, tail percent, ratio of tail length against head and body length, 68% in the holotype (♀), 65% in a male from Kagawa (IMAIZUMI, 1949) and 70% and 60% in two males from Kyoto and Shimane (KISHIDA, 1924) in larger than 55.4% of *lutra* (after MILLER, 1912), 60.5% of *chinensis* (after YAOTING, 1987), and 57.1% of *whiteleyi* (after GRAY, 1867).

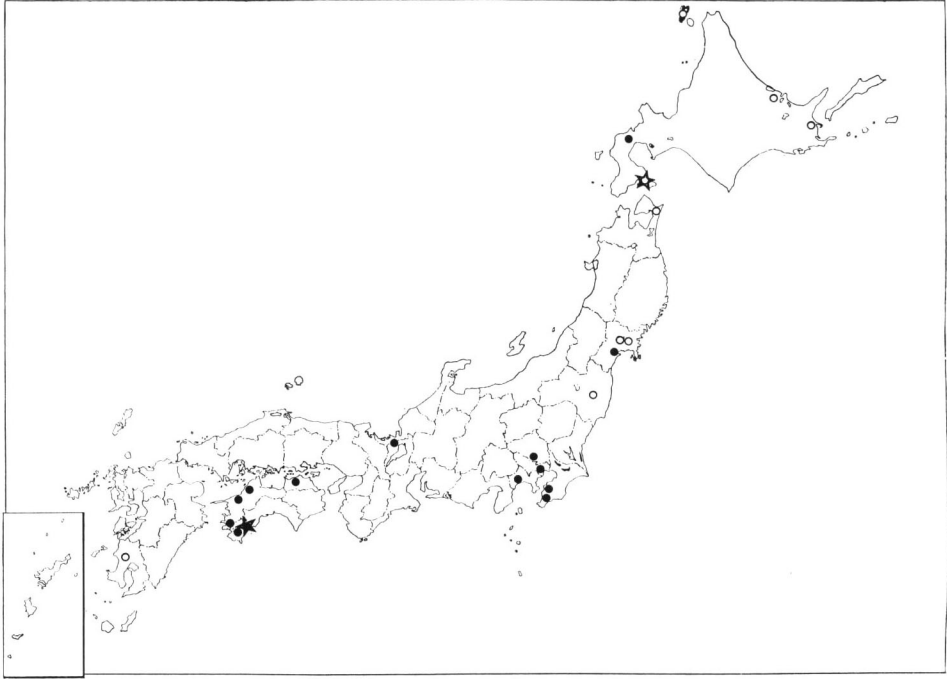


Fig. 1. Map showing the geographic range of *Lutra nippon* sp. nov. and *Lutra lutra whiteleyi*. ● Localities based on the specimens examined. ○ Localities from other records. ★ Type localities.

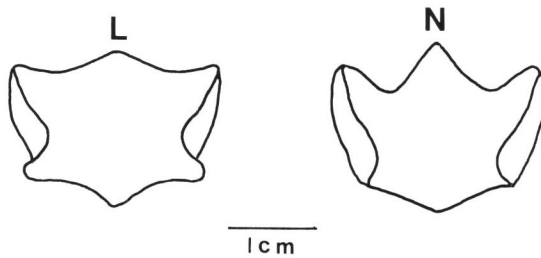


Fig. 2. Rhinalia of *Lutra lutra lutra* [L] and *Lutra nippon* [N].

Rhinalium, nostril pad, entirely naked and large, its breadth about 23 mm, its length about 18 mm, with upper margin strongly convex at centre and both sides, forming W-shaped pattern, its lower border slightly but evidently convex at centre, with small ala nasi, lateral protuberances of lower border, much smaller than that of *lutra* (Fig. 2); claws of the longest finger of manus about 13 mm, that of hind foot about 10 mm.

Fur short, glossy, dorsal hair consists in guard hair and wooly hair, the longest hair about 16 mm, dark brown in colour with light beige distal and proximal portions;

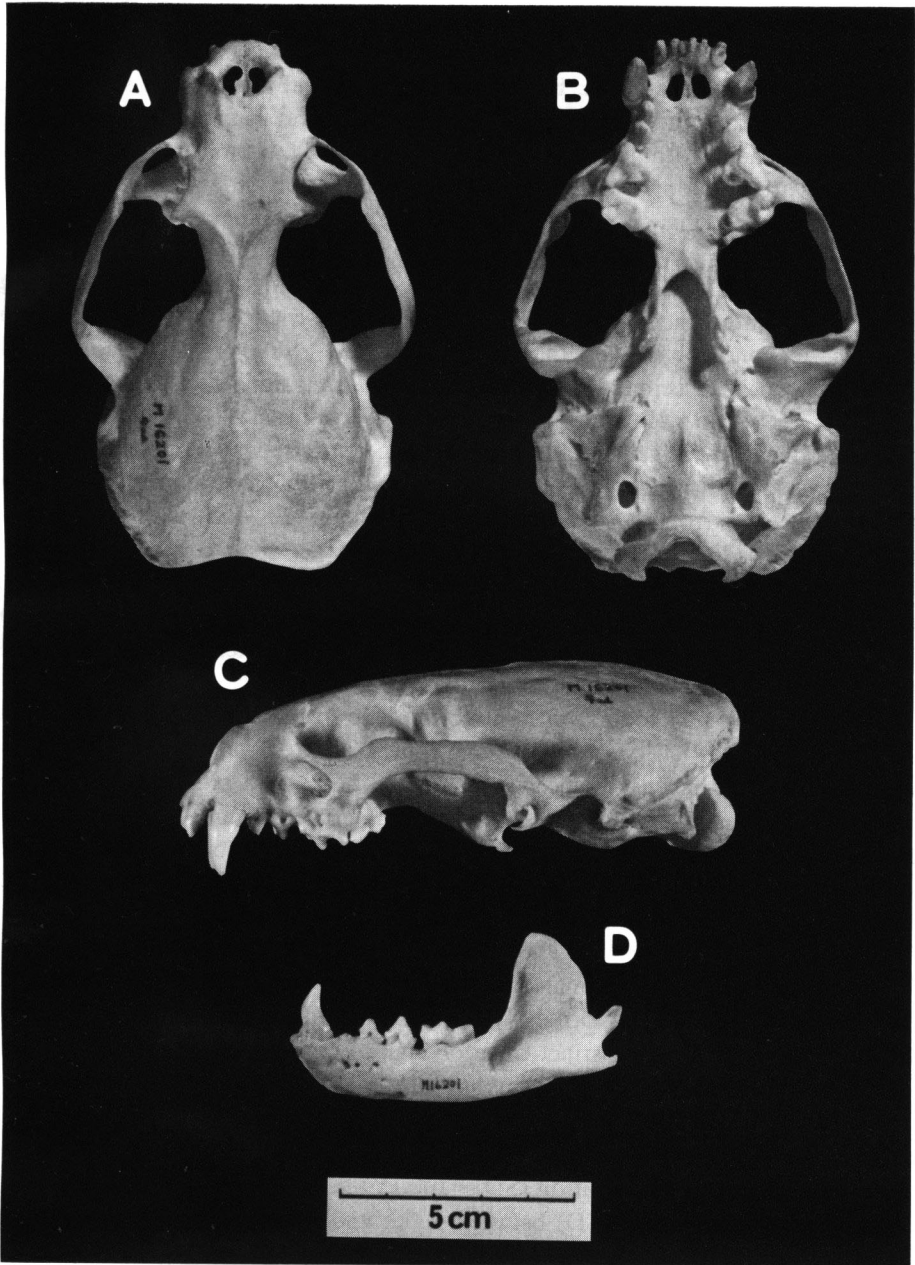


Fig. 3. Skull of *Lutra nippon* sp. nov., holotype, NSMT-M 16201, adult female. — A, Dorsal aspect of cranium; B, ventral aspect of cranium; C, lateral aspect of cranium; D, lateral aspect of mandible.

general colour of dorsal surface frosted dark brown, ventral surface with much whitish hairs, its general colour greyish brown, thorax washed by cinnamon, under hair of throat and posterior neck pale beige, hairs of upper lip pure white from tips to bases, cheeks and lateral necks whitish, but boundaries of lateral and ventral sides obscure, upper surfaces of fore and hind feet covered with short and rough hairs.

Skull. General form similar to that of *Lutra lutra*, but more massive, especially in zygomatic arch, its dorso-ventral breadth at middle portion extending to 6.5 mm; facial portion rather long, 56.5 mm in the holotype and 55.2 mm (average of 6 females) against 51.3 mm (N=4) in European *L. l. lutra* and 50.6 mm (N=3) in Ussuri *L. l. lutra* in both females. Facial ratio, that is, ratio of facial length (OGNEV, 1931), length from median point at the least width of postorbital constriction to anterior margin of premaxilla, to condylobasal length, $49.1 \pm 0.81\%$ (M \pm SD, N=5), against $46.4 \pm 1.26\%$ of European specimens (OGNEV, 1931, N=9), but similar to the ratio of Ussuri (47.9 ± 0.95 , N=4) and Hokkaido populations (49.7 and 51.8%, N=2) (Figs. 3, 5 and 6). Braincase relatively small; postorbital constriction at about the level of the middle of dorsal skull length; interorbital and postorbital constrictions broad; post-orbital processes of frontals thicker and longer than in *L. lutra*, width across post-orbital processes 26.4 ± 1.24 mm (M \pm SD, N=6) larger than rostrum width or as wide as the latter and about 32% of mastoid width; free portion of palate behind upper molars rather short; glenoid fossa deep, and postglenoid process well developed both in breadth and height. Foramen ovale distinctly posterior to glenoid fossa; auditory bulla relatively small and not swollen.

Teeth. Teeth small, the upper incisor similar to that of *L. lutra*, crown areas of I1 and I2 similar, P1 very small with one root, P2 and P3 subequal and partly imbricate, P4 triangular in ventral aspect, its inner lobe, protocone, rather small, its greatest length 7.0 mm, about 65% of the length of outer blade, 10.8 mm, anterior border of inner lobe extending to proximal base or neck of anterior cusp of outer blade, instead of directly extending to anterior cusp as in *L. lutra*; M1 quadrate in ventral aspect, with distinct paracone, metacone, protocone and hypocone, but the hypocone is rather weak.

Remarks. In *Lutra lutra* males are much larger than females in condylobasal length (after OGNEV, 1931). OGNEV (1931) has pointed out that males of *L. lutra* are different from females by a distinct trace of sagittal crest which is completely absent in females. Condylobasal length (in mm) in *L. lutra* from Europe, Ussuri and Kamtchatka is as follows.

Mean (M) \pm Standard deviation (SD)= 118.91 ± 3.514 , N=26 (♂♂)

Mean (M) \pm Standard deviation (SD)= 108.15 ± 2.794 , N=12 (♀♀)

Coefficient of difference (CD) between males and females in condylobasal length of *L. lutra*=1.706. The CD indicates that more than 95% of females is different from more than 95% of males. The condylobasal length of females belonging to Asiatic subspecies of *Lutra lutra* constitutes a linear cline when arranged correctly according to temperature index X. The index X=1 means that the average tem-

Table 2. Cranial measurements of *Lutra nippon* sp. nov.

| Specimen number | Sex | Age | Loc. | CBL | ZYG | MAST | BCB | BCD | IOC | POC |
|-------------------|-----|--------|----------|-------|------|------|------|------|------|------|
| NSMT-M16201, type | ♀ | adult | Kôchi | 113.4 | 73.1 | 64.3 | 54.2 | 34.9 | 21.8 | 16.4 |
| NSMT-M303 | ♀ | subad. | Tokyo | 109.3 | 67.3 | 59.7 | 52.5 | 34.7 | 21.1 | 12.4 |
| NSMT-M5270 | ♀ | adult | Ehime | 114.3 | 70.5 | 60.8 | 50.0 | 35.8 | 21.0 | 13.2 |
| NSMT-M17323 | ♀ | adult | Kôchi | 112.6 | 72.6 | 62.7 | 57.3 | 35.0 | 22.3 | 13.9 |
| KANEKO | ♀ | adult | Chiba | 110.3 | 69.9 | 63.1 | 52.3 | 34.7 | 21.1 | 14.4 |
| KOIKE | ♀ | adult | Kanagawa | 115.4 | 70.8 | 64.5 | 56.0 | 37.7 | 22.6 | 14.7 |
| Ehime Mus. | ♂ | juv. | Ehime | 103.5 | 59.9 | 56.4 | 51.3 | 34.5 | | |
| Ditto | ♂ | adult | Ehime | 116.6 | 74.1 | 69.9 | | | | |

Abbreviations: CBL—condylobasal length of skull without I; ZYG—zygomatic breadth; MAST—mastoid breadth; BCB—breadth of braincase; BCD—depth of braincase at middle; IOC—interorbital constriction; POC—postorbital constriction.

Table 3. Cranial and dental measurements of *Lutra nippon* sp. nov.

| Specimen number | Sex | Age | ABL | C-C | M1-M1 | C-M1 | I3-M1 | MAND | c-m1 | i3-m1 |
|-------------------|-----|--------|------|------|-------|------|-------|------|------|-------|
| NSMT-M16201, type | ♀ | adult | 28.2 | 28.8 | 36.6 | 34.2 | 41.7 | 73.2 | 41.8 | 43.2 |
| NSMT-M303 | ♀ | subad. | 29.0 | 26.4 | 34.0 | 34.1 | 39.5 | 66.2 | 40.7 | 40.8 |
| NSMT-M5270 | ♀ | adult | 27.0 | 22.2 | 34.2 | 33.4 | 39.9 | 69.2 | | |
| NSMT-M17323 | ♀ | adult | 28.1 | 32.1 | 37.1 | 38.7 | 41.4 | 69.9 | 42.1 | 44.9 |
| KOIKE | ♀ | adult | 31.6 | 28.3 | 35.6 | 35.2 | | | | |
| KANEKO | ♀ | adult | 29.9 | 27.3 | 35.4 | 35.3 | 41.1 | | | |
| KANEKO | ? | adult | | | | | | 67.9 | | 39.6 |
| KANEKO | ? | adult | | | | | | 79.9 | | 45.7 |
| Ehime Mus. | ♂ | juv. | | 25.2 | 32.4 | | | 64.1 | 40.3 | |
| Ehime Mus. | ♂ | adult | | 32.9 | 36.8 | | | 80.9 | 41.6 | |

Abbreviations: ABL—auditory bulla; C-C—width across upper canines (alveoli); M1-M1—distance of first upper molars (alveoli); C-M1—length of maxillary tooth row (crown); I3-M1—total upper tooth row (crown); MAND—mandible without i; c-m1—length of lower tooth row (crown); i3-m1—total lower tooth row (crown).

Table 4. Female mean values of the condylobasal length in subspecies of *Lutra lutra* and temperature index.

| Subspecies | Reference | Condylo-basal l. | N | Temperature index |
|---------------------------------------|--------------|------------------|----|-------------------|
| <i>L. l. monticola</i> HODGSON, 1839 | POCOCK, 1941 | 112.5 | 1 | 15 |
| <i>L. l. lutra</i> (LINNAEUS, 1758) | OGNEV, 1931 | 108.2 | 12 | 15 |
| <i>L. l. meridionalis</i> OGNEV, 1931 | OGNEV, 1931 | 108.0 | 2 | 13 |
| <i>L. l. chinensis</i> GRAY, 1837 | POCOCK, 1941 | 104.2 | 3 | 8 |
| <i>L. l. nair</i> F. CUVIER, 1823 | POCOCK, 1941 | 102.0 | 1 | 5 |
| <i>L. l. barang</i> F. CUVIER, 1823 | POCOCK, 1941 | 98.5 | 2 | 2 |

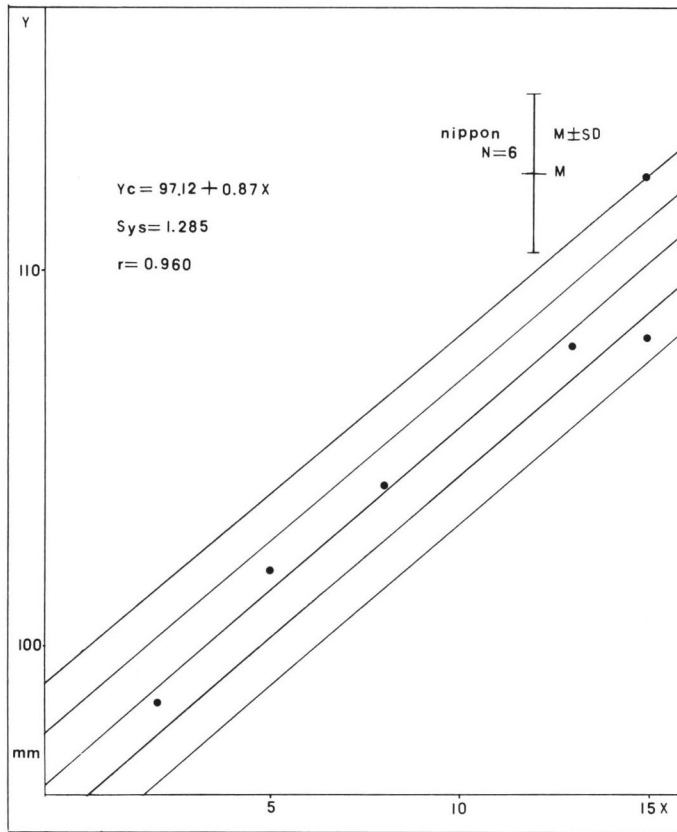


Fig. 4. Relationships in mean values of female condylobasal length between *Lutra nippon* and the cline of *Lutra lutra* ($Y_c \pm 2S_{ys}$). Vertical line indicates the range of $M \pm SD$ of condylobasal length of *Lutra nippon*. X-axis: Temperature index. Y-axis: condylobasal length.

perature of January in the habitat of the specimen is about 27–28°C, $X=2$ is about 25–26°C, and $X=15$ is about 0°C or less. We examined the correlation between condylobasal length and temperature index based on 21 specimens (Table 4), and obtained the following results:

$$Y_c = 97.12 + 0.87X$$

$$S_{ys} = 1.285$$

$$r = 0.960$$

The range of $Y_c \pm 2S_{ys}$ of this linear cline (Fig. 4) indicates that about 95% of condylobasal length of females belonging to the species *L. lutra* are contained in it.

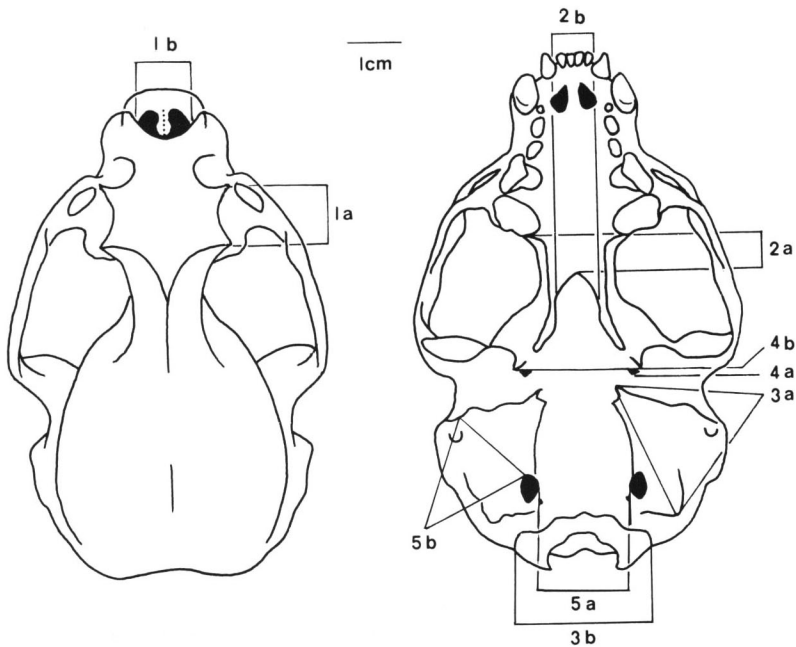


Fig. 5. Cranial characters of *Lutra nippon* sp. nov. — 1a, Length of interorbital region; 1b, inner breadth of anterior naris; 2a, length of free portion of palate; 2b, breadth of mesopterygoid fossa at middle; 3a, greatest length of auditory bulla including paroccipital process; 3b, greatest breadth across occipital condyles; 4a, foramen ovale; 4b, level of posterior surfaces of glenoid fossa; 5a, breadth between posterior lacerated foramina; 5b, distance from posterior lacerated foramen to lower border of external auditory meatus.

However, most females of *Lutra nippon* are out of the range of *L. lutra* as shown in Fig. 4. This means that this form is not a subspecies of *L. lutra* but an independent species.

For the discrimination of this species, the following six features may be useful (Table 5, Fig. 5). The condition expressed by the type of *L. nippon* seems to be in less advanced stage of evolution than in *L. l. whiteleyi* (GRAY, 1875) and other forms of *L. lutra* (LINNAEUS, 1758).

Also, relatively long tail, longer facial and interorbital region, generally, strongly developed postorbital process, rather short free portion of palate, relatively small auditory bulla, thick zygomatic bridge and rather small braincase of *Lutra nippon* indicate that the species is in a less advanced stage of evolution than *Lutra lutra*.

1. Antero-posterior diameter of interorbital region, namely the distance from the posterior end of anteorbital recess to the most anterior point of temporal ridge forming posterior border of postorbital processes, is longer than the largest inner diameter of anterior naris.

2. Median length of free portion of palate, behind posterior border of alveolus

of M1, is shorter than the breadth of mesopterygoid fossa at the middle portion.

3. Greatest length of auditory bulla, including paroccipital process, is shorter than the greatest breadth across occipital condyles.

4. Foramen ovale lies posterior to the posterior wall of articular surface of glenoid fossa.

5. Breadth between posterior lacerate foramina is longer than the least distance from the foramen to lower border of external auditory meatus.

6. Anterior border of inner lobe (protocone) of P4 does not extend to the anterior cusp of outer blade but attaches to its neck.

Table 5. Important characters for discrimination of *Lutra nippon*.

| Char- acters | <i>L. nippon</i> | | | | | | <i>L. l. whiteleyi</i> | | <i>L. l. lutra</i> | | <i>L. l. monticola</i> |
|-----------------|------------------|-----|------|-------|-----|------|----------------------------|------|------------------------|-----|----------------------------|
| | Type | 303 | 5761 | 17321 | KOI | KANE | 872 | KANE | MIL | HAR | POC |
| 1 | + | + | + | + | + | + | - | - | - | - | - |
| 2 | + | + | + | + | + | + | - | - | - | ± | - |
| 3 | + | + | + | + | + | + | - | - | - | - | + |
| 4 | + | + | + | + | + | + | - | - | - | - | - |
| 5 | + | ± | + | + | + | + | - | - | - | - | - |
| 6 | + | ± | + | + | + | + | - | - | - | - | - |

Marks and abbreviations: + same, - different, ± intermediate; KOI—KOIKE's coll.; KANE—KANEKO's coll.; MIL—MILLER, 1912; HAR—HARRIS, 1968; POC—POCOCK, 1941.

Key to the Species of the Subgenus *Lutra* in Eurasia

1. Rhinalium entirely covered with hairs. *Lutra sumatrana*
(Type locality: Sumatra. Range: Sumatra, Peninsular Siam, Malay States, North Borneo, Assam)
2. Rhinalium entirely naked.
 - 2a. Ala nasi of rhinalium well developed (Fig. 2); tail percent 53–60% foramen ovale at a level of glenoid fossa, internal lobe of upper fresh-tooth P4 large. *Lutra lutra*
(Type locality: Upsala, Sweden. Range: Europe, European Russia, Siberia, Central Asia, China, Formosa, Korea, Hokkaido, Ceylon, India, Burma, Assam, Sumatra, Persia, Palestine, Morocco and Algeria)
 - 2b. Ala nasi of rhinalium only slightly developed (Fig. 2); tail percent 60–70%; foramen ovale posterior to the level of glenoid fossa, internal lobe of upper fresh-tooth P4 small. *Lutra nippon*
(Type locality: as mentioned in the description. Range: Honshu, Shikoku and Kyushu).



Fig. 6. Crania of *Lutra nippon* and *Lutra lutra whiteleyi*; dorsal and ventral aspects. — A, C: Type of *Lutra nippon* from Kôchi Pref. B, D: *Lutra lutra whiteleyi* from Hokkaido (KANEKO's collection).

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