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Mammals of Korea: a review of their taxonomy, distribution and conservation status

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Abstract

The Korean Peninsula and its associated Pacific islands have a distinctive, yet poorly studied mammalian fauna. Korea was a land of invasions and wars for many centuries. The loss of large mammals per unit area that has occurred in Korea may have been greater than in any other country. The peninsula has a depauperate rodent community. The forests are mostly harvested, replaced by intensive agriculture. Unfortunately, the dissemination of information about the mammals of Korea and their taxonomy has been limited because most publications were written in Japanese or Korean. We provide an updated checklist of all the species of Korean mammals, including a review of their taxonomy, distribution, and conservation status based on information extracted from international museum collections, local survey databases (Wildlife Survey and National Nature-Environmental Survey, South Korea) and a literature review. We identify 84 species of terrestrial mammals and 43 species of marine mammals that occur, or once occurred, in Korea. Due to previous, erroneous identifications, we delisted three soricids, two vespertilionids, one phocid, one sciurid and one murid. In total, we confirm the presence in Korea of 127 species of mammals distributed in eight Orders and 32 Families. We provide dichotomous keys for the identification of all the Korean species of mammals together with updated distribution maps.

Key words: Checklist, Conservation status, Distribution map, Identification Key, Korean mammals

Introduction

The first listing of mammals from Korea did not occur until the late 19th century (Won & Smith 1999). Later, Korean mammalogy gradually progressed through two major distractions from fieldwork: the Japanese invasion (1910–1945) and the Korean War (1950–1953). Although the first Korean mammal (*Crocidura lasiura*) was reported in 1887 with 47 birds and 3 reptile species (Giglioli & Salvadori 1887), the first studies of the mammalian fauna reported by western scientists came through zoological expeditions: the Duke of Bedford Zoological Exploration, the Far East Asian Expedition by the British Museum and Roy Chapman Andrews expedition (Thomas 1906, 1907b, Allen & Andrews 1913). Following these investigations, Japanese mammalogists actively investigated the mammalian fauna during the occupation of Korea (1910–1945). A checklist of the mammals of Korea and Japan reported new and rare mammals (Kuroda & Mori 1923). Kishida and Mori (1931) described distributions and applied three ecotypes (austral, boreal and oriental) in a checklist of terrestrial mammals. Kuroda (1939) delineated the taxonomy of 51 species of terrestrial mammals and five subspecies.

During the Korean War, hemorrhagic fever became problematic among UN soldiers. Medical personnel from the United States developed interest in small mammals as vectors of the disease. J. Knox Jones, Jr., a U.S. Army medical officer from the Armed Forces Epidemiological Board, collected small mammals in South Korea in 1954–1955 and deposited them in the Smithsonian Museum of Natural History and University of Kansas Natural History Museum. He published papers with David H. Johnson, curator of mammals at the National Museum of Natural History on Korean mammals, especially the taxonomy and systematics of rodents, lagomorphs and insectivores (Johnson & Jones 1955a, b; Jones 1956; Jones & Johnson 1955, 1956, 1960, 1965). In these reports, they revised the taxonomic status of most small mammals in Korea.

After the Korean War, mammalogists from Korea began field collections that formed the foundation of modern mammalogy in Korea. Won (1967) in South Korea and Won (1968) in North Korea published lists of the mammals of Korea with identification keys. During 1971 to 1992, the Cracow Institute of Systematics and Evolution of Animals of the Polish Academy of Sciences conducted 15 zoological expeditions to North Korea that resulted in the collection of 340 specimens of mammals on seven excursions, which were deposited in the Institute (Pawlowski & Tomek 1997). Based on these assemblages, Nadachowski *et al.* (1982) analyzed the zoogeographic patterns of the terrestrial vertebrates in the Korean Peninsula, and Nadachowski (1984) listed 10 species of small mammals. In addition to the Polish expeditions, the Hungarian Natural History Museum also collected specimens of animals in North Korea (Báldi & Waliczky 1992).

Since the 2000s, both North and South Korea acknowledged a severe decline of wildlife (including mammals). North Korea published a Red Data Book of Animals in 2002 (UNESCO's Man and the Biosphere Program [MAB], National Committee of DPR Korea 2002), and South Korea issued a Red Data Book of mammals in 2012 (National Institute of Biological Resources [NIBR] 2012). In addition, several books were published in Korean such as *The Wildlife of Korea* by Yoon (1992), *The Wild Mammals of Korea* by Yoo (2000), *The Mammals of Korea* by Won (2004), and *Illustrated Encyclopedia of Wildlife* by Choi & Choi (2007). Unfortunately, recent taxonomic changes

based on molecular studies have rarely been taken into consideration on such lists since Won and Smith (1999). As a result, governmental agencies established and followed their taxonomy, instead of an internationally accepted taxonomic reference such as Nowak (1999) or Wilson and Reeder (2005). This use of non-standardized taxonomy by governmental agencies led to confusion in the scientific names and systematics of the mammals from the Korean Peninsula and its associated waters.

We review the taxonomy, distribution and status of native and nonindigenous species and subspecies of mammals currently inhabiting Korea. Our purpose is to produce a benchmark that will become the standard for the taxonomy of the mammals of Korea. Korea, as used here, includes both South (Republic of Korea) and North (Democratic People's Republic of Korea) Korea and all islands associated with these governmental entities (Fig. 1). The taxonomy generally follows the third edition of *Mammals of the World* (Wilson & Reeder 2005). We organized the nomenclatorial hierarchy as Order, Suborder, Family, Subfamily, Genus, Species and Subspecies. Any linear classification communicates only a limited amount of the existing knowledge on phylogenetic relations. The sequence of orders and families used here reflects the latest revisions based on recent peer-reviewed discoveries in paleontology, molecular phylogenetics, ethology, cladistics, phylogeography, biogeography, zootaxa, paleomammalogy, archaeozoology and other approaches to biological classification.

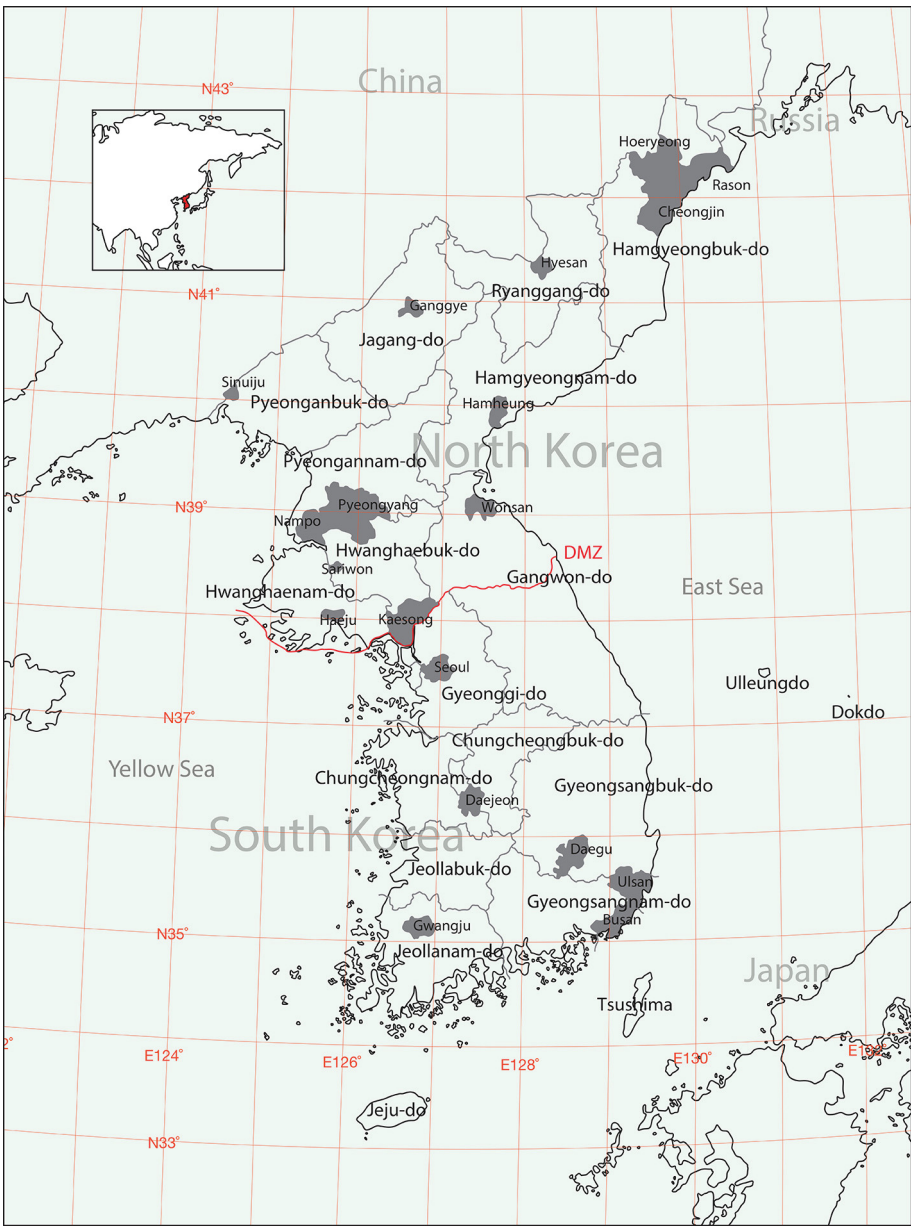

FIGURE 1. Administrative map of Korea.

Accounts of species

Since the publication of the accounts of Korean mammals (Won 1967, 1968), many significant taxonomic and nomenclatorial changes have appeared in the scientific literature. We compiled data on the mammals of Korea primarily from peer-reviewed publications, museum specimens and fieldwork conducted in Korea. Most accounts begin with a statement of the genus, species and standard English common name (capitalized first letter) accepted by professional mammalian societies and other common names (first letter lower case) used worldwide, regionally or nationally. The account continues with information on the distribution, followed by the conservation status if appropriate and remarks about habitat, subspecies, genetics and items of interest.

Distribution data were obtained from the following museum collections: the National Institute of Biological Resources Korea (NIBR), the Smithsonian National Museum of Natural History, the Science Museum Tokyo and the Yamashina Institute for Ornithology. We used data from the Second and Third National Environmental Survey by the Ministry of Environment Korea (electronic data from 'www.me.go.kr') to determine mammalian distributions in South Korea. We combined all wildlife survey data by NIBR (unpublished data from 1956 to 2014). We merged IUCN Red List data (www.iucnredlist.org) with data from the primary literature to attain the distribution of mammals in regions neighboring Korea. Since public and published information on mammalian collections and research in North Korea lack continuity, we communicated with scholars and governmental officers from North Korea to obtain information on the distribution of mammals.

Key to orders of mammals in Korea

1	Tetrapod body; 4 limbs (or flippers) present; nostril at front of head; hair present	2
-	Fusiform body; posterior limbs repressed (vestigial); nostrils on dorsal surface of head; hairless	Cetacea
2	Toes with hoof	Artiodactyla
-	Hoof absent	3
3	Manus with membranes forming wing	Chiroptera
-	Wing membrane absent in manus	4
4	Upper and lower incisors chisel shape; canine teeth absent	5
-	Upper and lower incisors not chisel shape; canine teeth present	6
5	Upper incisors 2 pairs (2/1)	Lagomorpha
-	Upper incisors 1 pair (1/1)	Rodentia
6	Canine elongated; well-developed claws on all digits	Carnivora
-	Canine unspecialized; claws small	7
7	Dorsal hair modified spines	Erinaceomorpha
-	Both dorsal and ventral pelage soft fur	Soricomorpha

ORDER LAGOMORPHA Brandt, 1855

Mammalogists previously united Lagomorpha with Rodentia as a single order (Carleton & Musser 2005). These two orders were frequently considered as a single cohort (Glires; Landry 1999) that diverged into two orders at the Cretaceous-Paleogene boundary (Huchon *et al*. 2002).

The order Lagomorpha in Korea contains two families, two genera and three species. Lagomorphs in the Family Ochotonidae only inhabit extreme northern Korea (southern limit is Mt. Myohyang), whereas, members of the Leporidae commonly occur throughout the Korean Peninsula.

Key to families of Lagomorpha in Korea

-	External tail absent; ears no longer than wide	Ochotonidae
-	Short tail present; ears longer than wide	Leporidae

Family OCHOTONIDAE Thomas, 1897

This family was previously named as Lagomyidae (Corbet 1978). The Family Ochotonidae in Korea contains a single species. This family only inhabits the high mountains in extreme northern Korea.

Genus *Ochotona* Link, 1795

Ochotona is a single genus in the Family Ochotonidae. Only the species *O. coreana* occurs in Korea.

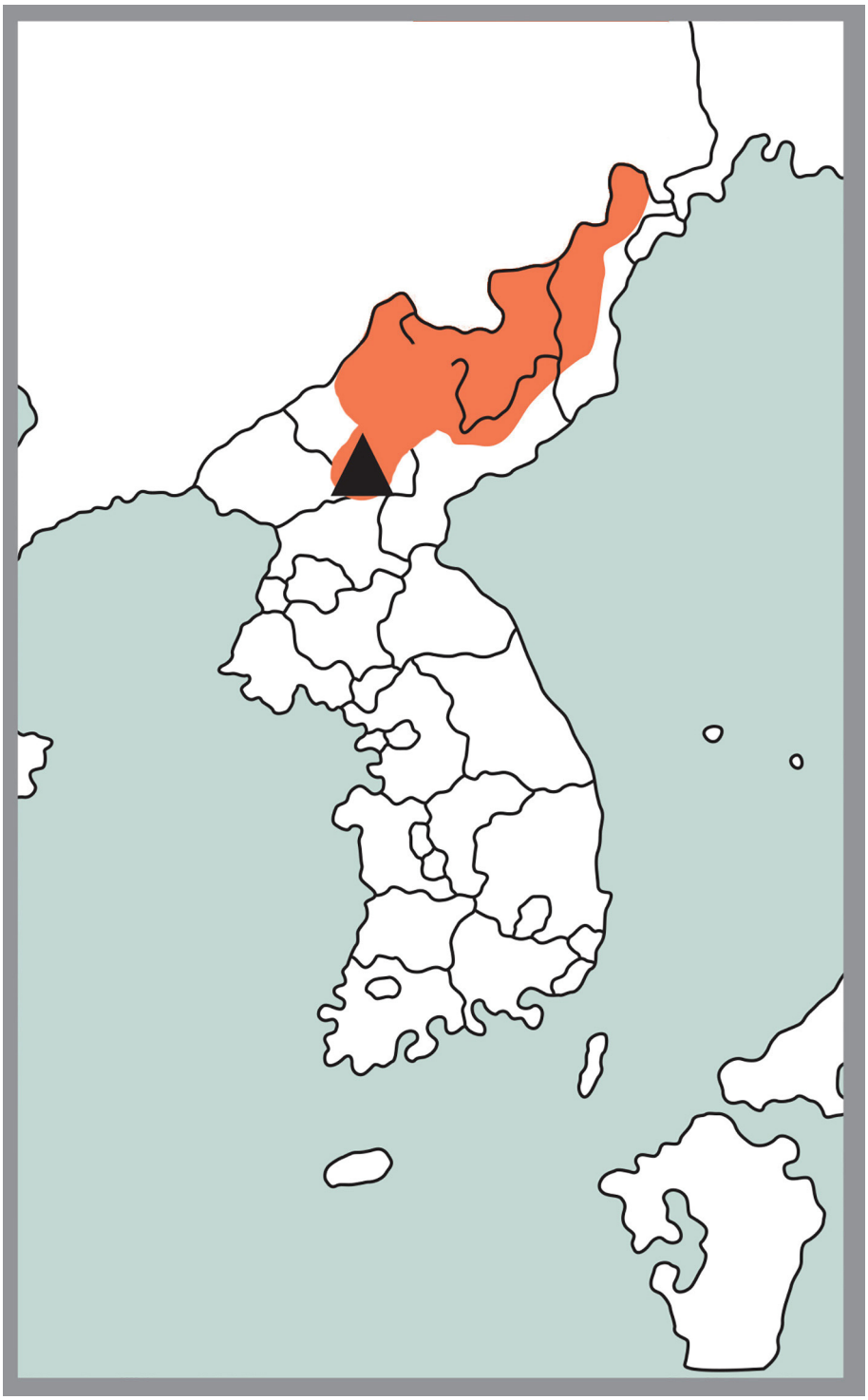

FIGURE 2. Range map of *Ochotona coreana* in Korea.

Ochotona coreana Allen and Andrews, 1913—Korean Pika

Ochotona (*Pica*) *coreanus* Allen and Andrews, 1913 p.429; Type locality- Pochong, North Korea.
O. hyperborea coreana: Kuroda, 1938 p.42; Tate, 1947 p.209; Ellerman & Morrison-Scott, 1951 p.455; Jones & Johnson, 1965 p.361; Won, 1958 p.443; Won, 1967 p.157; Won & Smith 1999 p.28.
O. alpina coreana: Won, 1968 p.141.
O. alpine: Corbet, 1978 p.69.
O. alpina alpine: Corbet, 1978 p.69; Yoon, 1992 p.59.
O. hyperborea: Han, 1994 p.46; Won & Smith, 1999 p.28; Han, 2004b p.97.
O. coreana: Smith & Jo, 2018 p.39.

Range: The distribution of Korean pika extends throughout northern alpine, talus habitats near Hamgyeongbuk Province, Hamgyeongnam Province, Ryanggang Province and Jagang Province in North Korea (Won 1968; Kim *et al.* 2015; Fig. 2). With a recent report of the species at Mt. Myohyang, (Smith & Jo 2018a) the distribution of Korean pika in Korea is expanding.

Remarks: The Korean pika was formerly considered a subspecies of the northern pika, *O. hyperborea* (Jones & Johnson 1965). However, Lissovsky *et al*. (2008) proposed elevating *O. h. coreana* to the species level based on analysis of the cytochrome *b* gene. Despite morphological similarity with sibling species, Lissovsky (2014) suggested *O. coreana* as a species with the provision that the taxonomic status depended on the application of the species concept.

Conservation status: In 1980, North Korea designated the habitat at Sanyang, Beagam County, Ryanggang Province a Natural Monument. North Korea classified this species as 'Rare' in the Red Data Book (MAB National Committee of DPR Korea 2002).

Family LEPORIDAE Fischer, 1817

In Korea, the Family Leporidae contains two species of the Genus *Lepus*, *L. coreanus* and *L. mandshuricus*. These two species have often been confused (Jones & Johnson 1965). *Lepus coreanus* is present in most of Korea, while *L. mandshuricus* occupies the northern border regions between Korea and China.

Genus *Lepus* Linnaeus, 1758

Hoffmann and Smith (2005) identified 13 subgenera in the Genus *Lepus;* two species of one Subgenus *Eulagos* Gray, 1867 occur in Korea.

Key to species of Genus *Lepus* in Korea

- Pelage coarse; grayish black to blackish brown dorsally and breast, flank, and legs are cinnamon; bullae slightly smaller (almost equal) than basioccipital. . . . . *L. coreanus*
- Pelage soft; dorsally dark gray (rarely melanistic) and breast, flanks, and legs pinkish cinnamon; bullae smaller than basioccipital (Fig. 3). . . . . *L. mandshuricus*

Lepus coreanus Thomas, 1892—Korean Hare

Lepus sinensis coreanus Thomas, 1892 p.146; Type locality-Seoul; Ellerman & Morrison-Scott, 1951 p.442; Won, 1958 p.443; Won, 1967 p.159; Corbet, 1978 p.73; Yoon, 1992 p.62.
L. coreanus: Thomas, 1906 p.865; Jones & Johnson, 1965 p.362; Han, 1994 p.46; Won & Smith, 1999 p.28; Han, 2004b p.99.
L. sinensis: Ellerman & Morrison-Scott, 1951 p.441; Corbet, 1978 p.73.
L. mandschuricus: Won, 1968 p.145 (probably misspelling of *mandshuricus*).

Range: The distribution of *L. coreanus* ranges throughout the Korean Peninsula (Smith & Jo 2018b; Fig. 4).

Although Korean hares inhabit coastal islands connected by bridges to the mainland, no record exists for the remote islands.

Remarks: Previously regarded as a subspecies of *L. sinensis*, but the two species are allopatric (Jones & Johnson 1965). *Lepus coreanus* has an endemic status in Korea (Ministry of Environment 2005). Although Wu *et al*. (2005) merged this species to *L. timidus* based on cytochrome *b* gene analyses, *L. coreanus* is clearly distinguished from *L. timidus* by analysis of both nuclear thyroglobulin (*TG*) gene and mitochondrial control region (Koh & Jang 2010). Hoffmann and Smith (2005) failed to recognize a subspecies for *L. coreanus* in Korea.

Conservation status: The South Korean government removed *Lepus coreanus* as a game species in 2005 because of declining populations. Also, Ulsan and Gwangju Metropolitan governments made *L. coreanus* a provincially protected species.

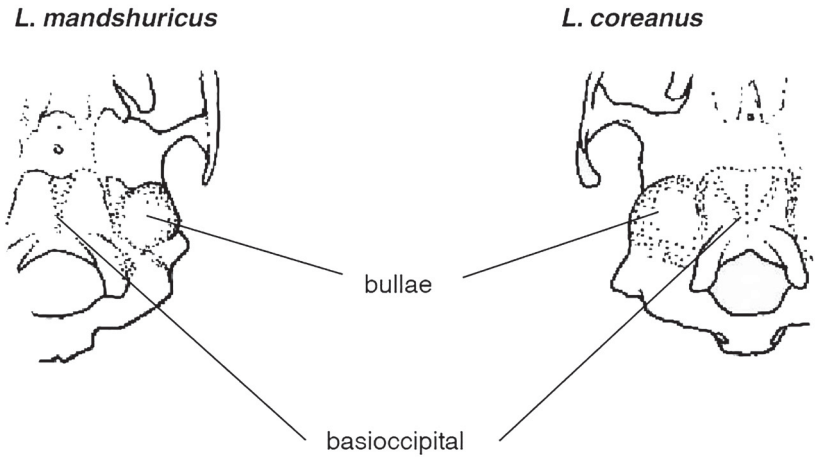

FIGURE 3. Basal view of skulls of *L. madshricus* and *L. coreanus.*

Lepus mandshuricus Radde, 1861—Manchurian Hare

Lepus mandshuricus Radde, 1861 p.684; Type locality-Mt. Bureja, eastern Siberia; Jones & Johnson, 1965 p.363; Corbet, 1978 p.74; Han, 1994 p.46; Won & Smith, 1999 p.28; Han, 2004b p.101.
L. europaeus mandshuricus: Tate, 1947 p.205.
L. brachyurus: Ellerman & Morrison-Scott, 1951 p.442.
L. brachyurus mandshuricus: Ellerman & Morrison-Scott, 1951 p.442.

Range: The Manchurian hare has a limited distribution in extreme northern Korea through Pyeonganbuk Province, Jagang Province, Ryanggang Province, and Hamgyeongbuk Province (Kim *et al.* 2015; Fig. 5).

Remarks: The taxonomic assignment of the Manchurian hare (*L. mandshuricus*) has fluctuated. Sowerby (1923, 1933) and Loukashkin (1943) recognized this hare as a separate species, while Ellerman and Morrison-Scott (1951) placed it as a subspecies of the Japanese hare *L. brachyurus,* because of similarities in characteristics of the teeth and cranial measurements. Wu *et al*. (2005) supported a species status based on the inferred phylogenetic relationships and the mean maximum likelihood distance on the complete mitochondrial cytochrome *b*, 12S, partial ND4 and control region fragments between the Manchurian hare and Japanese hare (0.197).

In addition, mammalogists confused *Lepus mandshuricus* with *L. coreanus*. Jones and Johnson (1965) found specimens of *L. mandshuricus* identified as *L. coreanus*. Won (1967) listed *L. coreanus* as the only species of hare in Korea; whereas, Won (1968) reported *L. mandshuricus* as the only species in Korea. However, nuclear and mitochondrial analyses supported *L. mandshuricus* as a distinct species from *L. timidus* and *L. coreanus* (Koh & Jang 2010).

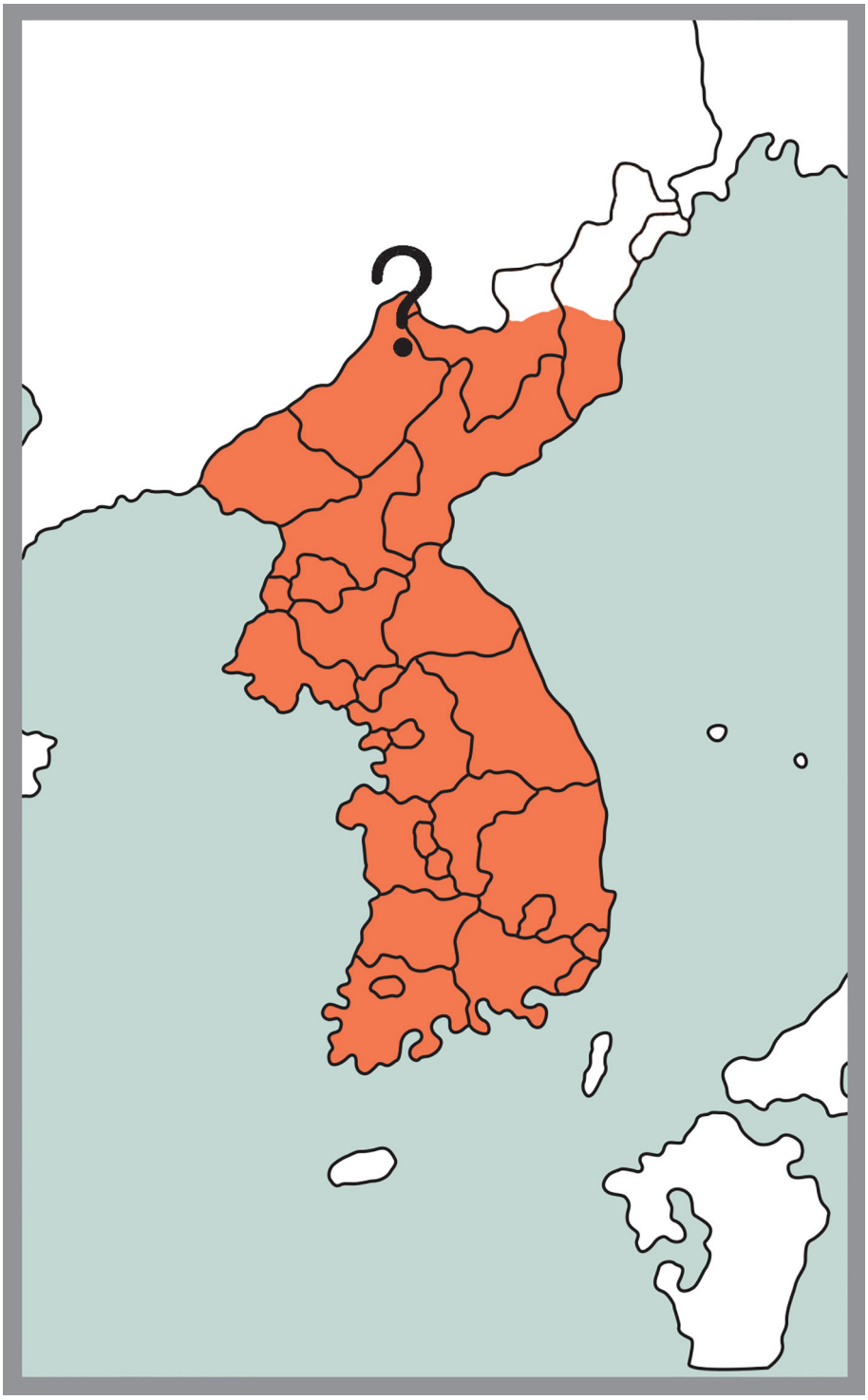

FIGURE 4. Range map of *Lepus coreanus* in Korea.

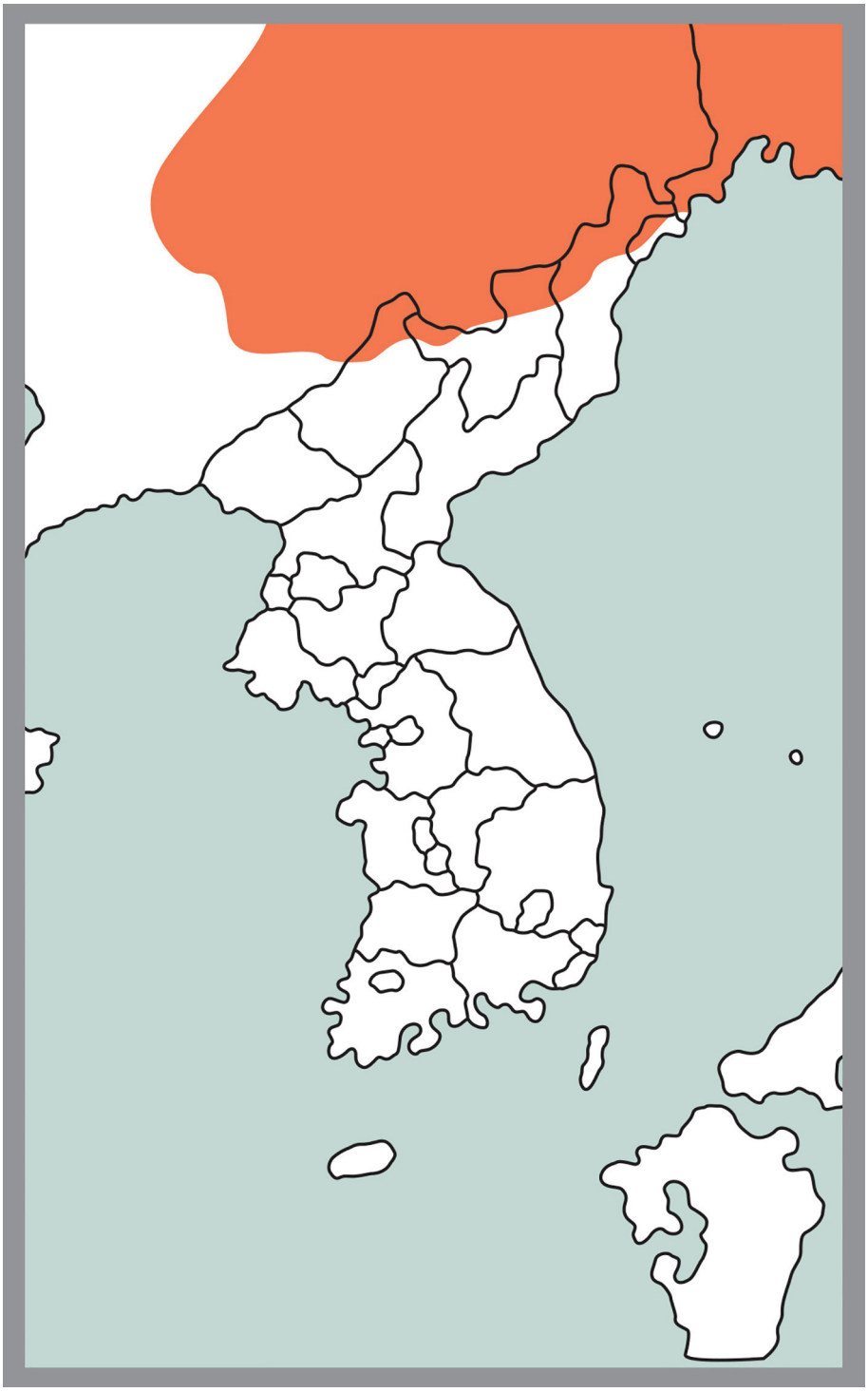

FIGURE 5. Range map of *Lepus mandshuricus* in Korea.

ORDER ERINACEOMORPHA Gregory, 1910

Erinaceomorpha used to be included in the Order Insectivora or Lipotyphla (Hutterer 2005a). Murphy *et al*. (2001) found that the Erinaceidae strongly clustered with the Soricidae and Talpidae, and therefore, placed the three families Erinaceidae, Soricidae, and Talpidae in the Order Eulipotyphla. Roca *et al.* (2004) confirmed this classification and included the Solenodontidae in the order. However, there remains disagreement over the Order Eulipotyphla (Vaughan *et al.* 2013). Here, we followed the classification proposed by Hutterer (2005a).

In Korea, the order is represented by one species, *Erinaceus amurensis*, which ranges throughout the Korean Peninsula.

Family ERINACEIDAE G. Fischer, 1814

Subfamily Erinaceinae G. Fischer, 1814

Genus *Erinaceus* Linnaeus, 1758

A single species, *Erinaceus amurensis*, represents this genus in Korea.

Erinaceus amurensis Schrenk, 1858—Amur Hedgehog

Erinaceus europaeus var. *amurensis* Schrenk, 1858 p.100; Type locality- Gulssoja, Northeastern China.
E. orientalis Allen, 1903 p.179; Type locality- Vladivostok, Russia.
E. koreanus Lönnberg, 1922 p.624; Type locality- Korea.
E. amurensis koreensis: Mori, 1922a p.616: Jones & Johnson, 1960 p.554; Han, 2004a p.21.
E. europaeus koreensis: Tate, 1947 p.39; Won, 1958 p.450; Won, 1967 p.262; Yoon, 1992 p.17.
E. europaeus orientalis: Won, 1958 p.450.
E. amurensis orientalis: Jones & Johnson, 1960 p.556.
E. europaeus orientalis amurensis: Won, 1967 p.262.
E. europaeus amurensis: Ellerman & Morrison-Scott, 1951 p.20; Won, 1968 p.40; Corbet, 1978 p.14; Yoon 1992 p.15.
E. europaeus koreanus: Ellerman & Morrison-Scott, 1951 p.22.
E. amurensis: Han, 1994 p45; Won & Smith, 1999 p.8; Han, 2004a p.20.

Range: *Erinaceus amurensis* commonly inhabits deciduous and mixed forests of Korea, except most islands (Yoo 2000; Fig. 6).

Remarks: Several mammalogists classified *Erinaceus amurensis* in the *europaeus* group, but Corbet (1984) suggested the taxon was a separate species. Zaitsev (1984) and Bannikova *et al*. (1996) confirmed the species status of the Amur hedgehog by morphological and DNA investigations, respectively. Oka *et al*. (2010) also determined *E. amurensis* and *E. concolor* as subspecies of *E. europaeus* based on mtDNA analysis. Two allopatric subspecies, *E. a. orientalis* in the North and *E. a. koreensis* in the South are recognized in Korea (Jones & Johnson, 1960) but Won (1968) recognized *E. amurensis* as a monotypic species. The subspecific status is uncertain in Korea (Won & Smith 1999).

Conservation status: Populations in South Korea have declined due to habitat loss and use for traditional medicine (NIBR 2012). The species was designated as provincially protected by Seoul, Ulsan, Gwangju, Daejeon, Gyeonggi Province and Jeollanam Province local governments.

ORDER SORICOMORPHA Gregory, 1910

Soricomorpha, Erinaceomorpha, and Afrosoricida previously composed the single Order Insectivora or Lipotyphla (Hutterer 2005b). Currently, the Order Insectivora has a paraphyletic designation. Since Soricidae has a closer relationship to Erinaceidae than Talpidae, Soricomorpha also seems polyphyletic. Several mammalogists advocated combining Eulipotyphla with Erinaceomorpha and Soricomorpha (Waddell *et al.* 1999; Murphy *et al.* 2001; Roca *et al.* 2004). Since greater consensus does not exist for these orders (Vaughan *et al.* 2013), we followed Wilson and Reeder (2005).

In Korean, 13 species representing four genera and two families compose the Order Soricomorpha. In this review, we removed three species from Soricidae and confirmed 10 species (see below).

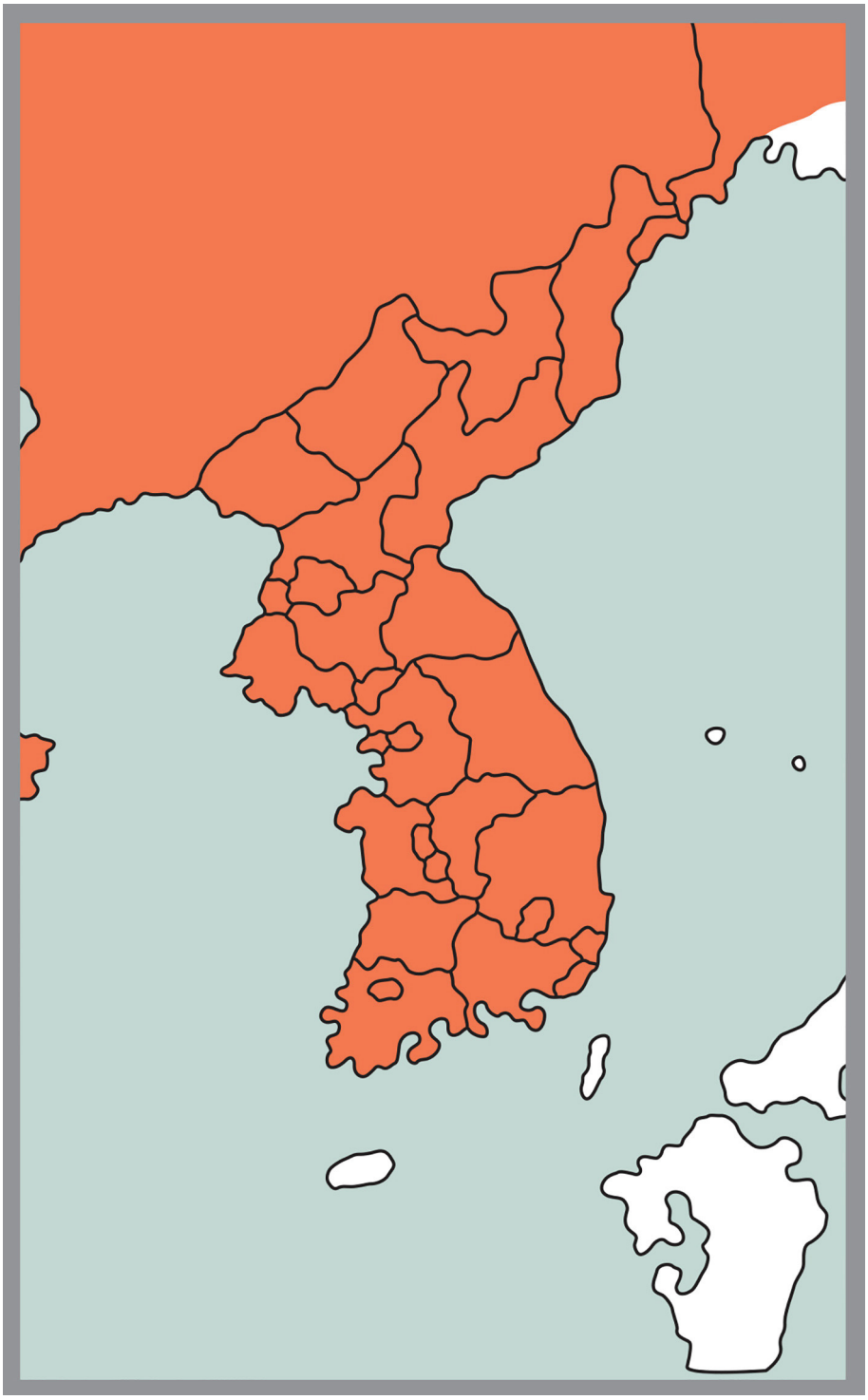

FIGURE 6. Range map of *Erinaceus amurensis* in Korea.

Key to families of Soricomorpha in Korea

- Zygomatic arch absent; number of teeth <32 . . . . . Soricidae
- Zygomatic arch present; number of teeth 42. . . . . Talpidae

Family SORICIDAE G. Fischer, 1814

In Korea, the Family Soricidae represents two subfamilies, three genera and 12 species (Churchfield 1990): (i) Soricinae (genera *Sorex* and *Neomys*), residing in colder environments, and (ii) Crocidurinae (Genus *Crocidura*) inhabiting warmer environs in Korea. Soricinae has limitations to high alpine habitats, and Crocidurinae commonly inhabits lower elevations throughout Korea.

Although previously listed as a Korean soricid, *Crocidura dsinezumi* in Korea was considered an erroneous identification (Motokawa *et al*. 2003, Jo *et al*. 2012). Also, *S. araneus* was often listed as a mammal of Korea because *Sorex isodon* was registered as a subspecies of *S. araneus* (Hoffmann & Lunde 2008). The presence of *S. unguiculatus* was alleged in Korea, but the specimen was confused with *S. a. isodon* and erroneously identified (Ohdachi & Han 2005). Therefore, the three soricid species *C. dsinezumi*, *S. araneus* and *S. unguiculatus* are delisted here and not considered in the list of Korean mammals (see below).

Key to genera of Soricidae in Korea

1 Tip of teeth white; 3 upper unicuspids; tail with dense short and sparse long hairs . . . . . *Crocidura*
- Tip of teeth red (not conspicuous if the teeth worn) 2
2 Upper unicuspids 4; hind feet and ventral line of tail fringed with hair . . . . . *Neomys*
- Upper unicuspids 5; tail with only short dense hairs . . . . . *Sorex*

Genus *Crocidura* Wagler, 1832

Two species of *Crocidura* occur in Korea. *Crocidura dsinezumi* is not considered a Korean species for the following reasons. Kuroda (1934a) reported *C. dsinezumi quelpartis* on Jeju Island; after that, only one specimen was collected (Won 1968). After 2001 and the description of the white-toothed shrew *C. shantungensis* from Jeju Island (Iwasa *et al*. 2001), researchers only collected *C. shantungensis* on Jeju Island. Although Han *et al*. (2002) supported the occurrence of two species, *C. dsinezumi* and *C. shantungensis* on Jeju Island based on mtDNA identification, the type specimen of *C. dsinezumi quelpartis* in 1934 clustered within *C. shantungensis* (Motokawa *et al*. 2003). Thus, currently, only one species of *Crocidura* probably inhabits Jeju Island, *C. shantungensis* (Jo *et al*. 2012). Nevertheless, taxonomic skepticism exists on whether the population on Jeju Island warrants a subspecific level classification or specific level classification. Therefore, additional research on the *Crocidura* on Jeju Island might resolve the taxonomic status of the *Crocidura* on Jeju Island (Motokawa *et al*. 2003). Here, we regard populations of white-toothed shrews on Jeju Island as *C. shantungensis* and remove *C. dsinezumi* from the list of Korean mammals.

Key to species of Genus *Crocidura* in Korea

- Second upper unicuspid tooth larger than 3rd; larger size; uniform colored tail shorter than (<50%) head-body length *C. lasiura*
- Second upper unicuspid tooth smaller than 3rd; smaller size; bi-colored tail longer than (>50%) head-body length. . . . . *C. shantungensis*

Crocidura lasiura Dobson, 1890—Ussuri White-toothed Shrew

Crocidura lasiura Giglioli and Salvadori, 1887 p.581; Locality-Korea (*Nomen nudum*).
C. lasiura Dobson, 1890 p.31.; Type locality-southeastern Siberia; Ellerman & Morrison-Scott, 1951 p.84; Jones & Johnson, 1960 p.563; Won, 1968 p.68; Corbet, 1978 p.29; Han, 1994 p.45; Won & Smith, 1999 p.9; Han, 2004a p.26.
C. thomasi Sowerby, 1917 p.318; Tate, 1947 p.60.
C. lizenkani Kishida and Mori, 1931 p.377 (*Nomen nudum*).
C. neglecta Kuroda, 1934a p.238.
C. yamashinai Kuroda, 1934a p.237; Type locality- Manpo, northeastern Korea; Tate, 1947 p.60.
C. sodyi Kuroda, 1935 p.327; Type locality- Manpo, Korea; Tate, 1947 p.60; Jones & Johnson, 1960 p.566.

C. russula: Ellerman & Morrison-Scott, 1951 p.78.
C. russula sodyi: Ellerman & Morrison-Scott, 1951 p.81; Won, 1958 p.451; Won, 1967 p.274; Yoon, 1992 p.25.
C. lasiura thomasi: Ellerman & Morrison-Scott, 1951 p.84; Won, 1958 p.452; Won, 1967 p.278.
C. lasiura yamashinai: Ellerman & Morrison-Scott, 1951 p.84; Won, 1958 p.452; Won, 1967 p.282.
C. lasiura lasiura: Won, 1958 p.452; Won, 1967 p.277; Yoon, 1992 p.26.

Range: *C. lasiura* ranges throughout Korea, except remote islands (3rd National Nature-Environmental Survey 2006–2013 unpublished electronic data; Fig. 7).

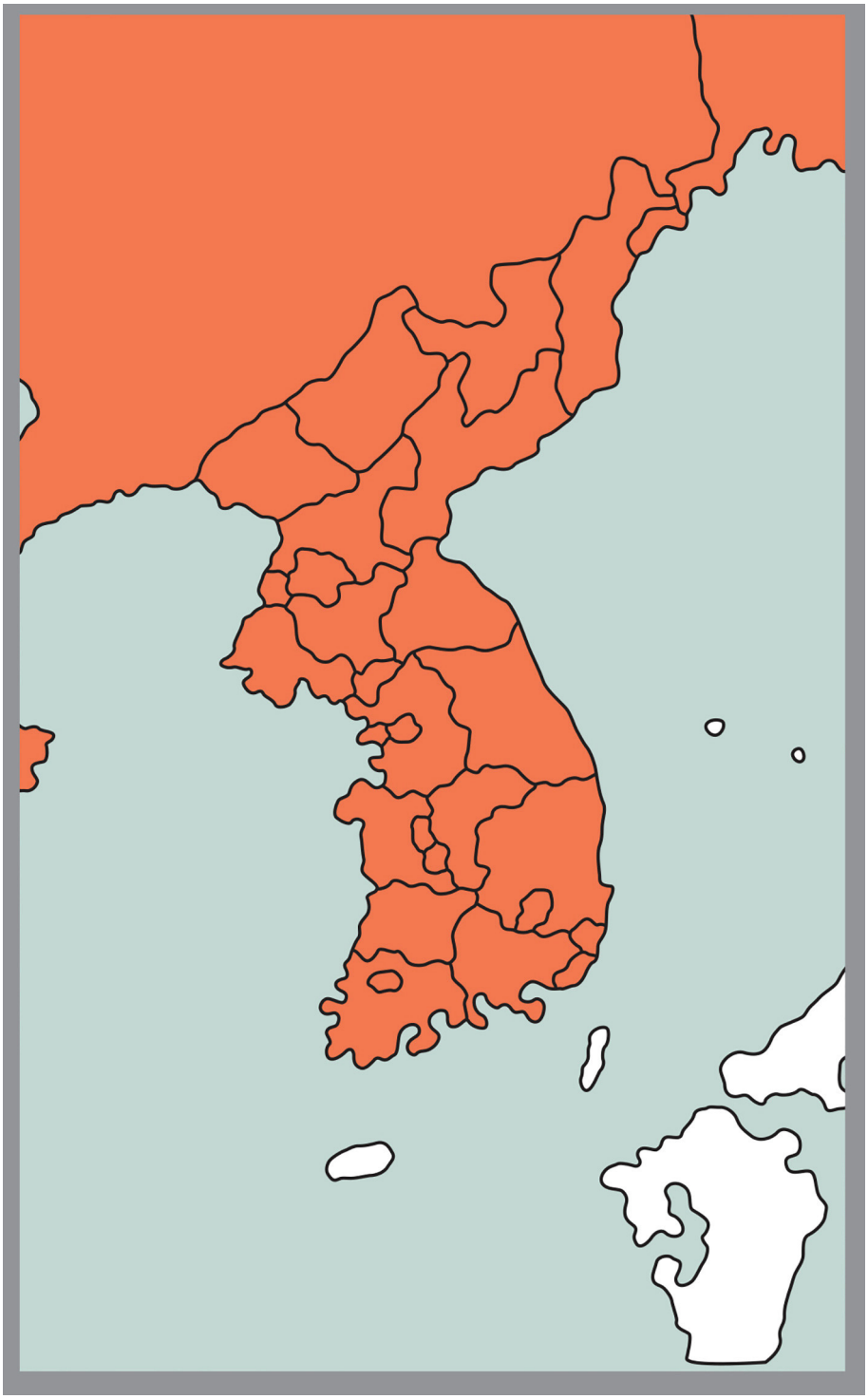

FIGURE 7. Range map of *Crocidura lasiura* in Korea.

Remarks: Previously, *C. lasiura* in Korea subsumed to three subspecies, *C. l. lasiura* Dobson, 1890, *C. l. thomasi* Sowerby, 1917 and *C. l. yamashinai* Kuroda, 1934 (Jones & Johnson 1960; Won 1968). However, the taxonomic status of *C. lasiura* in East Asia was recently converted to a monotypic species (Hutterer 2005b). Koh *et al*. (2014c) supported subspecific classification of *C. l. thomasi* for populations of Korea based on genetic differences between populations in China and Korea.

Conservation status: Gwangju metropolitan City and Gyeonggi Province designated the Ussuri white-toothed shrew as a provincially protected species, due to locally decreasing populations.

Crocidura shantungensis Miller, 1901—Asian Lesser White-toothed Shrew

Crocidura shantungensis Miller, 1901 p.158; Type locality-Shantung, China; Jo *et al*., 2012 p.250.
C. coreae Thomas, 1907b p.462; Type locality- Korea (Pyeongchang, Gimhwa, and Cheongju); Tate, 1947 p.60.
C. longicauda Mori, 1927 p.28; Type locality- Seoul; Tate, 1947 p.60.
C. dsinezumi quelpartis Kuroda, 1934a p.236; Jones & Johnson, 1960 p.562; Corbet, 1978 p.28; Yoon, 1992 p.26.
C. utsuryoensis Mori, 1937 p.41; Type locality- Ulleung Island, Korea; Won, 1958 p.451; Won, 1967 p.277; Won, 1968 p.72.
C. ilensis shantungensis: Kuroda, 1940 p.182.
C. ilensis coreae: Imaizumi, 1949 p.80.
C. suaveolens coreae: Bobrinskoy & Kuzyakin *in* Bobrinskoy *et al.*, 1944 p.57; Jones & Johnson, 1960 p.567.
C. suaveolens: Ellerman & Morrison-Scott, 1951 p.76; Corbet, 1978 p.27.
C. bolivari: Ellerman & Morrison-Scott, 1951 p.85 (Ulleung Island).
C. suaveolens shantungensis: Ellerman & Morrison-Scott, 1951 p.77; Won, 1958 p.451; Won, 1967 p.275; Won, 1968 p.66; Corbet, 1978 p.23; Yoon, 1992 p.24.
C. russula quelpartis: Ellerman & Morrison-Scott, 1951 p.81; Won, 1958 p.451; Won, 1967 p.273.
C. suaveolens utsuryoensis: Jones & Johnson, 1960 p.569; Corbet, 1978 p.23; Yoon, 1992 p.24.
C. suaveolens: Won, 1968 p.65; Han, 1994 p.45; Won & Smith, 1999 p.9; Han, 2004a p.27.
C. lasiura quelpartis: Won, 1968 p.71.
C. dsinezumi: Corbet, 1978 p.28; Han, 1994 p.45; Won & Smith, 1999 p.8; Han, 2004a p.25.

Range: The distribution of *C. shantungensis* covers the Korean Peninsula and most Korean islands (Fig. 8; 3rd National Nature-Environmental Survey 2006–2013 unpublished electronic data).

Remarks: Although *C. shantungensis* was regarded as a subspecies of *C. suaveolens*, Jiang and Hoffmann (2001) demonstrated morphological differences between *C. shantungensis* and *C. suaveolens* and treated *C. suaveolens shantungenis* as a separate species with the population in East Asia referred to *C. shantungensis*, as originally described by Miller (1901). Genetic investigations using mtDNA (Ohdachi *et al.* 2004) and nuclear genes (Dubey *et al.* 2008) distinguished *C. shantungensis* from *C. suaveolens*.

In Korea, Mori (1937) differentiated the Asian lesser white-toothed shrew on Ulleung Island from the peninsula population, *C. s. coreae* Thomas, 1907 and recognized it as the Subspecies *C. s. utsuryoensis* Mori, 1937. Although the population on Jeju Island was considered a subspecies of *C. dsinezumi* or *C. russula*, Iwasa *et al*. (2001) identified the population of white-tooted shrew on Jeju Island as *C. shantungensis qeulpartis* Kuroda, 1934 (Jo *et al*. 2012).

Conservation status: Although the North Korean government listed this species as 'Rare' (MAB National Committee of DPR Korea 2002), the South Korean government deemed *C. shantungensis* as 'Least Concern' (NIBR 2012).

Genus *Neomys* Kaup, 1829

The Genus *Neomys* is represented in Korea by a single species, *N. fodiens*.

Neomys fodiens Pennant, 1771—Eurasian Water Shrew

Sorex fodiens Pennant, 1771 p.308; Type locality-Berlin, Germany.
Neomys fodiens orientis Thomas, 1914 p.564; Type locality- Swamps of Kammanajaretschka River, Semirechyia, Russian

central Asia; Won, 1968 p.62; Yoon, 1992 p.22 (Won (1968) and Yoon (1992) used the name *orientalis*, perhaps a misprint of *orientis*).

N. watasei Kishida, 1930 p.372 (*Nomen nudum*).

N. fodiens watasei: Kuroda, 1941 p.114; Type locality- Toyohara, Sakhalin Island, Russia.

N. limchunhunii Won, 1954 p.41; Type locality- Pungseo, Ryanggang Province, Korea.

N. fodiens: Won, 1968 p.62; Han, 1994 p.45; Won & Smith, 1999 p.9; Han, 2004a p.28.

Range: Eurasian water shrews inhabit the northeastern peninsula from Mt. Baekdu southward to Mt. Seorak National Park along high mountain ranges (Fig. 9). Since the first collection of this species in 1953 near Ryanggang Province, mammalogists have viewed *N. fodiens* as a species from North Korea (Won 1968). However, since 2007 this shrew has been observed in South Korea (NIBR 2012).

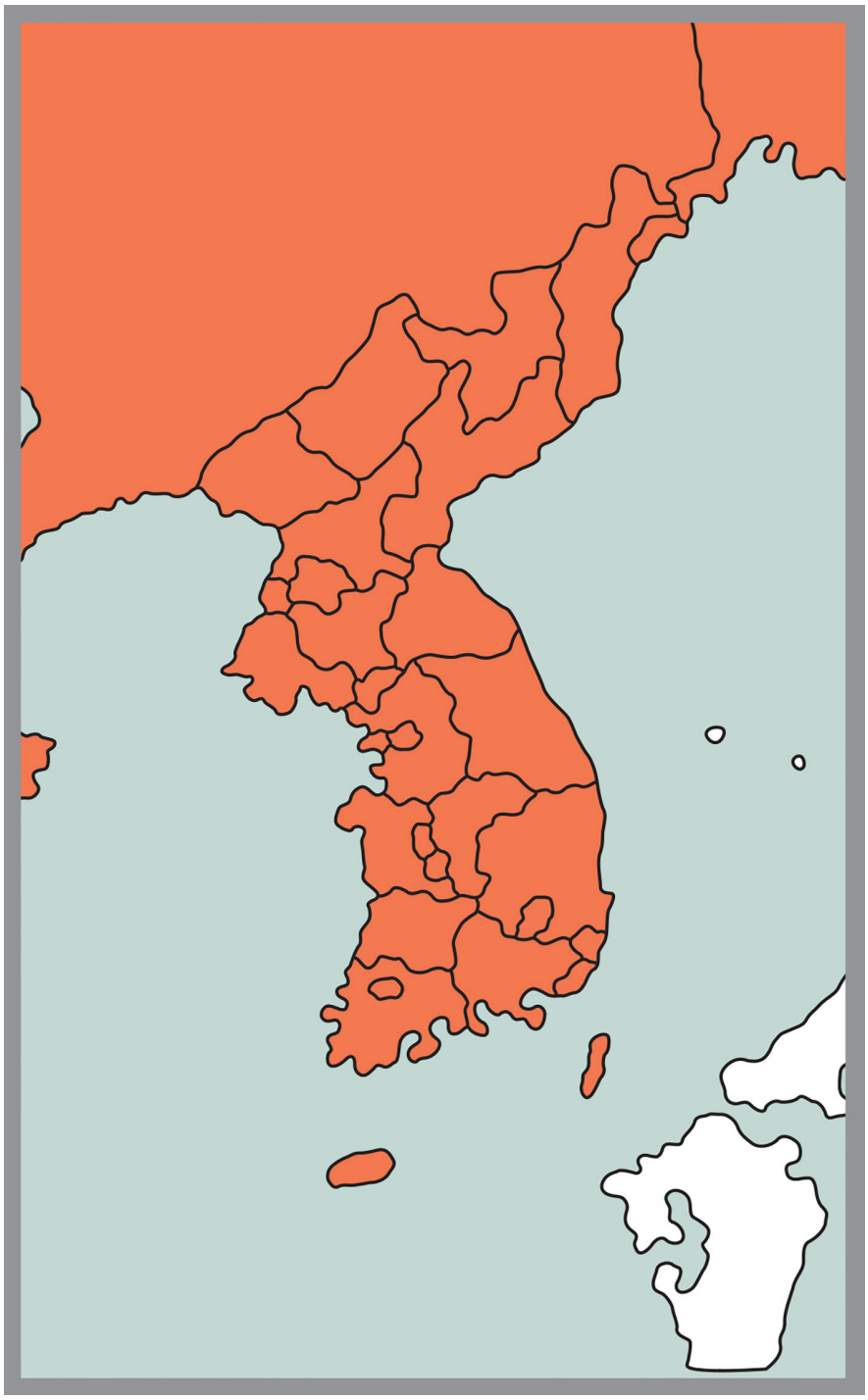

FIGURE 8. Range map of *Crocidura shantungensis* in Korea.

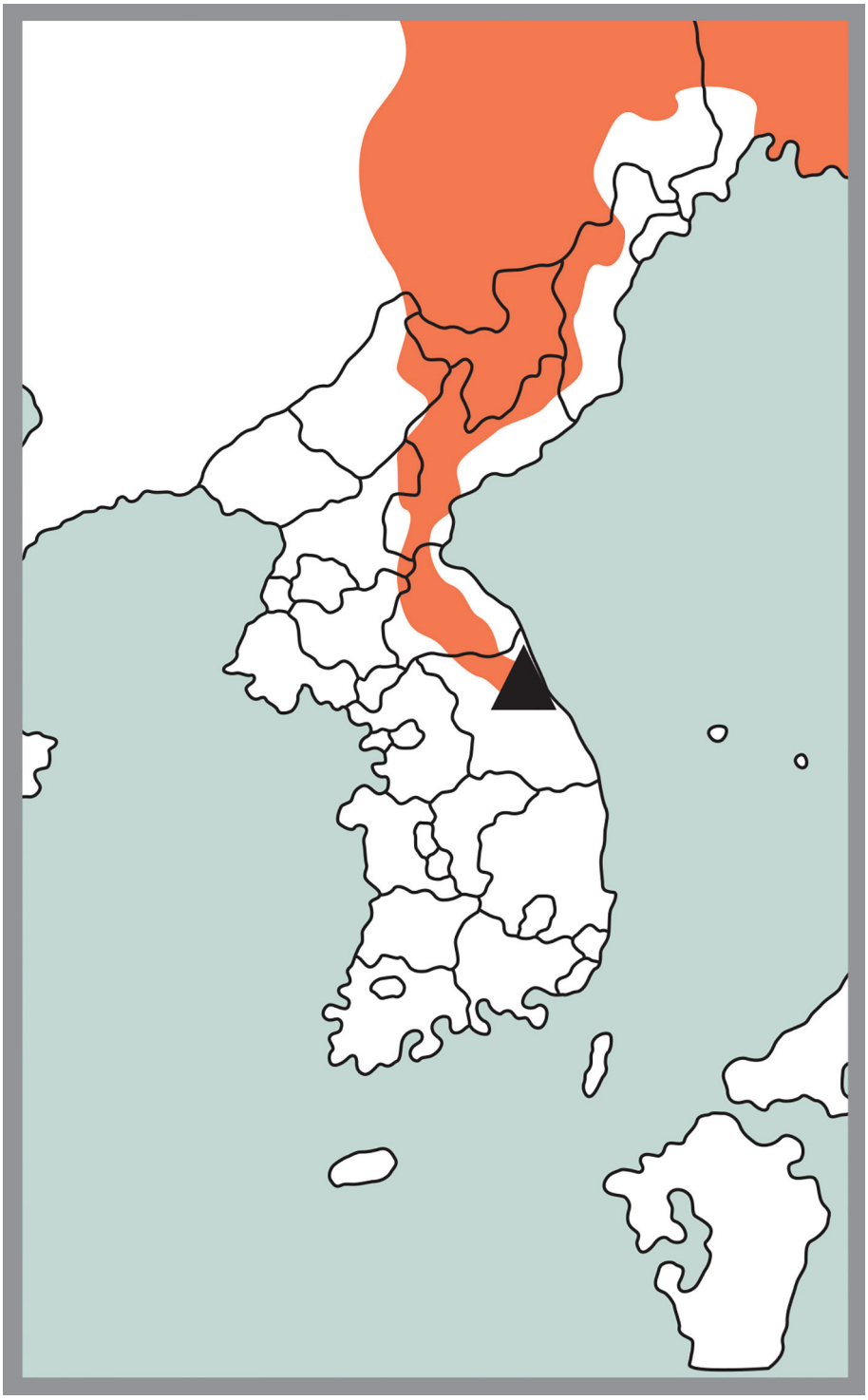

FIGURE 9. Range map of *Neomys fodiens* in Korea.

Remarks: This species was first described as a new species, *Neomys limchunhunii* Won, 1955. Korean populations of the Eurasian water shrew are now considered *N. fodiens orientis*. Literature citations previously referred to this shrew as *N. f. orientalis* (Won 1968; Yoon 1992; Won & Smith 1999), but *Neomys fodiens orientis* Thomas, 1914 had priority over *Neomys fodiens orientalis* Hinton, 1915 as the proper scientific name (Corbet 1978).

Conservation status: The North Korean government classified *N. fodiens* as a 'Rare' species (MAB National Committee of DPR Korea 2002).

Genus *Sorex* G. Fischer, 1814

Of the eight species traditionally listed as inhabiting Korea, we regarded *S. araneus* and *S. unguiculatus* as either misidentification or error of records. Therefore, we identified six species of *Sorex* in Korea.

Sorex araneus has a wide distribution in the Palearctic, occurring from Britain through central, northern and eastern Europe and Asia as far east as Lake Baikal and as far north as the Arctic Coast. Since *Sorex isodon* was regarded as *Sorex araneus isodon* (Hoffmann & Lunde 2008), *S. araneus* has been listed as a Korean mammal (Tate 1947; Won & Smith 1999). However, the distribution of *S. araneus* does not extend into eastern Asia (Hutterer 2005b). Thus, we delisted *S. araneus* from the mammals of Korea.

Sorex unguiculatus share morphological similarities with *S. isodon* such as large body size, dark-brown ventral color, and broad forefeet. The collection of specimens of *S. unguiculatus* in North Korea brings into question the problem of possible misidentification (Han *et al.* 2000). The identification of these specimens is apparently problematic (Han *et al.* 2000) and should be examined to validate their identity. For the moment, we chose to delist *S. unguiculatus* from Korean mammals.

Key to species of Genus *Sorex* in Korea

1 Total length >120 mm, hind foot >16 mm . . . . . *S. mirabilis*
- Total length <120 mm, hind foot <15 mm 2
2 Heavily pigmented teeth (red pigment reaching into bases of molariform teeth). . . . . *S. daphaenodon*
- Red pigment not extending into bases of molariform 3
3 Rostrum narrow and slender (nasal bone ratio to least interorbital breath 2); 1st to 3rd upper unicuspids teeth similar size; 4th and 5th unicuspids much smaller . . . . . *S. gracillimus*
- Rostrum not narrow (nasal bone ratio to least interorbital breath <2); 1st to 3rd upper unicuspids teeth not similar size 4
4 Second upper unicuspid tooth smaller than 1st and 3rd unicuspids. . . . . *S. minutissimus*
- Second upper unicuspid tooth same or larger than 3rd unicuspid 5
5 Head and body >70 mm; upper unicuspids size evenly decrease from 1st to 5th; ventral pelage color almost as dark as dorsal color. . . . . *S. isodon*
- Head and body <60 mm; 1–4 upper unicuspids in similar size (1st & 2nd in same size; 3rd & 4th in same but slightly smaller than 1st & 2nd pair; 5th is noticeably small); pelage dorsal color much darker than ventral color . . . . . *S. caecutiens*

Sorex mirabilis Ognev, 1937—Ussuri Shrew

Sorex mirabilis Ognev, 1937 p.268; Type locality-Kiskinka River, Russia; Corbet, 1978 p.23; Han, 1994 p.45; Won & Smith, 1999 p.10; Han, 2004a p.34.

S. mirabilis kutscheruki Stroganov, 1956 p.6; Jones & Johnson, 1960 p.560; Won, 1968 p.52; Corbet, 1978 p.23; Yoon, 1992 p.21.

Range: Most records of *S. mirabilis* originated from northern Korea (Won 1968). The distribution of the Ussuri shrew ranges through higher mountains of Korea (Han 2004a; Fig. 10).

Remarks: The populations in Korea were classified as *Sorex mirabilis kutscheruki* Stroganov, 1956 (Jones & Johnson 1960; Won 1968).

Conservation status: The Red Data Book of North Korea lists *S. mirabilis* as 'Rare'.

Sorex daphaenodon Thomas, 1907—Siberian Large-toothed Shrew

Sorex daphaenodon Thomas, 1907b p.407; Type locality- Sakhalin Island, Russia; Han, 2004a p.31.

Range: A specimen of *S. daphaenodon* collected at Mt. Baekdu in North Korea in 2001 represents the only record in Korea (Ohdachi & Han 2005; Fig. 11). *S. daphaenodon* inhabits moist and humid areas in mixed forest (conifer and broad-leaved forests) over much of its range and may also occupy birch groves in the wooded steppe.

Remarks: The Siberian large-toothed shrew is rare in Korea. Three subspecies (*S. d. daphaenodon, S. d.*

sanguinidens, and *S. d. scaloni*) have been reported but the subspecies inhabiting Korea remain unstudied. Additional research around Mt. Baekdu is warranted to define the status of this species in Korea.

Sorex gracillimus **Thomas, 1907—Slender Shrew**

Sorex minutus gracillimus Thomas, 1907b p.408; Type locality- Sakhalin, Russia; Ellerman & Morrison-Scott, 1951 p.48; Won, 1958 p.450; Jones & Johnson, 1960 p.561; Won, 1967 p.269; Won, 1968 p.59.
Sorex gracillimus: Corbet, 1978 p.19; Yoon, 1992 p.19; Han, 1994 p.45; Won & Smith, 1999 p.10; Han, 2004a p.32.

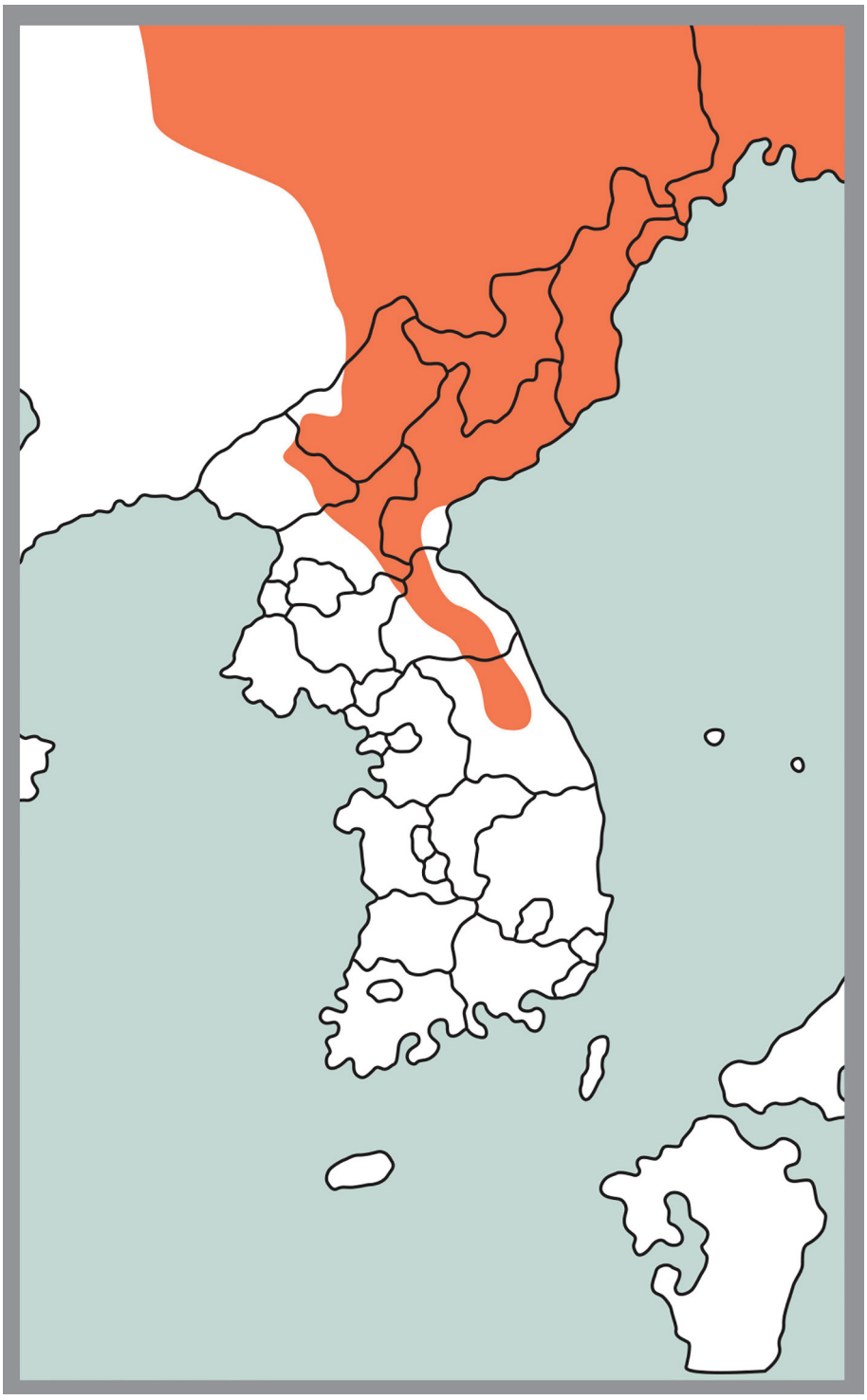

FIGURE 10. Range map of *Sorex mirabilis* in Korea.

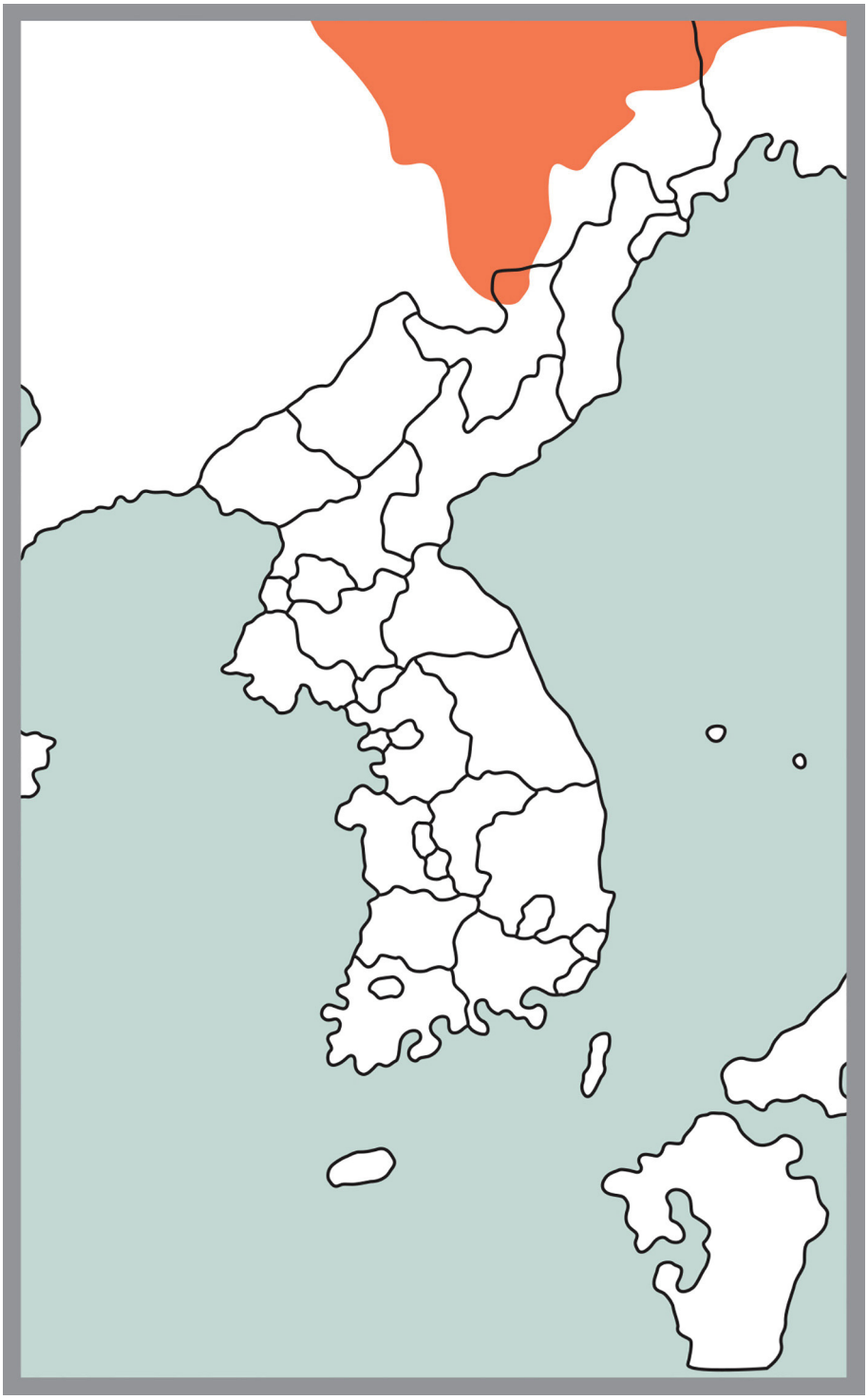

FIGURE 11. Range map of *Sorex daphaenodon* in Korea.

Range: *Sorex gracillimus* has its distribution limited to extreme northeastern Korea at Mt. Baekdu (Fig. 12). An alleged collection of this shrew at Mt. Jiri in 1983 found no support from a specimen or official collection of this shrew in South Korea (Han 2004a). Thus, the occurrence of this species in South Korea remains problematic.

Remarks: Additional efforts are necessary to determine the status of this species in North Korea. Previously, *S. gracillimus* was considered a subspecies of *Sorex minutus*. The subspecies inhabiting Korea remains doubtful, but is probably *S. g. hyojironis,* since this subspecies occupies nearby Manchuria.

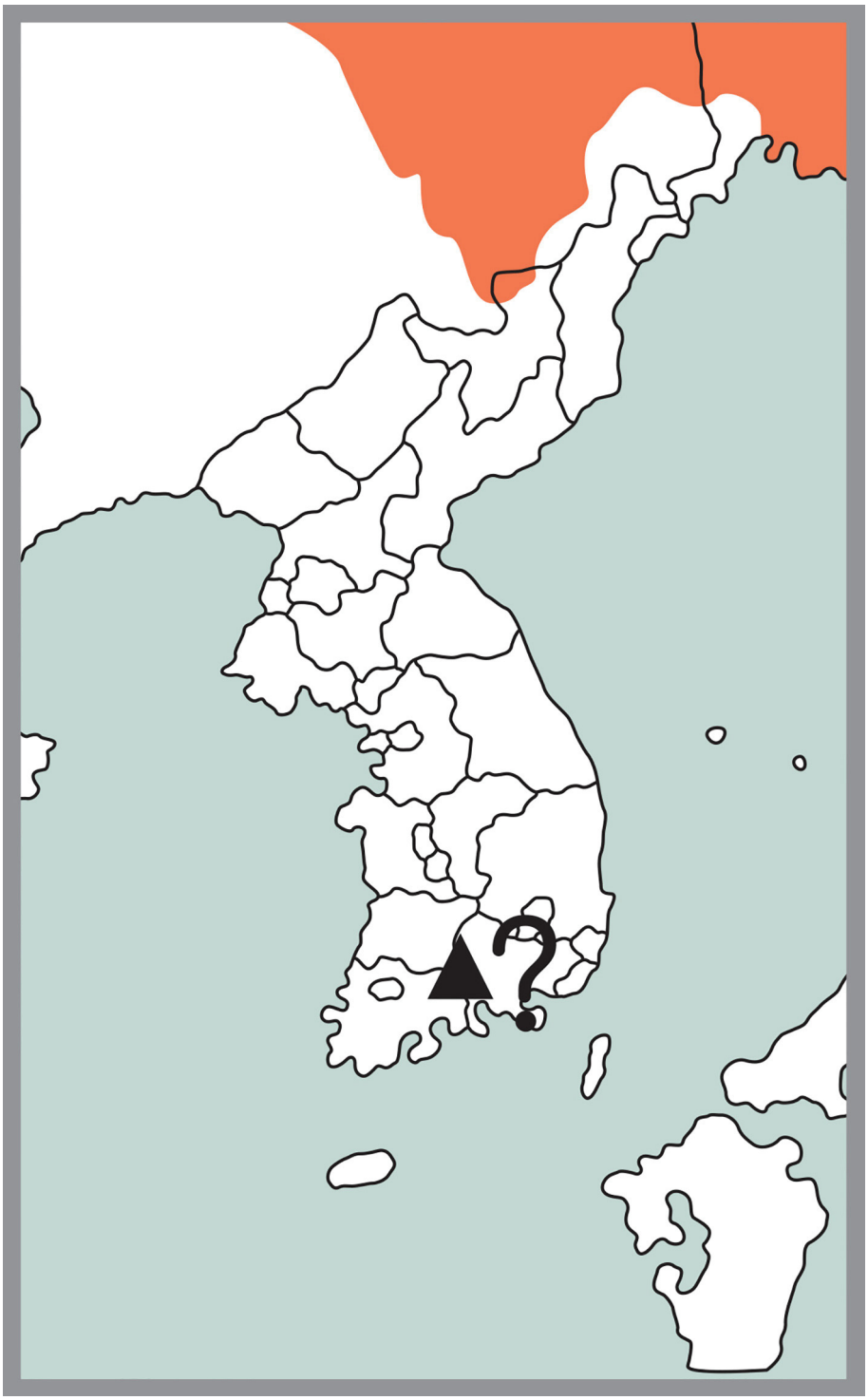

FIGURE 12. Range map of *Sorex gracillimus* in Korea.

Sorex minutissimus Zimmermann, 1780—Eurasian Least Shrew

Sorex minutissimus Zimmermann, 1780 p.385; Type locality-Yenisei, Russia; Han, 1994 p.45; Won & Smith, 1999 p.10; Han, 2004a p.33.
S. minutissimus ishikawai Yoshiyuki, 1988 p.152; Yoon, 1992 p.18.

Range: Only five specimens of the Eurasian least shrew were collected in Korea. The records came from collections made around Mt. Seorak and Odae (Han 2004a; Fig. 13).

Remarks: Yoshiyuki (1988) subsumed the population in Korea as *S. minutissimus ishikawai* based on specimens collected at Mt. Odae, but other mammalogists did not recognize the subspecies name (Yoon 1992; Won & Smith 1999; Han 2004a). Additional research on this taxon is needed to delineate its distribution and taxonomy in Korea.

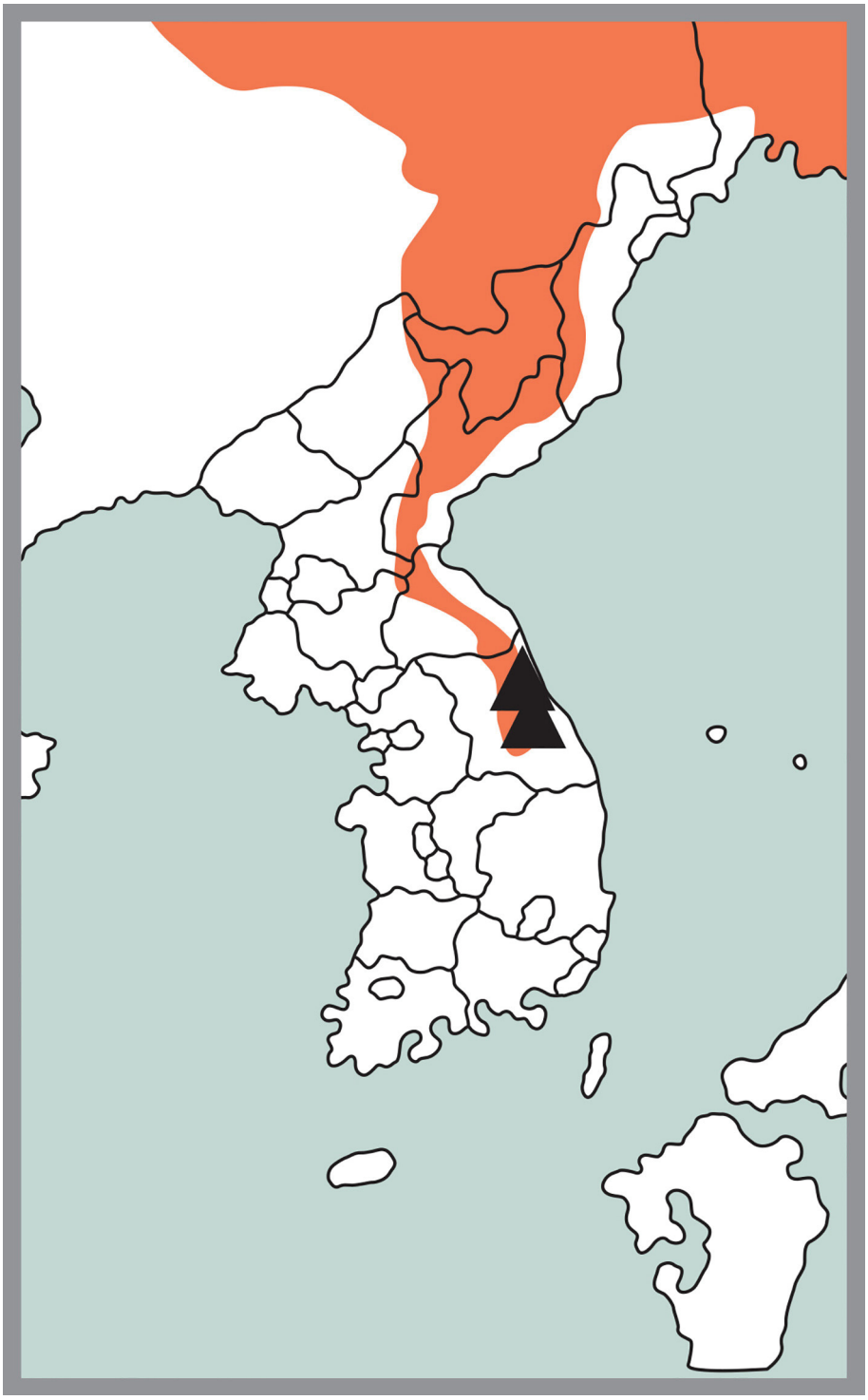

FIGURE 13. Range map of *Sorex minutissimus* in Korea.

Sorex isodon Turov, 1924—Taiga Shrew

Sorex araneus tomensis isodon Turov, 1924 p.111; Type locality- Lake Baikal, Russia.
S. gravesi Goodwin, 1933 p.3; Type locality-Monoma River, Eastern Siberia, Russia.
S. araneus: Han, 1994 p.45; Won & Smith, 1999 p.9.
S. isodon: Han, 2004a p.33.

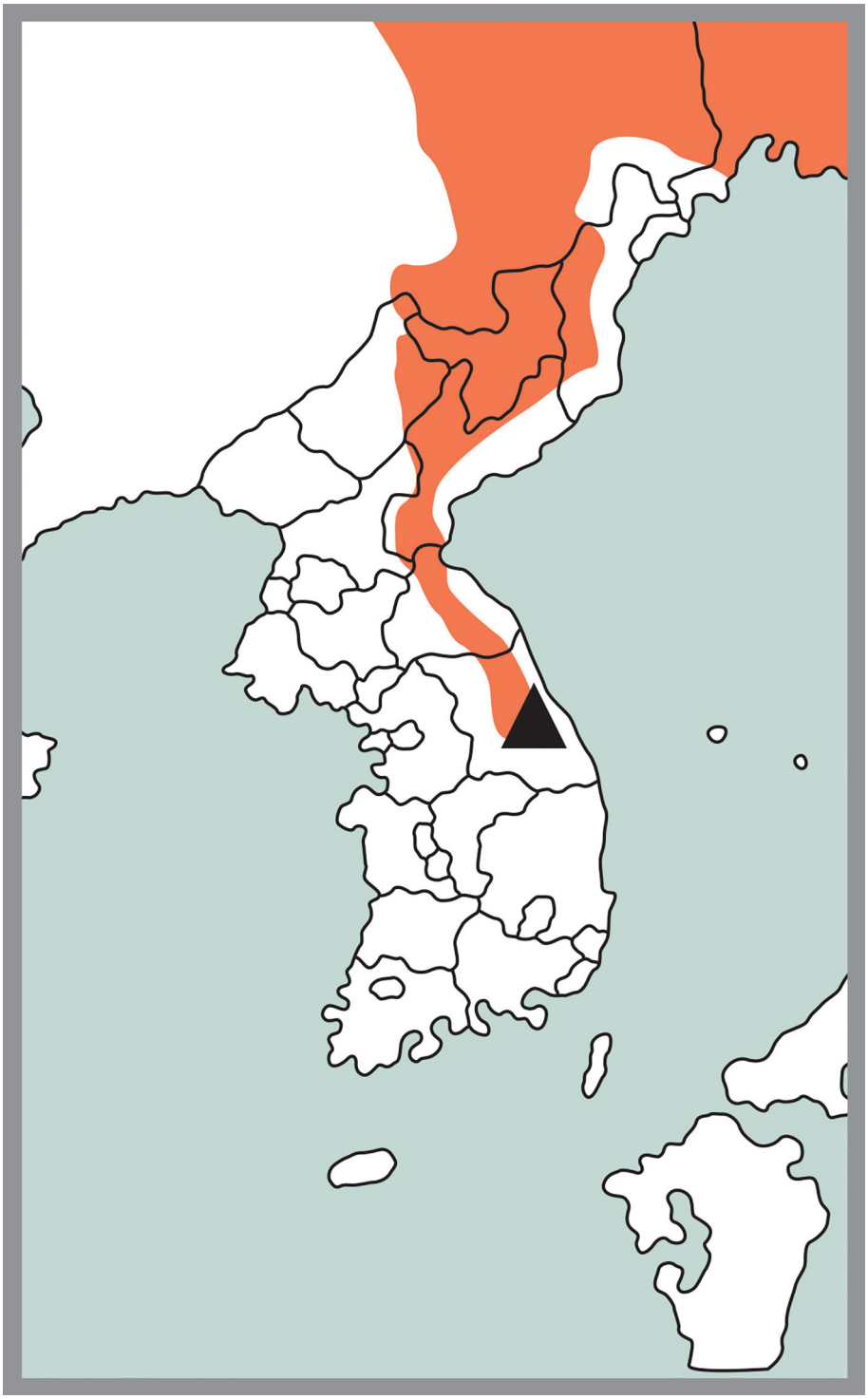

FIGURE 14. Range map of *Sorex isodon* in Korea.

Range: The first collection of *S. isodon* occurred in 1999 on Mt. Odae in South Korea, but previous records in North Korea, possibly mistakenly identified genuine *S. isodon* as *S. unguiculatus* (Ohdachi & Han 2005). If the North Korean records represent *S. isodon,* the distribution would range throughout higher mountain ranges from central Korea northward into northern North Korea (Kim *et al.* 2015; Fig. 14).

Remarks: Previously, *S. isodon* was classified as a subspecies of *S. araneus* or *S. sinalis*. Since the name *isodon* had a prior use for an infrasubspecific taxon (*Sorex araneus tomensis isodon*), 'Turov, 1924', *isodon* was considered an invalid name by Corbet (1978). Therefore, *gravesi* Goodwin, 1933 preceded *isodon* Stroganov, 1936 as a species name. However, Hoffmann (1987) recommended the use of '*Sorex isodon* Turov, 1924' as an available name retaining the commonly used *isodon* instead of the unfamiliar *gravesi*. Hutterer (2005b) adopted Hoffmann's recommendation. We followed this suggestion.

Sorex caecutiens Laxmann, 1788—Laxmann's Shrew

Sorex caecutiens Laxmann, 1788 p.285; Type locality-southwest shore of Lake Baikal, Russia; Ellerman & Morrison-Scott, 1951 p.48; Corbet, 1978 p.20; Han, 1994 p.45; Won & Smith, 1999 p.9; Han, 2004a p.30.
S. macropygmaeus Miller, 1901 p.158.
S. annexus Thomas, 1906 p.859.
S. caecutiens annexus: Van den Brink, 1953 p.108; Won, 1958 p.450; Jones & Johnson, 1960 p.559; Won, 1967 p.271.
S. caecutiens macropygmaeus: Won, 1968 p.56.
S. caecutiens caecutiens: Yoon, 1992 p.19.
S. caecutiens hallamontanus: Jo *et al*., 2012 p.249.

Range: As the most common species of the Genus *Sorex*, *S. caecutiens* ranges throughout the Korean Peninsula and Jeju Island (Jo *et al.* 2012; Fig. 15). It is locally abundant in the northeastern Korean Peninsula along higher mountain ranges (Kim *et al.* 2015). *Sorex caecutiens* also inhabits the region near Seoul. Mt Odae and Mt. Jiri are known as habitats of this species in South Korea (Yoon 1992).

Remarks: The subspecific status of *S. caecutiens* in Korea remains ambiguous (*S. c. annexus* Jones and Johnson, 1960; *S. c. macropygmaeus* Miller, 1901). The first collection of Laxmann's shrew on Jeju Island occurred in 1994 (Ohdachi *et al.* 2003; Jo *et al.* 2012). Ten years later, Ohdachi *et al*. (2005) assigned a new Subspecies *Sorex caecutiens hallamontanus* Abe and Oh, 2005, to the population on Jeju Island. The Jeju subspecies has morphological similarity with *S. shinto*, but DNA data grouped the Jeju subspecies with *S. caecutiens* (Ohdachi *et al*. 2005). Also, populations of *S. caecutiens* from Korea clustered with populations on Sakhalin Island based on cytochrome *b* analysis (Ohdachi *et al.* 2003).

Family TALPIDAE G. Fischer, 1814

In Korea, the Family Talpidae contains the single species *Mogera robusta*. Here, *M. wogura coreana* is regarded as synonym of *M. robusta* whereas, *M. wogura* is considered endemic in Japan (Corbet 1978; Kawada & Yokohata 2009).

Genus *Mogera* Pomel, 1848

Mogera was included in the Genus *Talpa* (Corbet 1978), but *Talpa* has 44 teeth, whereas, *Mogera* has 42 teeth due to the loss of one pair of lower incisors (Motokawa *et al*. 2001). Although only one species inhabits Korea, the taxonomic status remains controversial.

Mogera robusta Nehring, 1891—Ussuri Mole

Mogera robusta Nehring, 1891 p.96; Type locality- Vladivostok, Russia; Won, 1968 p.47; Han, 1994 p.45; Won & Smith, 1999 p.11.
M. wogura coreana Thomas, 1907b p.463; Tate, 1947 p.44; Won, 1968 p.45.
Talpa wogura coreana: Jones & Johnson, 1960 p.572; Won, 1968 p.45; Yoon, 1992 p.28.
T. wogura robusta: Jones & Johnson, 1960 p.573.
T. micrura: Ellerman & Morrison-Scott, 1951 p.39.
T. micrura coreana: Ellerman & Morrison-Scott, 1951 p.41; Won, 1958 p.453; Won, 1967 p.287.

T. micrura robusta: Ellerman & Morrison-Scott, 1951 p.40; Won, 1958 p.453; Won, 1967 p.292.
T. robusta: Corbet, 1978 p.35.
T. robusta coreana: Corbet, 1978 p.36
M. wogura robusta: Corbet & Hill, 1991 p.38.
T. robusta robusta: Corbet, 1978 p.36; Yoon, 1992 p.28.
M. wogura: Won & Smith, 1999 p.11; Han, 2004a p.22.

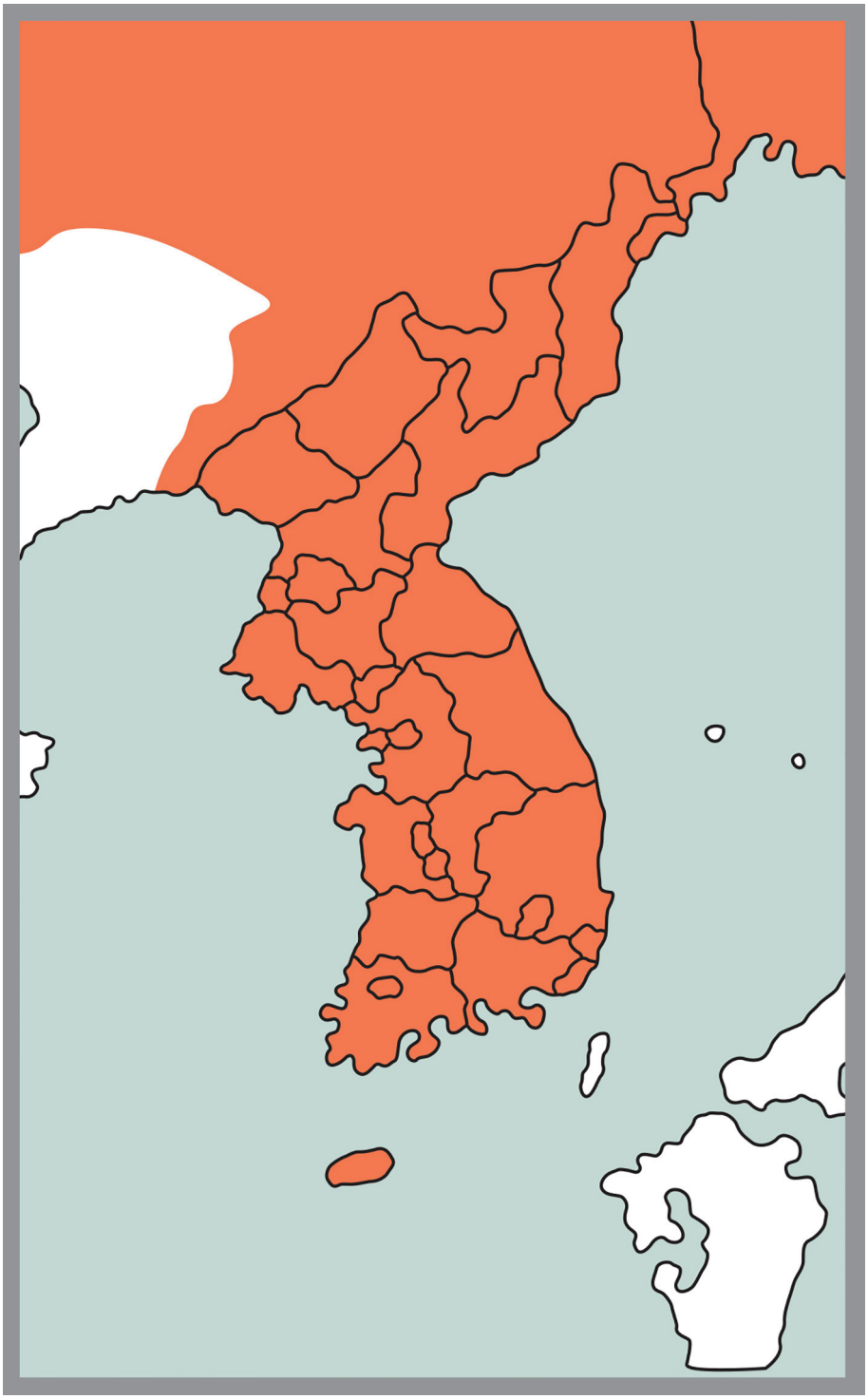

FIGURE 15. Range map of *Sorex caecutiens* in Korea.

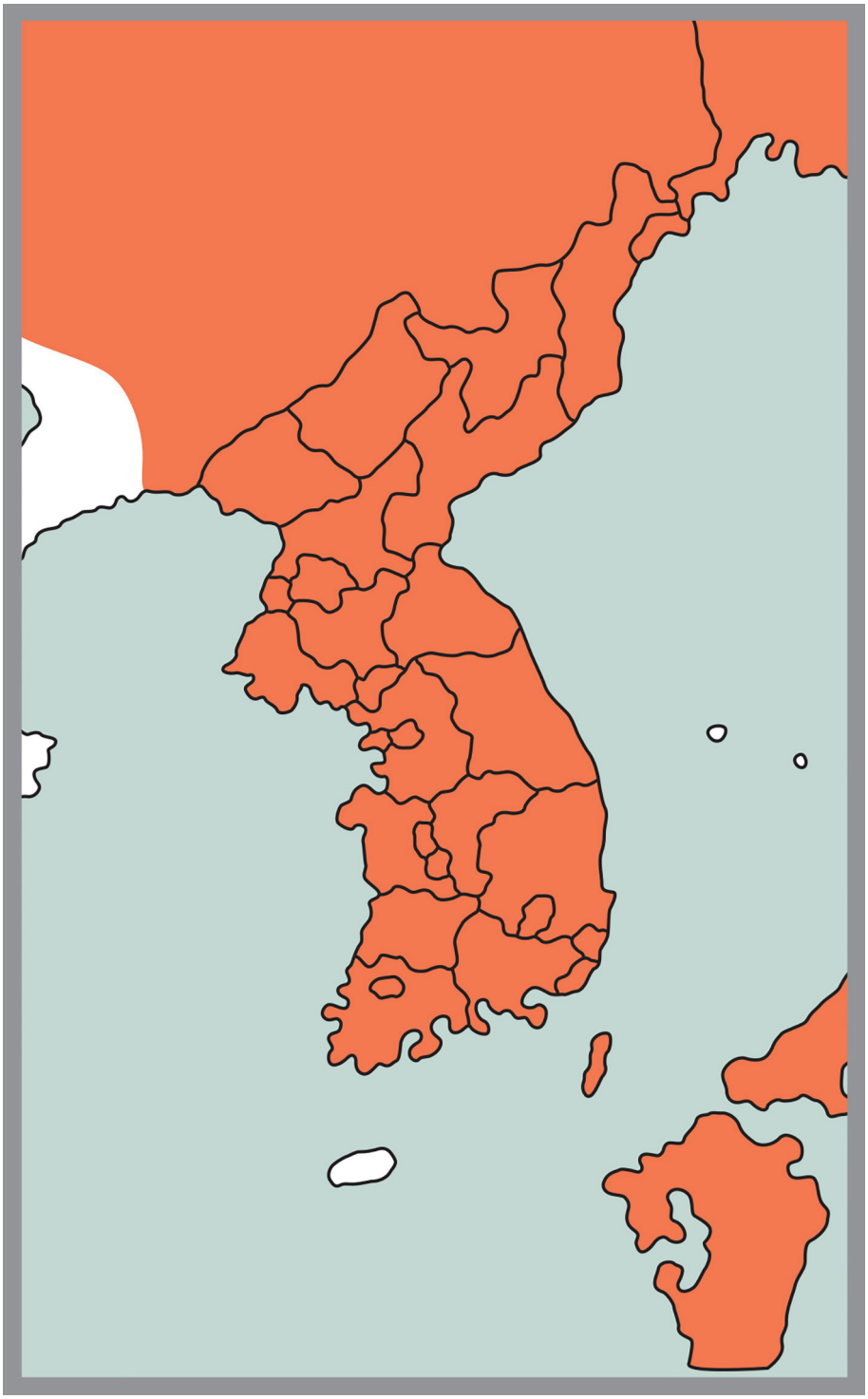

FIGURE 16. Range map of *Mogera robusta* in Korea.

Range: The Ussuri mole commonly inhabits friable soils over most of Korea except remote islands (3rd National Nature-Environmental Survey 2006–2013 unpublished electronic data; Fig. 16).

Remarks: Two subspecies, *M. r. robusta* Nehring, 1891 and *M. r. coreana* Thomas, 1907 were recorded in Korea. Based on mitochondrial cytochrome *b* gene analysis, *M. robusta* from South Korea clustered with samples from the Russian Far East (Tsuchiya *et al.* 2000). Also, the moles of South Korea showed no genetic divergence (rRNA and cytochrome *b* gene) from moles in northeastern China and Russian Far East, despite considerable morphological differences with *M. wogura* (Koh *et al.* 2012b). The larger *M. r. robusta* inhabits alpine environments in extreme northern Korea and the smaller *M. r. coreana* occupies most of Korea except the extreme North. Hutterer (2005b) regarded *M. robusta* as a subspecies of *M. wogura*.

ORDER CHIROPTERA Blumenbach, 1779

Traditionally, taxonomists have divided the Chiroptera into two suborders, Megachiroptera and Microchiroptera, with the Microchiroptera comprised of two infraorders, Yinochiroptera and Yangochiroptera (Simmons 2005). Recently, molecular analyses confirmed the two suborders, Yinpterochiroptera and Yangochiroptera (Vaughan *et al.* 2013), despite support for the traditional taxonomy (i.e., Megachiroptera and Microchiroptera) based on echolocation (O'Leary *et al*. 2013).

Four chiropteran families exist in Korea. The Rhinolophidae and Molossidae, each represented by a single species, the Miniopteridae by two species (one indigenous and one vagrant), whereas, 20 species represent the Vespertilionidae (including one vagrant species). Of the 26 species listed in Korea, we confirmed 24 species (representing 11 genera) and regard *Eptesicus kobayashii* and *Pipistrellus pipistrellus* as erroneous identifications.

Key to families of Chiroptera in Korea

1 Nose-leaf present; tragus absent; antitragus well developed; premaxillae separated from surrounding bones except slender palatal branches . . . . . Rhinolophidae
- Nose-leaf absent; tragus present but reduced in size; premaxilla fused with neighboring bones 2
2 Reduced tragus present; tail extending for between 1/3 to 1/2 of its length beyond margin of uropatagium; ears directed horizontally forward; fifth finger shorter than forearm . . . . . Molossidae
- Tragus present; tail enclosed within uropatagium or terminal one or two vertebrae project beyond margin of uropatagium; ears upright; fifth finger longer than forearm 3
3 Second phalanx third finger <3 times of first phalanx; 3 functional phalanges in third finger . . . . . Vespertilionidae
- Second phalanx third finger ≥3 times length first phalanx; 2 functional phalanges in third finger . . . . . Miniopteridae

Family RHINOLOPHIDAE Gray, 1825

The Rhinolophidae represents the only bat family in Korea of the infraorder Yinpterochiroptera. A single species, *Rhinolophus ferrumequinum*, represents the Family Rhinolophidae in Korea.

Genus *Rhinolophus* Lacépède, 1799

Rhinolophus is the sole genus of the Family Rhinolophidae. Csorba *et al*. (2003) proposed six subgenera (*Aquias, Phyllorhina, Rhinolophus, Indorhinolophus, Coelophyllus* and *Rhinophyllotis*). A single species, *R. ferrumequinum* (Subgenus *Rhinolophus*) occurs in Korea.

Rhinolophus ferrumequinum (Schreber, 1774)—Greater Horseshoe Bat

Vespertilio ferrum-equinum Schreber, 1774 p.174; Type locality- Burgundy, France.
Rhinolophus nippon pachyodontus Kishida and Mori, 1931 p.379 (*Nomen nudum*).
R. quelpartis Mori, 1933 p.4; Type locality- Geumnyeong Cave, Jeju Island.
R. ferrumequinum korai Kuroda, 1938 p.91; Type locality- Suryun County, Gyeongsangbuk Province, Korea. Ellerman & Morrison-Scott, 1951 p.112; Won, 1967 p.302; Won, 1968 p.77; Yoon 1992 p.32; Yoon 2010 p.13.
R. ferrumequinum nippon: Tate, 1947 p.105; Corbet, 1978 p.43.
R. ferrumequinum: Ellerman & Morrison-Scott, 1951 p.111; Won, 1958 p.453; Won, 1967 p.302; Won, 1968 p.76; Corbet, 1978 p.42; Han, 1994 p.45; Won & Smith, 1999 p.11; Son, 2001 p.89; Yoon, 2004 p.47; Yoon, 2010 p.13.
R. ferrumequinum quelpartis: Ellerman & Morrison-Scott, 1951 p.112; Won, 1958 p.453; Won, 1967 p.305; Won, 1968 p.81; Yoon, 1992 p.34.

Range: *Rhinolophus ferrumequinum* commonly occurs throughout Korea, including remote islands (Yoon 2010; Fig. 17).

Remarks: Csorba *et al*. (2003) and Simmons (2005) identified seven subspecies. These included *R. f. ferrumequinum* in Europe and northwestern Africa; *R. f. creticum* in Crete; *R. f. irani* in Iraq, Iran and Turkmenia;

R. f. proximus from Afghanistan and Uzbekistan east to Kashmir; *R. f. tragatus* from northern India to eastern China; *R. f. korai* in Korea; *R. f. nippon* in Japan and eastern China. Despite a lack of voucher specimens, two separate species were identified, *R. ferrumequinum* in the western Palearctic and *R. nippon* in the eastern Palearctic, based on high (21.6–24.5%) sequence divergence (Csorba *et al*. 2003). Benda and Vallo (2012) also supported the hypothesis of two distinct species by both morphology and mtDNA. However, based on cytochrome *b* gene analysis, Koh *et al*. (2014a) identified 4 clades, *R. f. nippon* from Japan, Korea, and northeastern China; east Chinese clade; central Chinese population; and a western Asian and European clade.

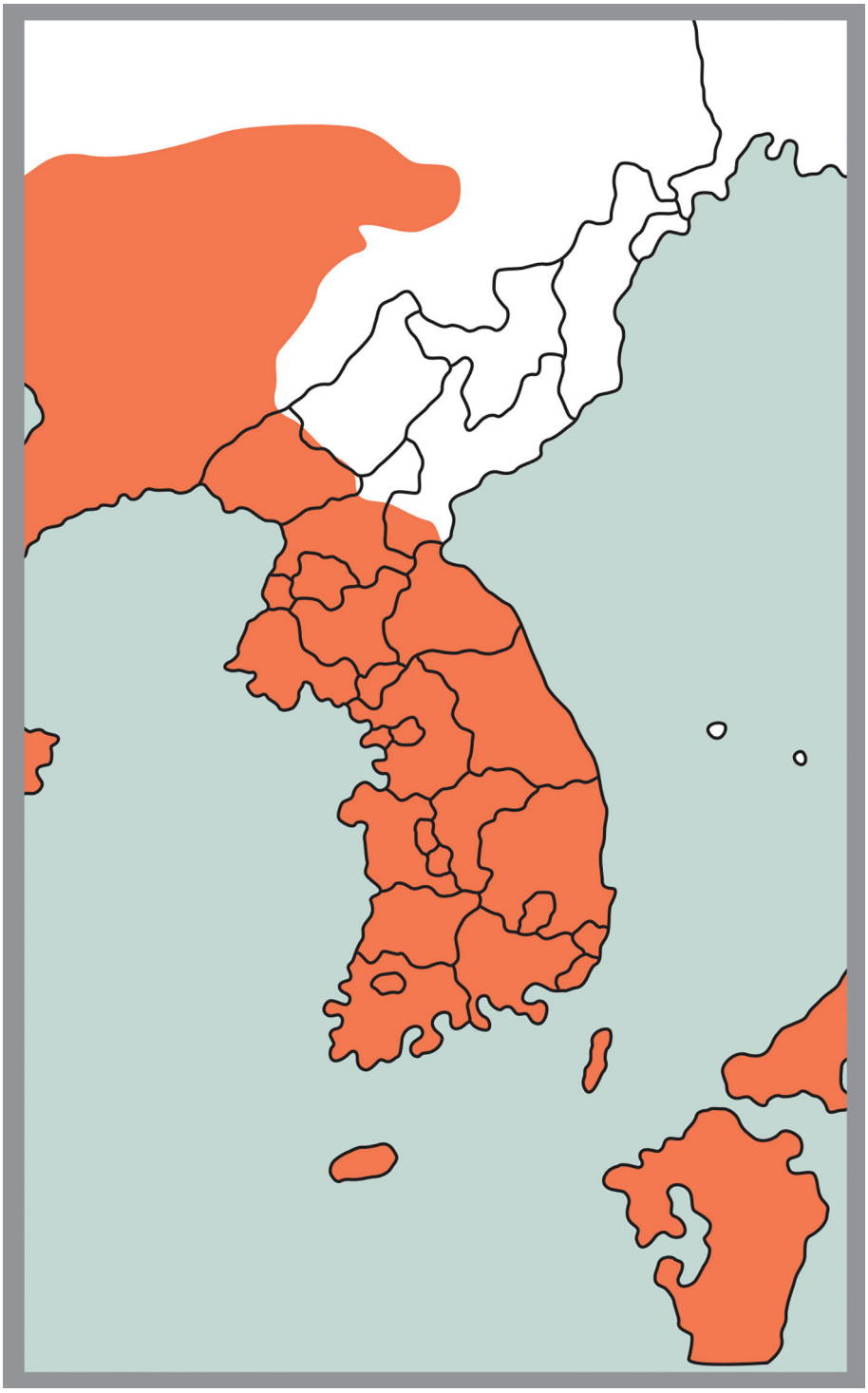

FIGURE 17. Range map of *Rhinolophus ferrumequinum* in Korea.

Although three subspecies, *R. f. pachyodontus*, *R. f. korai*, and *R. f. quelpartis,* have been reported, *pachyodontus* and *korai* were synonymized with *R. f. quelpartis* Mori, 1933. The first reported the greater horseshoe bat population on the Korean Peninsula as *R. nippon pachyodontus* without any description of a specimen (Kishida & Mori 1931). Therefore, Kuroda (1938) treated *R. n. pachyodontus* as *nomen nudum* and proposed a new name, *R. ferrumequinum korai*. The greater horseshoe bat population on Jeju Island was first classified as a monotypic species, *R. quelpartis* Mori, 1933 (Yoon 2010). Then, the taxon name was changed to *R. ferrumequinum* as the taxon *R. f. quelpartis* (Won 1967). However, based on morphological and DNA analysis, Shim (1986) subsumed populations on Jeju Island and the Korean Peninsula into one subspecies. Although *R. f. korai* Kuroda, 1938 has been mostly used for Korean subspecies, the first name *R. f. quelpartis* Mori, 1933 has priority for populations in Korea since Kuroda (1938) requested the earlier name *R. f. pachyodontus* Kishida, 1931, to be a *nomen nudum.* However, Corbet (1978), Koopman (1994) and Koh *et al*. (2014a) considered both *R. f. quelpartis* and *R. f. korai* as synonyms of *R. f. nippon*.

Conservation status: Jeollanam Province and Gwangju Metropolitan City in South Korea have designated this bat as a provincially protected species.

Family MOLOSSIDAE Gervais, 1856

Only one species, *Tadarida insignis,* representing the Subfamily Molossinae, occurs in Korea.

Genus *Tadarida* Rafinesque, 1814

Tadarida insignis (Blyth, 1862)—East Asian Free-tailed Bat

Cephalotes teniotis Rafinesque, 1814 p.12; Type locality-Sicily, Italy.
Nyctinomus insignis Blyth, 1862 p.90; Type locality- Amoy, Fujian, China.
Tadarida latouchei Thomas, 1920 p.283; Type locality-Chili, China; Tate, 1947 p.98 (reaches Korea and Vladivostok).
N. insignis: Ognev, 1927 p.157.
T. septentrionalis Kishida: Kishida & Mori, 1931 p.379 (*Nomen nudum*).
T. teniotis insignis: Ellerman & Morrison-Scott, 1951 p.134; Won, 1958 p.460; Won, 1967 p.353; Won, 1968 p.139; Corbet, 1978 p.63; Yoon, 1992 p.56.
T. teniotis: Ellerman & Morrison-Scott, 1951 p.133; Corbet, 1978 p.63; Han, 1994 p.45; Won & Smith, 1999 p.15; Son, 2001 p.131; Yoon, 2010 p.99.
T. insignis: Yoon, 2004 p.93.

Range: The few specimens of *T. insignis* collected throughout Korea belie the fact that the species remains very rare. Recent records for *T. insignis* came from the warm coastal region such as Ansan, Geoje Island and Jeju Island (Han *et al.* 2011; Fig.18).

Remarks: Based on the morphological characteristics of Japanese populations, East Asian *T. teniotis* were attributed a separate species, *T. insignis* (Simmons 2005; Aulagnier *et al*. 2008). However, Korean free-tailed bats show a closer morphological affinity with *T. teniotis* than *T. insignis* in some features, such as color of dorsal pelage, shape of keel, emargination of the anterior palate and plagiopatagium (Yoon 2010). Since *T. teniotis latouchei* has been regarded as a separate species, there is a high possibility that Korean *Tadarida* belongs to *T. latouchei* Thomas, 1920. The type locality for *T. latouchei* is closer to the Korean Peninsula (380 km) than *T. insignis* (1400 km) and *T. teniotis* (9400 km). An analysis based on morphological measurements and including *T. latouchei* and *T. insignis* from Japan showed that Korean specimens were intermediate between the two species (Funakoshi & Kunisaki 2000). For example, the forearm length ranged from 53.6–56.5 mm and 60.4–65.3 mm for *T. latouchei* and *T. insignis*, respectively, while specimens from Korea measured 58.9–61 mm (Yoon 2010). Also, tibia length varied from 16.9–17.2 mm (*T. latouchei*) to 17–23 mm (*T. insignis*) and 19.8–19.7 mm (Korean *Tadarida*). Kishida and Mori (1931) assigned the subspecies *T. t. septentrionalis* to Korea. The classification of Korean *Tadarida* is not a fixed issue, and genetic studies are needed to address the taxonomic status of free-tailed bats in Korea. Here, we followed the taxonomy of Simmons (2005) and IUCN Red List by Maeda *et al*. (2008).

Conservation status: This species has regional protection in the neighboring countries (China and Japan), but not in Korea.

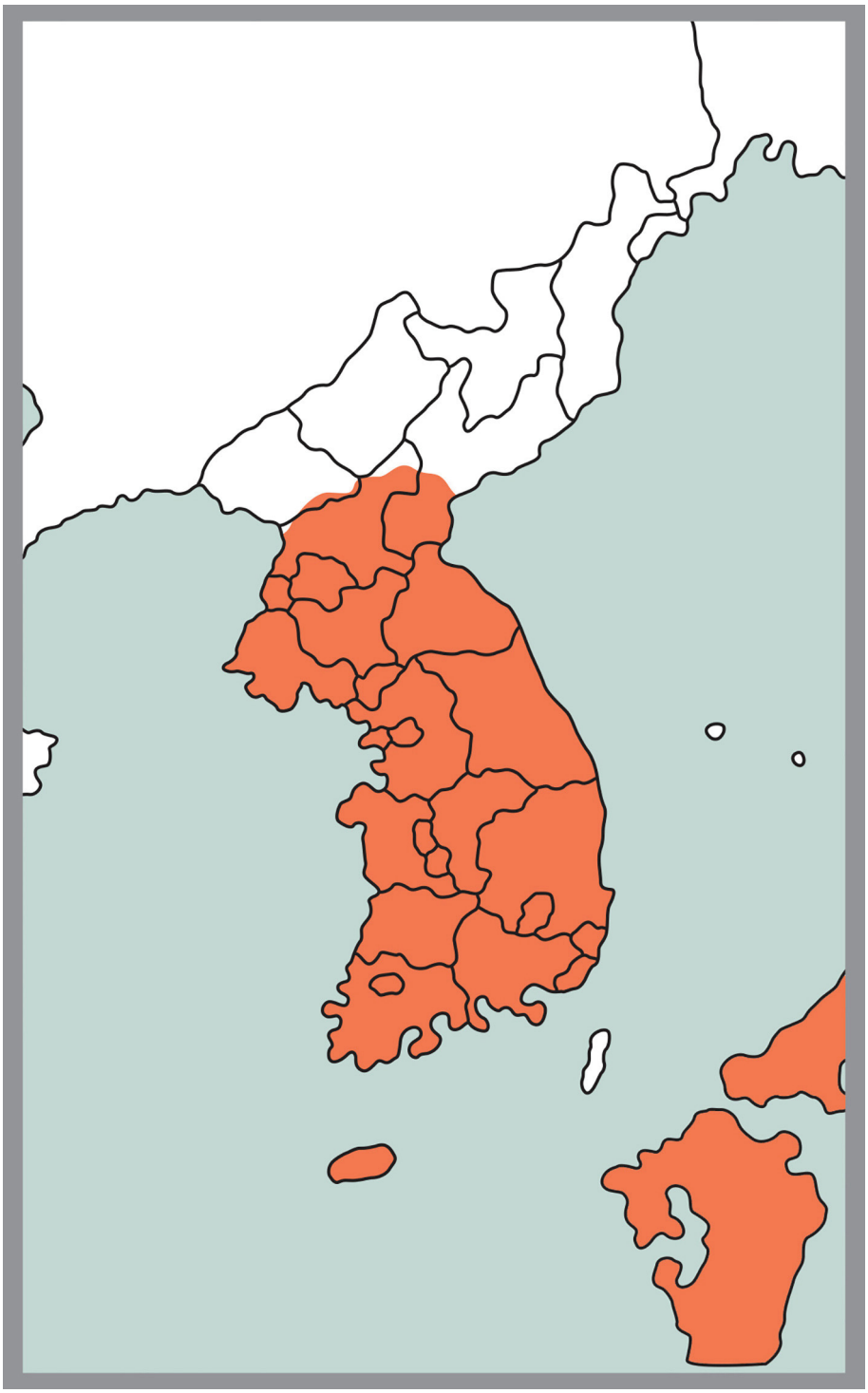

FIGURE 18. Range map of *Tadarida insignis* in Korea.

Family VESPERTILIONIDAE Gray, 1821

Most bat species in Korea represent the Family Vespertilionidae. Twenty species and eight genera within the Vespertilionidae occur in Korea. We considered other records of two species, *Eptesicus kobayashii* and *Pipistrellus pipistrellus* as erroneous identifications. Therefore, we omitted the two species from our checklist. Kishida and

Mori (1931) listed *Pactia morii* from Korea without any description or explanation. Although Ellerman and Morrison-Scott (1951) mentioned the species present in Korea as a synonym of *Myotis ricketti*, no evidence supports the presence of *Pactia morii* or *Myotis ricketti.* Eventually, we list 20 vespertilionids with valid information supporting their occurrences in Korea.

Key to genera of Vespertilionidae in Korea

1 Nostrils tubular and protruded outwards . . . . . *Murina*
- Nostrils not tubular and do not protruded outwards 2
2 Premolar 2/3; ear length >30 mm; ears joined across forehead . . . . . *Plecotus*
- Premolar 1/2, 2/2, or 3/3; ear length <20 mm; ears separated 3
3 Premolar 3/3; 38 teeth; slender, straight, pointed, upright tragus; tragus length 3 times greatest width) . . . . . *Myotis*
- Premolar 1/2 or 2/2; tragus not pointed (rounded or mushroom shape) 4
4 Dense fur on plagiopatagium between humerus and femur; length 5th finger a little longer than 4th metacarpal, reaching near midpoint of first phalanx) . . . . . *Nyctalus*
- Dense fur absent on plagiopatagium between humerus and femur. 5
5 Ears wide (>10 mm); premolar 1/2; 32 teeth 6
- Ears narrow (<8 mm); premolar usually 2/2; 34 teeth (small or absent upper anterior premolar in *Hypsugo*) 7
6 Conspicuously frosted dorsal pelage, long pale hair tips; ear almost reaching mouth; palatal emargination wider than long . . . . . *Vespertilio*
- Pelage not frosted; posterior margin of ear with a narrow furrow extending towards the corner of mouth ending before reaching mouth; palatal emargination longer than wide . . . . . *Eptesicus*
7 Tail beyond uropatagium <2 mm; post calcaneal lobe broad with well-developed keel . . . . . *Pipistrellus*
- Last 1 or 2 tail vertebrae 2–5 mm beyond uropatagium; post calcaneal lobe narrow and always without keel. . . . . *Hypsugo*

Genus *Murina* Gray, 1842

Murina represents the subfamily Murinae in Korea, with two species included in the Subgenus *Murina*.

Key to species of Genus *Murina* in Korea

- Forearm >40 mm; plagiopatagium attached on 1/3 of toe (distance to ankle) . . . . . *M. hilgendorfi*
- Forearm <40 mm; plagiopatagium attached on 1/2 of toe (close to ankle). . . . . *M. ussuriensis*

Murina hilgendorfi Peters, 1880—Hilgendorf's Tube-nosed Bat

Harpyiocephalus hilgendorfi Peters, 1880 p.24; Type locality- Yedo near Tokyo, Japan.
Murina hilgendorfi: Ognev, 1913 p.406.
M. ognevi: Kishida & Mori, 1931 p.379.
M. hilgendorfi intermedia Mori, 1933 p.5; Type locality- Mt. Geumgang, Korea; Kuroda, 1938 p.105; Won, 1968 p.136.
M. hilgendorfi ognevi: Kuroda, 1938 p.105; Won, 1968 p.135.
M. intermedia: Tate, 1947 p.94.
M. leucogaster: Won, 1967 p.350; Won, 1968 p.133; Corbet, 1978 p.62; Han, 1994 p.45; Won & Smith, 1999 p.15; Son, 2001 p.126; Yoon, 2004 p.88; Yoon, 2010 p.93; Jo *et al*. 2012 p.251.
M. leucogaster ognevi: Won, 1958 p.459; Won, 1967 p.351; Yoon, 1992 p.54.
M. leucogaster hilgendorfi: Ellerman & Morrison-Scott, 1951 p.185; Won, 1968 p.133; Corbet, 1978 p.62.
M. leucogaster intermedia: Ellerman & Morrison-Scott, 1951 p.185; Won, 1958 p.459; Yoon, 1992 p.52; Yoon, 2010 p.93.

Range: *Murina hilgendorfi* ranges throughout the Korean Peninsula and Jeju Island (Won 1968; Son 2001; Jo *et al.* 2012; Fig. 19). Hilgendorf's tube-nosed bat is considered widespread but naturally rare (Won & Smith 1999).

Remarks: *Murina hilgendorfi* was previously listed as a subspecies of *M. leucogaster* (Corbet 1978). Yoshiyuki (1989) elevated *M. hilgendorfi* to a species based on morphology, and Kruskop *et al*. (2012) confirmed its status through genetic data. Three subspecies, *M. l. hilgendorfi, M. l. ognevi*, or *M. l. intermedia,* have been

assigned to Korean populations, but their subspecific status in Korea is unclear. In fact, North and South Korean populations have been considered as a single subspecies (Yoon 2010).

Conservation status: The Red Data Book of North Korea classified this species as 'Rare' (MAB National Committee of DPR Korea 2002), but the Red Data Book of South Korea registered Hilgendorf's tube-nosed bat as 'Least Concern' (NIBR 2012).

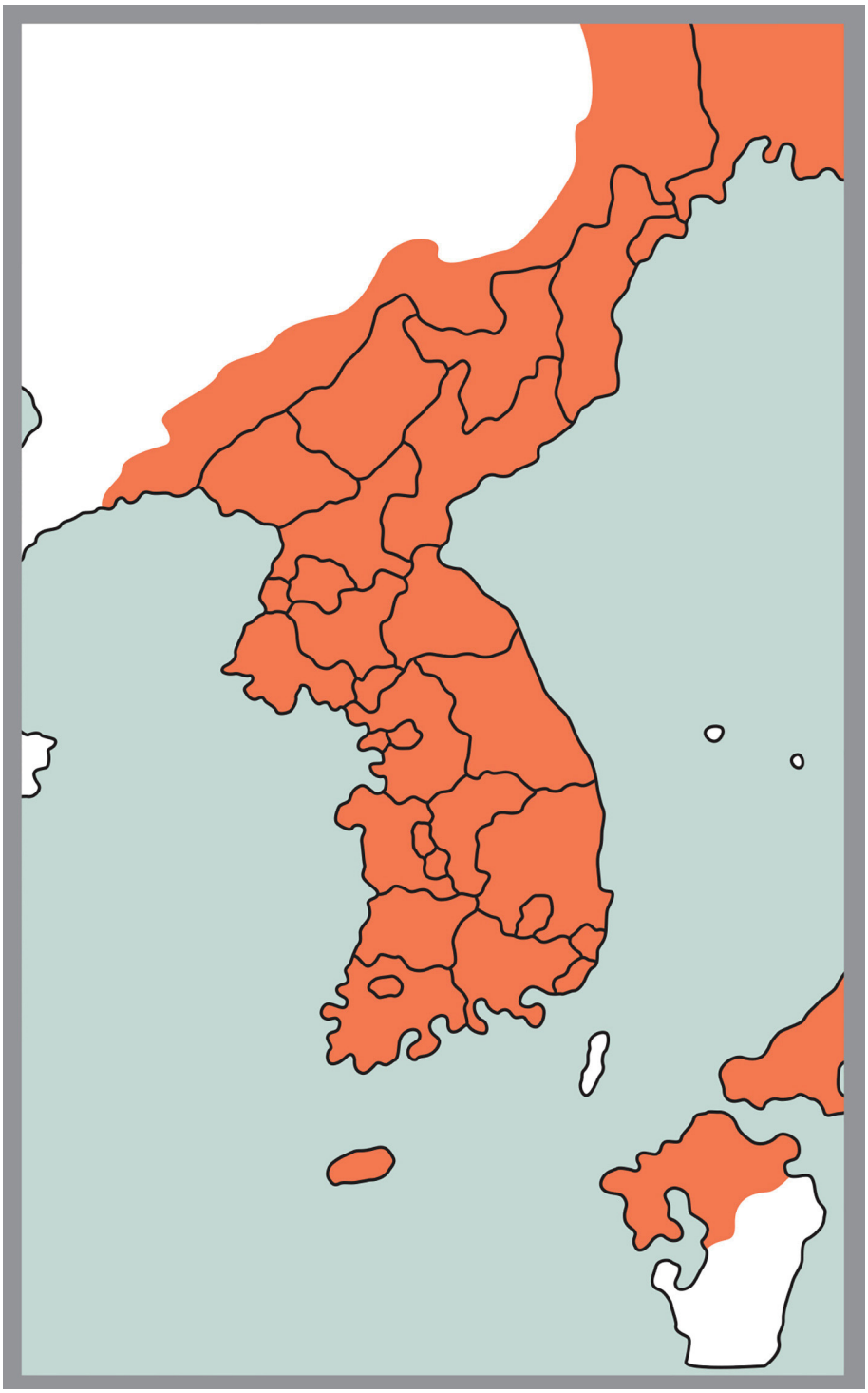

FIGURE 19. Range map of *Murina hilgendorfi* in Korea.

Murina ussuriensis Ognev, 1913—Ussurian Tube-nosed Bat

Murina ussuriensis Ognev, 1913 p.402; Type locality- Evseevka, Ussuri, Russia; Kishida & Mori, 1931 p.379; Kuroda, 1938 p.106; Han, 1994 p.45; Won & Smith, 1999 p.15; Son, 2001 p.128.
M. aurata ussuriensis: Ellerman & Morrison-Scott, 1951 p.185; Won, 1958 p.459; Won, 1967 p.351; Won, 1968 p.132; Yoon, 1992 p.52; Yoon, 2010 p.91.
M. aurata: Won, 1968 p.131; Corbet, 1978 p.62; Yoon, 2010 p.91.

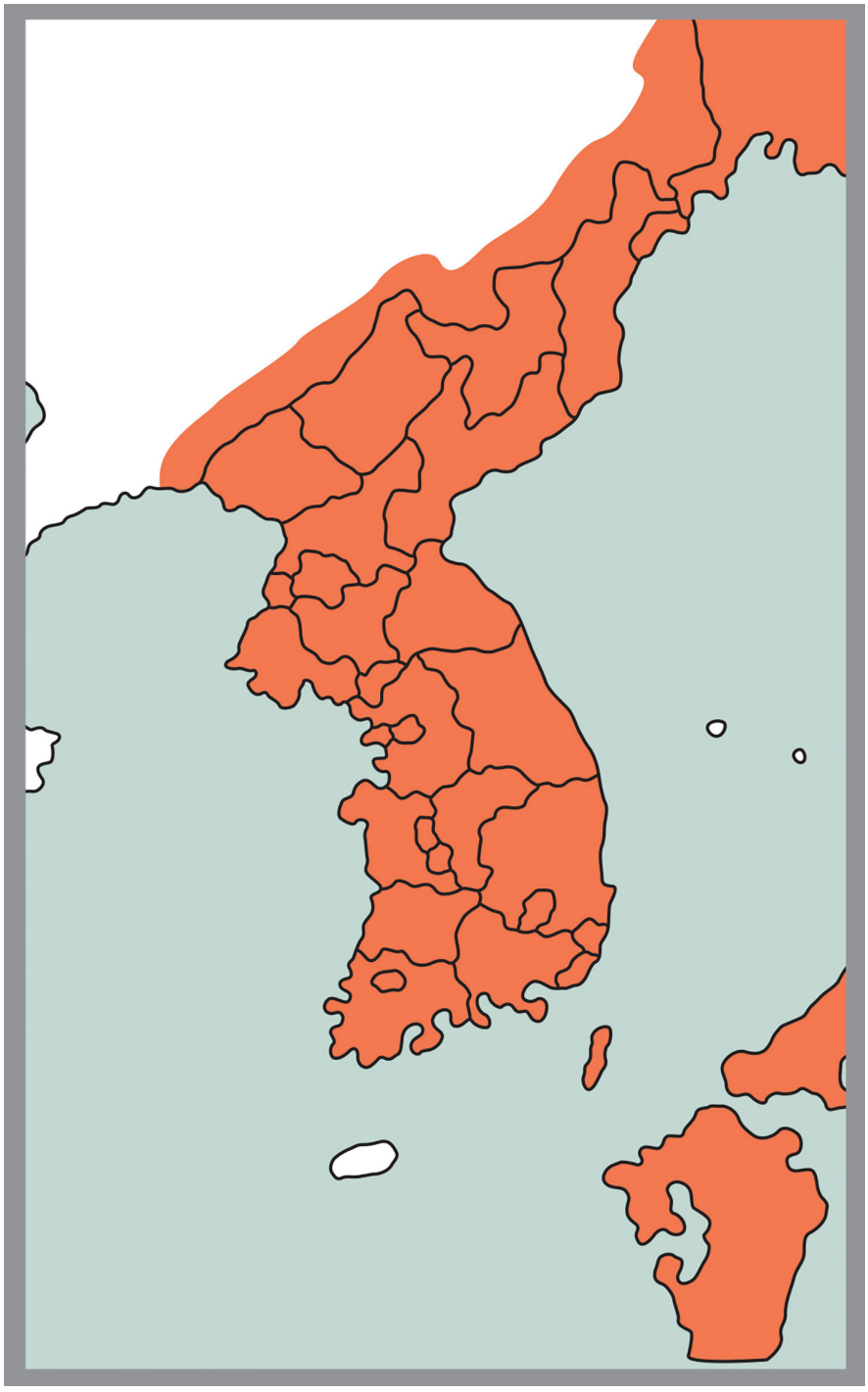

FIGURE 20. Range map of *Murina ussuriensis* in Korea.

Range: Only two specimens collected at Mt. Jiri in 1931 and three incomplete skins removed from a snake stomach in central Korea in 1959 represent *M. ussuriensis* in Korea (Won & Smith 1999). However, additional reports of this bat in 2011 confirmed the continued existence of the species in central Korea (Han *et al.* 2011; Fig. 20). This species inhabits inland montane forest (Yoon 2010).

Remarks: This species in Korea along with Japan and Russian Far-East was classified as the Subspecies *M. aurata ussuriensis* (Corbet 1978). Maeda (1980) promoted *M. a. ussuriensis* into a full species based on skull size, forearm length, rostrum and canines (larger than *M. aurata*); shorter nostril; and hair cover on back of forearm. The range of *M. aurata* is confined to Nepal, India and central China, whereas *M. ussuriensis* is limited to northeastern Asia. The subspecific status of populations in Korea remains uncertain.

Conservation status: The Ministry of Environment designated *M. ussuriensis* in South Korea as a threatened in 2005 and an endangered species in 2018. The IUCN Red List considers this species as 'Least Concern'. The North Korean Government classified populations as 'Rare' (MAB National Committee of DPR Korea 2002).

Genus *Plecotus* E. Geoffroy Saint-Hilaire, 1818

A single species of *Plecotus* (Tribe Plecotini, Subfamily Vespertilioninae) occurs in Korea.

Plecotus cf. *ognevi* Kishida, 1927—Ognev's Long-eared Bat

Plecotus auritus ognevi Kishida, 1927a p.418; Type locality- Sakhalin, Russia; Won, 1958 p.458; Won, 1967 p.346; Won, 1968 p.103; Yoon, 1992 p.411.
P. auritus: Won, 1968 p.102; Han, 1994 p.45; Won & Smith, 1999 p.14; Son, 2001 p.121; Yoon, 2004 p.66; Yoon, 2010 p.81.
P. auritus uenoi Imaizumi and Yoshiyuki, 1969 p.262; Type locality- Gangwon Province, Korea; Corbet, 1978 p.61; Yoon, 1992 p.42; Yoon, 2010 p.82.

Range: These rare bats occur in southern Korea below 37° N and mostly inhabit limestone strata in Gangwon Province (NIBR 2015; Fig. 21). One record exists from Ulleung Island (130 km from east coast of the Korean Peninsula) in the East Sea (Won 1967).

Remarks: This species was regarded as a subspecies of *P. auritus* (Simmons 2005). Asian populations were also identified as separate species, *P. ognevi* in continental Asia and *P. sacrimontis* in Japan (Spitzenberger *et al.* 2006; Stubbe *et al*. 2008). Mitochondrial DNA analyses confirmed a deep phylogeographic split between *P. auritus* and *P. ognevi* (Datzmann *et al.* 2012; Kruskop *et al.* 2012). In Korea, two Subspecies *P. a. ognevi* in the north and *P. a. uenoi* in the south were reported, but the geographical separation between the two species remains uncertain (Won & Smith 1999). Won (1967) stated that populations from Korea were closer to *P. ognevi* than *P. sacrimontis.* Thus, we assigned the name *Plecotus* cf. *ognevi* to the long-eared bat present in Korea. Further investigations are needed to assess the status of this bat in Korea.

Conservation status: Although IUCN regarded this species (*P. ognevi*) as 'Least Concern', the South Korean Government considered the species (*P. auritus*) 'Vulnerable' (NIBR 2012). The Ministry of Environment designated *Plecotus auritus* in South Korea an endangered species in 2005. Loss of broad-leaved forest, mainly mature trees, is the main threat. The species is affected locally by remedial timber treatment and loss of roost sites.

Genus *Myotis* Kaup, 1829

Eight species of the Genus *Myotis* represent the Subfamily Myotinae in Korea, including the recently reported cryptic species *M. davidii.* Although Subgenera *Myotis, Leuconoe,* and *Selysius* are identified, no consensus exists on the subgenera (Simmons 2005). For the Genus *Myotis,* we followed the English common name of 'Myotis' from Wilson and Reeder (2005). The common name 'Whiskered Bat' has also been common usage for this genus.

Key to species of Genus *Myotis* in Korea

1	Forearm >45 mm; orange pelage; wing membrane black	*M. rufoniger*
-	Forearm <45 mm; brown to gray pelage	2
2	Stiff hairs present on uropatagium margin	*M. bombinus*
-	Stiff hairs absent on uropatagium margin	3
3	Posterior uropatagium margins form acute angle	4

-	Posterior uropatagium margins form obtuse angle	5
4	Plagiopatagium inserted in middle or bottom of sole of upper heel or lower tibia	*M. macrodactylus*
-	Plagiopatagium attached at middle of ankles	*M. petax*
5	Length of tibia >18 mm; forearm 35–42 mm	*M. longicaudatus*
-	Length of tibia <17.5 mm	6
6	Dog-leg blood vessel on uropatagium (Fig. 22)	*M. ikonnikovi*
-	Straight blood vessel on uropatagium	'*M. sibiricus* (or *M. davidii*)*

*For identification of *M. sibiricus* and *M. davidii*, molecular analysis is needed (Tsytsulina *et al.* 2012).

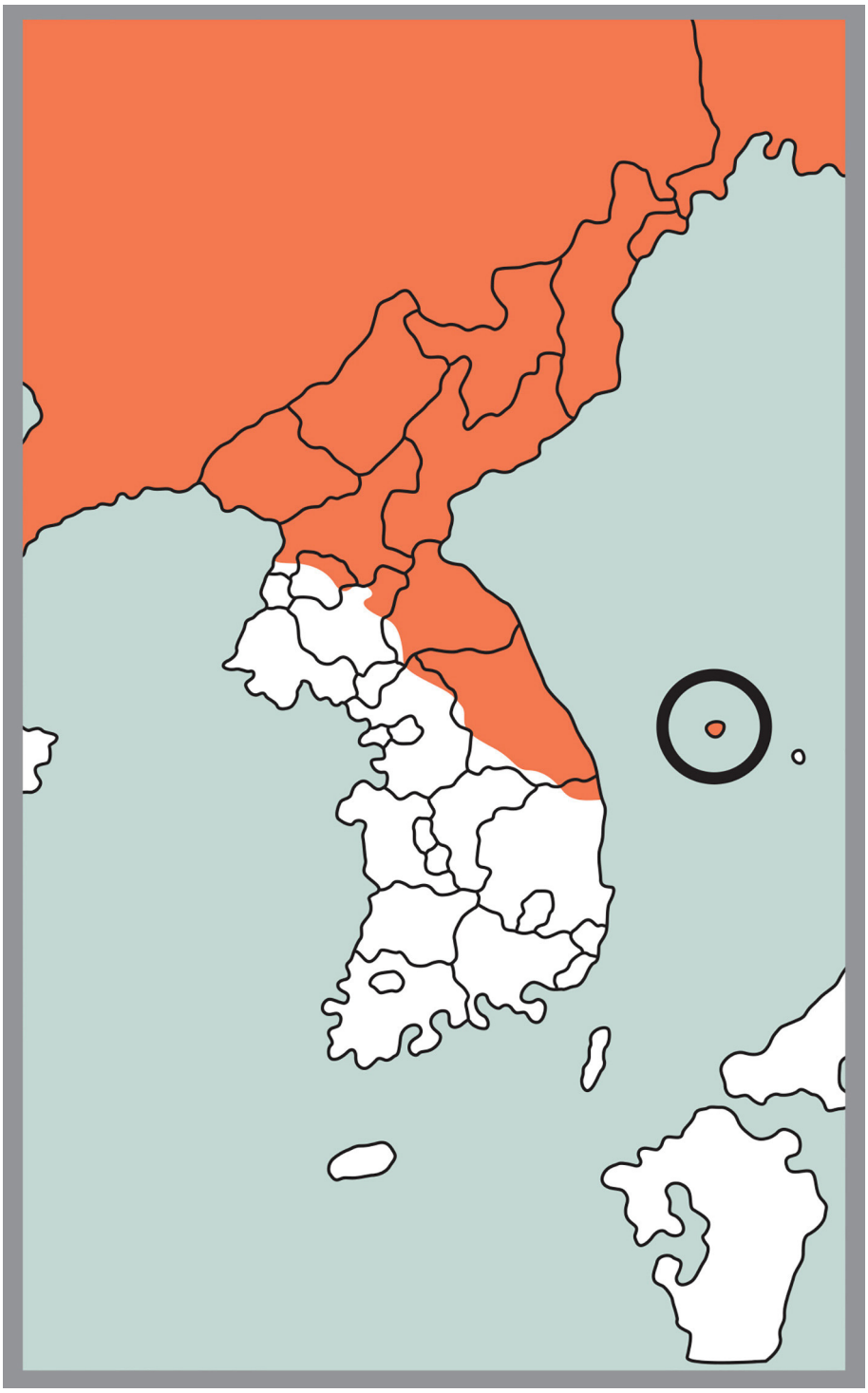

FIGURE 21. Range map of *Plecotus* cf. *ognevi* in Korea.

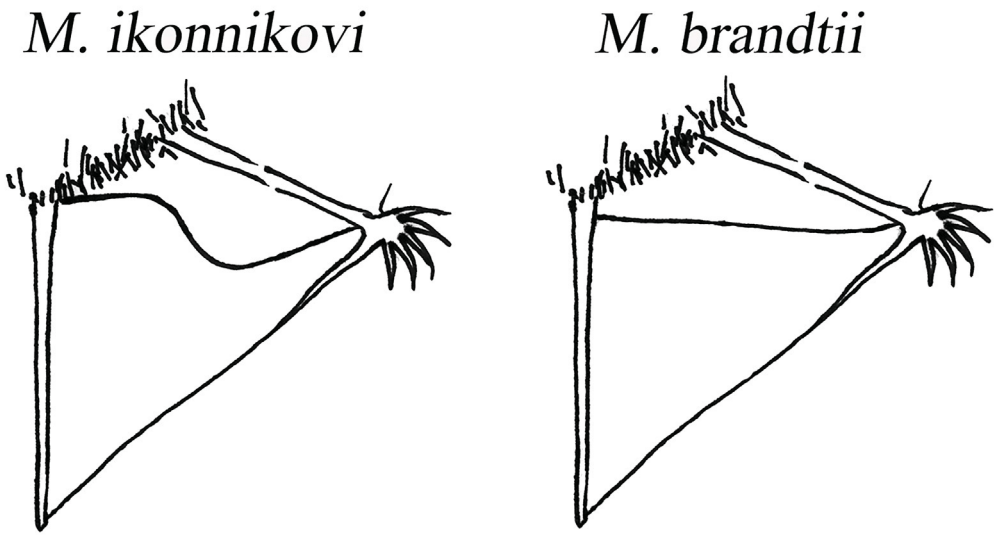

FIGURE 22. Blood vessel on uropatigium of *M. ikonnikovi* and *M. brandtii.*

Myotis rufoniger (Tomes, 1858)—Red and Black Myotis

Vespertilio rufo-niger Tomes, 1858 p.82; Type locality- Shanghai, China.
Myotis tsuensis Kuroda, 1922 p.43; Type locality- Tsushima, Japan.
M. chofukusei Mori, 1928 p.359; Type locality- Haeju, Korea; Kishida & Mori, 1931 p.378; Tate, 1947 p.82.
M. formosus tuensis: Kuroda, 1938 p.97; Won, 1967 p.317; Won, 1968 p.99; Corbet, 1978 p.50; Yoon, 1992 p.38; Yoon, 2010 p.32.
M. formosus chofukusei: Kuroda, 1938 p.97; Ellerman & Morrison-Scott, 1951 p.146; Won, 1958 p.455.
M. sicarius tsuensis?: Tate, 1941 p.548.
M. formosus: Ellerman & Morrison-Scott, 1951 p.146; Won, 1968 p.98; Corbet, 1978 p.50; Han, 1994 p.45; Won & Smith, 1999 p.12 Son, 2001 p.92; Yoon 2004 p.60; Yoon, 2010 p.31; Jo *et al*., 2012 p.251.

Range: The distribution of *M. rufoniger* extends over the Korean Peninsula with most records coming from Jeollanam Province (southwestern Korea) and Jeju Island (Fig. 23).

Remarks: *Myotis formosus* forms a taxonomic complex with several related species. Tomes (1858) based his evaluation of *V. rufoniger* on color differences (pinna edge black, dorsal and ventral hairs tipped with bright rufous) but hesitated in classifying it as a distinct species or a ''variety'' of *V. formosus* (Csorba *et al.* 2014). Kuroda (1922) depicted *M. tsuensis* as having reddish-brown fur dorsally and ventrally but only made a comparison with *M. macrodactylus* and *M. nattereri bombinus*. He identified *M. tsuensis* as a distinct species. Kishida (1924) defined *M. watasei* from Taiwan as matching the ''rufoniger-type'' based on red-brown ear color at the base edged with black, the basal dorsal and ventral pelage brown-yellow and terminal one-third brown and feet black. Mori (1928) differentiated *M. chofukusei* from *M. bechsteinii* by the ''capucine orange'' dorsal fur and ears emarginated with dark margins. Imaizumi (1970), however, regarded *M. tsuensis* as ''indistinguishable from *M. chofukusei* described from Korea'' and gave its range as Tsushima and the Korean Peninsula. Yoshiyuki (1989) and Yoon (2010) also regarded the Korean population as belonging to the Subspecies *M. formosus tsuensis*. Kim *et al*. (2011c) published the complete mitochondrial genome of the species (*M. formosus*) in Korea. Csorba *et al.* (2014) split *M. formosus* into six species: *M. bartelsi* in Java and Bali; *M. formosus* in Afghanistan, India, Nepal, China, Taiwan, and Vietnam; *M. hermani* in Sumatra, Thailand, and Malaysia; *M. rufoniger* in Korea, Japan, China, Taiwan, Laos, and Vietnam; *M. rufopictus* in the Philippines; and *M. weberi* in Sulawesi. The species from Korea grouped with the *rufoniger* group, not the *formosus* group (Csorba *et al.* 2014).

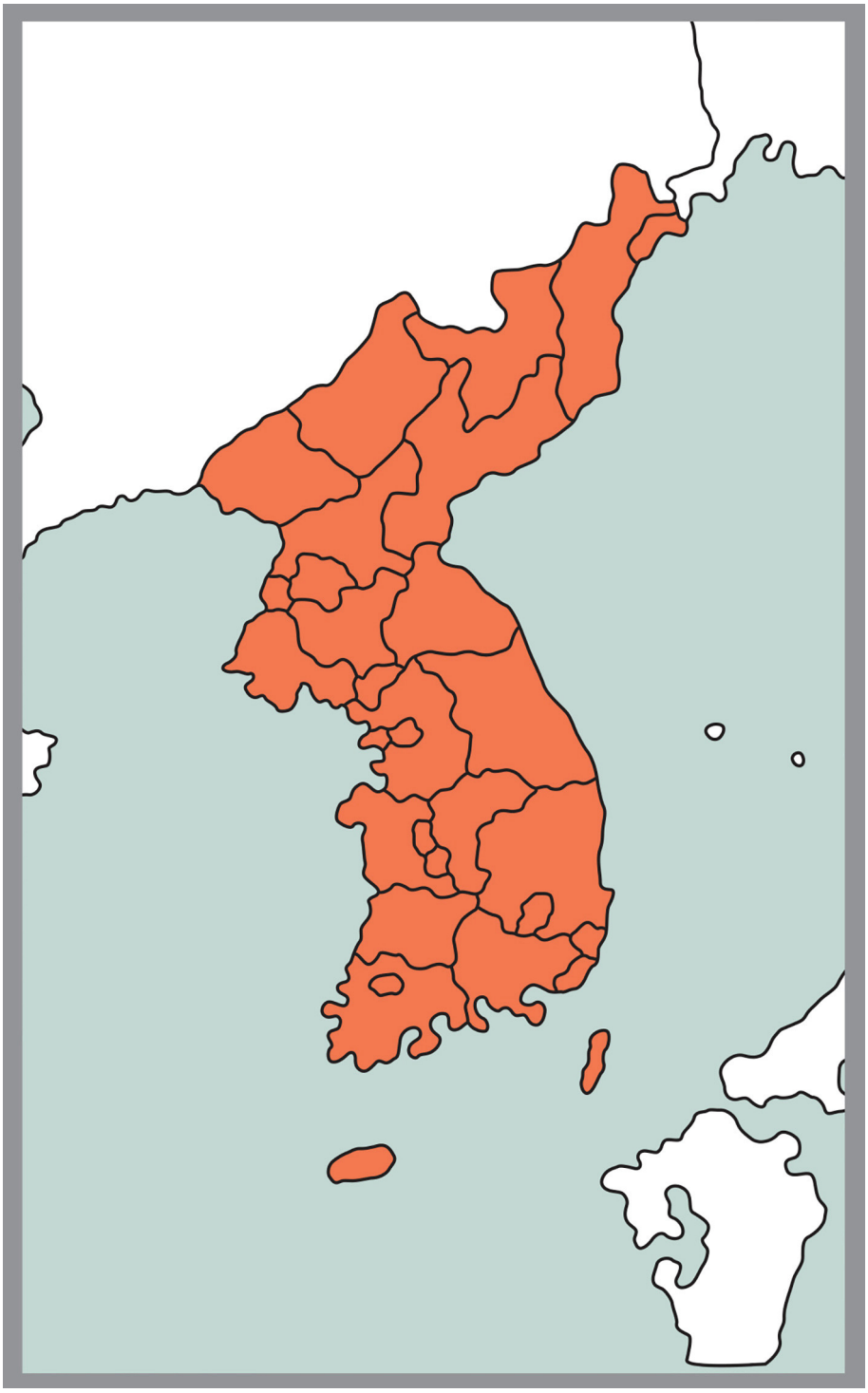

FIGURE 23. Range map of *Myotis rufoniger* in Korea.

Mori (1928) reported *M. chofukusei* on the Korean Peninsula and treated it as a synonym of *M. formosus tsuensis* Kuroda, 1922 from Tsushima, Japan (Yoon 2010). Since *M. f. tsuensis* had priority and represented a subspecies for Korea and Tsushima Island, we suggest assignment of *M. rufoniger tsuensis* as the subspecies for Korea.

Conservation status: The Ministry of Environment designated *M. formosus* (=*M. rufoniger*) as an endangered species in 1998 and the Cultural Heritage Administration listed it as a Natural Monument in 2005. Although the IUCN has not assigned a conservation status of this species, the Red Data Books for populations in South Korea and North Korea list *M. rufoniger* as 'Vulnerable' (NIBR 2012) and 'Rare' (MAB National Committee of DPR Korea 2002), respectively.

Myotis bombinus Thomas, 1906—Far Eastern Myotis

Myotis nattereri bombinus Thomas, 1905 [1906] p.337; Type locality- Miyazaki, Japan; Yoon, 1992 p.37; Yoon, 2010 p.44.
M. nattereri amurensis: Kishida & Mori, 1931 p.378; Kuroda, 1938 p.96; Ellerman & Morrison-Scott, 1951 p.143; Won, 1958 p.454; Won, 1967 p.314; Won, 1968 p.91; Corbet, 1978 p.49.
M. nattereri: Ellerman & Morrison-Scott, 1951 p.143; Won, 1968 p.90; Corbet, 1978 p.49; Son, 2001 p.104; Yoon, 2004 p.58; Yoon, 2010 p.44.
M. bombinus: Han, 1994 p.45; Won & Smith, 1999 p.12; Jo *et al*. 2012 p.251.

Range: The distribution of *M. bombinus* ranges throughout the Korean Peninsula and Jeju Island (Son 2001; Fig. 24); it commonly inhabits volcanic caves on Jeju Island (Jo *et al*. 2012).

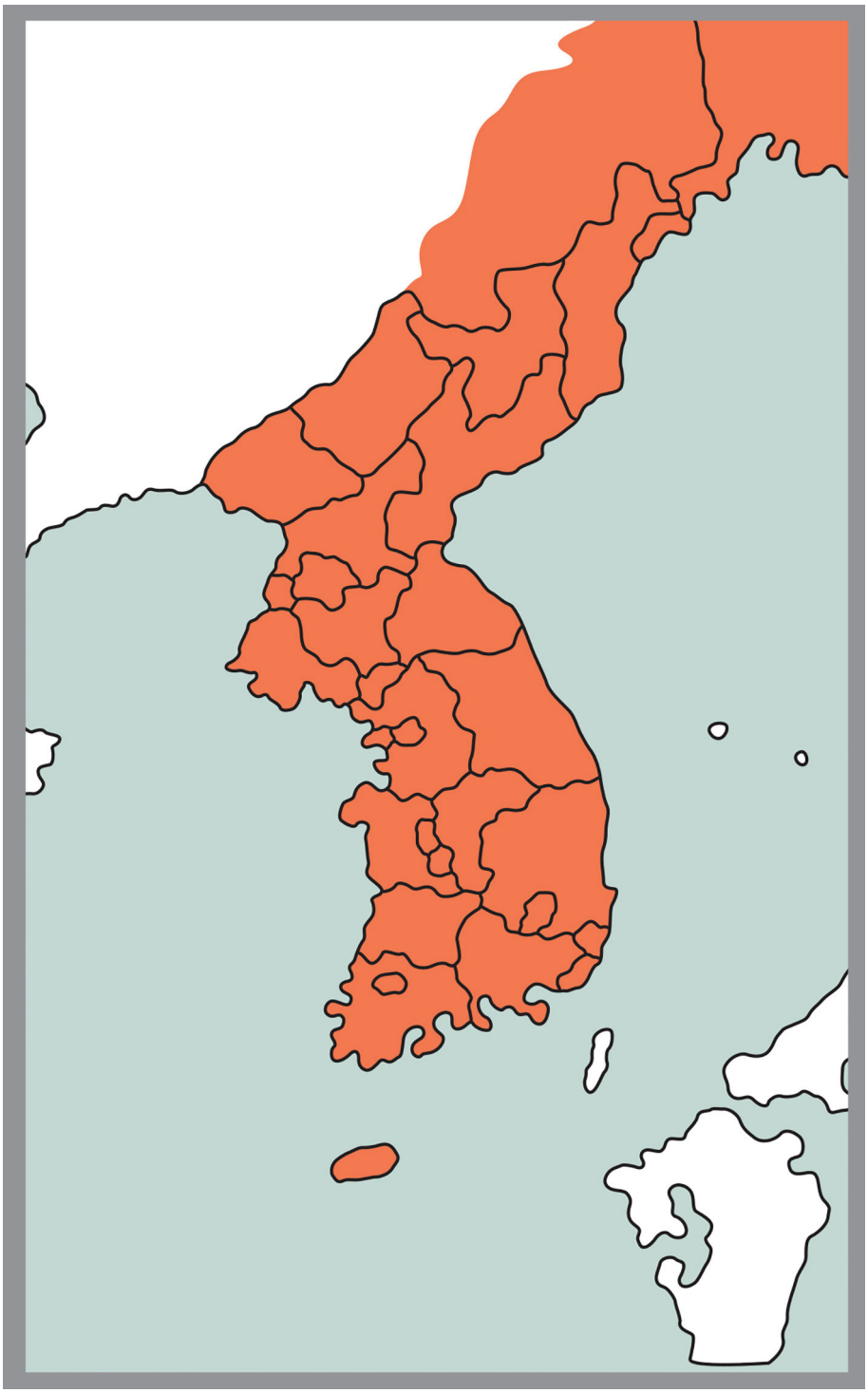

FIGURE 24. Range map of *Myotis bombinus* in Korea.

Remarks: Previously, *M. bombinus* was considered a subspecies of *M. nattereri* (Yoon 2010). Based on mtDNA analysis, *M. bombinus* seemed more related to *M. chinensis* and clearly distinct from *M. nattereri* in Greece (Kawai *et al.* 2003).

Conservation status: The IUCN Red List registered *M. bombinus* as 'Near threatened' (Tsytsulina 2008). However, populations in Korea have rarely received consideration for protection.

Myotis macrodactylus (Temminck, 1838)—Big-footed Myotis

Vespertilio macrodactylus Temminck, 1838 p.231; Type locality- Japan.
V. (*leuconoe*) *capaccinii macrodactylus*: Trouessart, 1897 p.124.
Myotis (?*daubentonii*) *macrodactylus*: Kuroda, 1938 p.92.
M. capaccinii: Won, 1968 p.88.
M. capaccinii macrodactylus: Won, 1968 p.88.
M. macrodactylus: Yoon, 1992 p.40; Han, 1994 p.45; Won & Smith, 1999 p.13; Son, 2001 p.94; Yoon, 2010 p.36; Jo *et al.*, 2012 p.251.
M. macrodactylus macrodactylus: Yoon, 2004 p.64.

Range: The big-footed myotis inhabits the Korean Peninsula and Jeju Island and is one of the most common bat species (Won & Smith 1999; Jo *et al*. 2012; Fig. 25).

Remarks: This species was previously classified as a subspecies of *M. capaccinii* (Won 1968), but the absence of hair on the uropatagium margin near the calcar clearly distinguishes *M. macrodactylus* from *M. capaccinii* (Corbet 1978; Yoshiyuki 1989).

Conservation status: The Red Data Book of North Korea lists *M. macrodactylus* as a 'Rare' species (MAB National Committee of DPR Korea 2002).

Myotis petax Hollister, 1912—Eastern Water Bat

Myotis petax Hollister, 1912 p.6; Type locality- Altai district, Siberia, Russia.
M. daubentonii ussuriensis Ognev, 1927 p.146; Type locality- Vladivostok, Russia; Kishida & Mori, 1931 p.378; Kuroda, 1938 p.96; Ellerman & Morrison-Scott, 1951 p.147; Won, 1958 p.454; Won, 1967 p.312; Won, 1968 p.84; Yoon, 1992 p.38; Yoon, 2010 p.40.
M. daubentonii: Tate, 1947 p.84; Won, 1968 p.84; Corbet, 1978 p.50; Han, 1994 p.45; Won & Smith, 1999 p.12; Son, 2001 p.96; Yoon, 2004 p.61; Yoon, 2010 p.40; Jo *et al*., 2012 p.251.

Range: *Myotis petax* is a common bat over the Korean Peninsula and Jeju Island (Yoon 2010; Fig. 26).

Remarks: *Myotis daubentonii ussuriensis* has been used to designate the Korean population (Yoon 2010). A combined approach based on molecular, morphological and ecological data identified two distinct species in *M. daubentonii*, 1) a western group (west of Omsk, Russia) *Myotis daubentoniid,* and 2) an eastern group (east of Omsk) *M. petax*, described by Hollister in 1912 from the Republic of Altai in the south of western Siberia (Kruskop 2004; Matveev *et al*. 2005). Mitochondrial (ND1 gene) analysis had *M. petax* clustered with *M. ikonnikovi, M. mystacinus*, and *M. aurascens*, whereas, *M. daubentonii* clustered with *M. nattereri, M. bombinus, M. chinensis, M. schaubi*, and *M. escalerari* (Datzmann *et al.* 2012). Combined mitochondrial cytochrome *b* and nuclear Rag 2 analyses together with craniodental morphology identified *M. petax* closer to *M. macrodactylus* and *M. daubentonii* closer to *M. frater* (Ruedi *et al.* 2013, 2015). Therefore, *M. petax* is the proper name for this species in Korea.

Myotis longicaudatus Ognev, 1927—Long-tailed Myotis

Myotis longicaudatus Ognev, 1927 p.145; Type locality- Vladivostok, Russia; Kuroda, 1938 p.97; Won, 1958 p.455; Won, 1967 p.316.
M. frater: Ellerman & Morrison-Scott, 1951 p.142; Won, 1968 p.97; Corbet, 1978 p.49; Han, 1994 p.45; Won & Smith, 1999 p.13; Son, 2001 p.102; Yoon, 2010 p.28.

M. frater longicaudatus: Ellerman & Morrison-Scott, 1951 p.143; Won, 1968 p.98; Yoon, 2010 p.29.
M. frater frater: Yoon, 1992 p.37.

Range: The distribution of *M. longicaudatus* ranges throughout the Korean Peninsula (Son 2001; Fig. 27). This species ranges from central Siberia (Altai and Yenisei River) through northeastern China and the Korean Peninsula, Russian Far East to Honshu and Hokkaido, Japan (Tsytsulina & Strelkov 2001).

Remarks: *Myotis longicaudatus* applied to populations of this bat in Korea, Ussuri region and Altai Mountains of Russia, but *longicaudatus* has been relegated as a subspecies of *M. frater* (Yoon 2010). However, recent molecular phylogenetic data identified *M. longicaudatus* as a distinct species from *M. frater* (Ruedi *et al*. 2015) and including two subspecies (*kaguyae* Imaizumi, 1956 and *eniseensis* Tsytsulina and Strelkov, 2001).

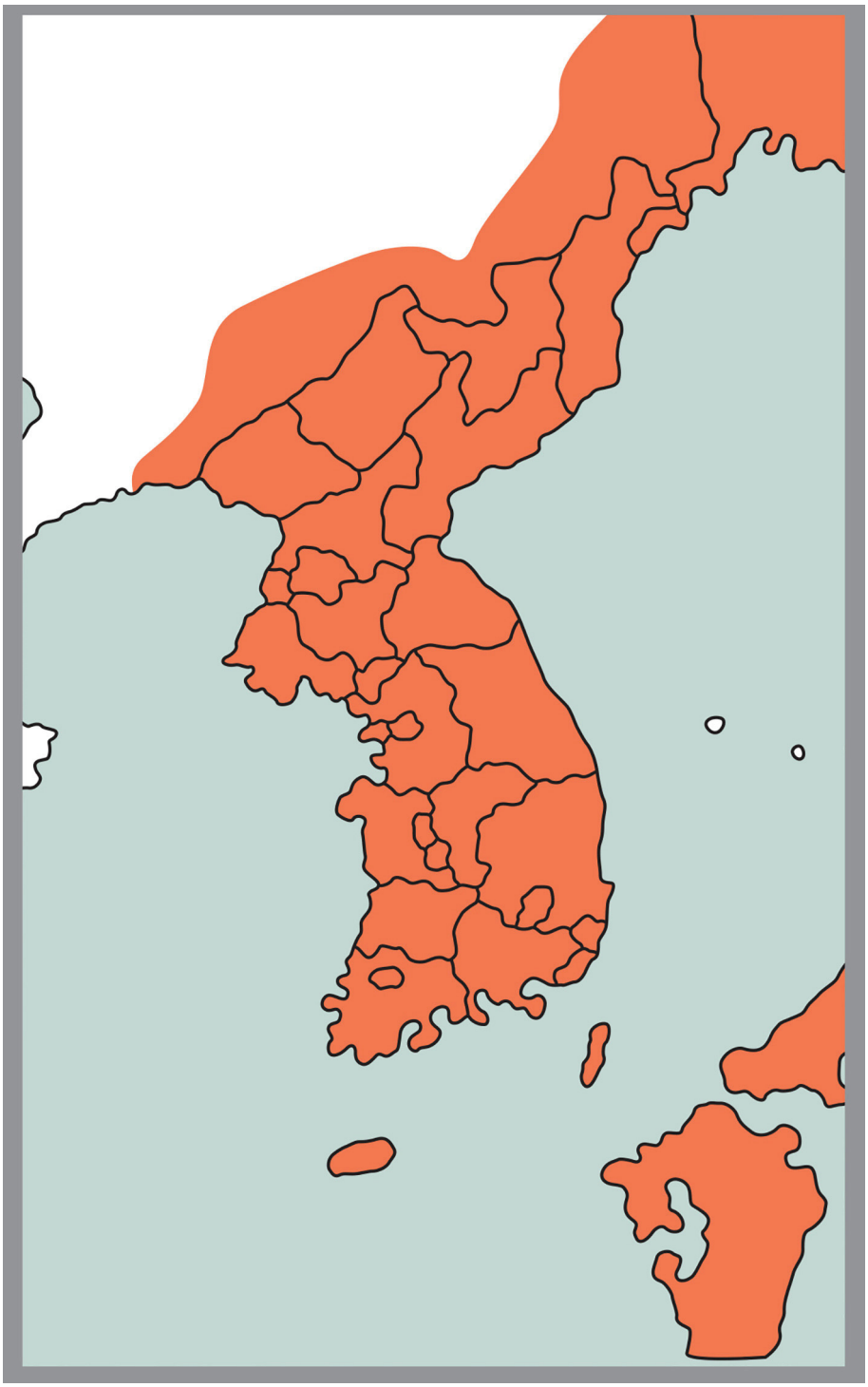

FIGURE 25. Range map of *Myotis macrodactylus* in Korea.

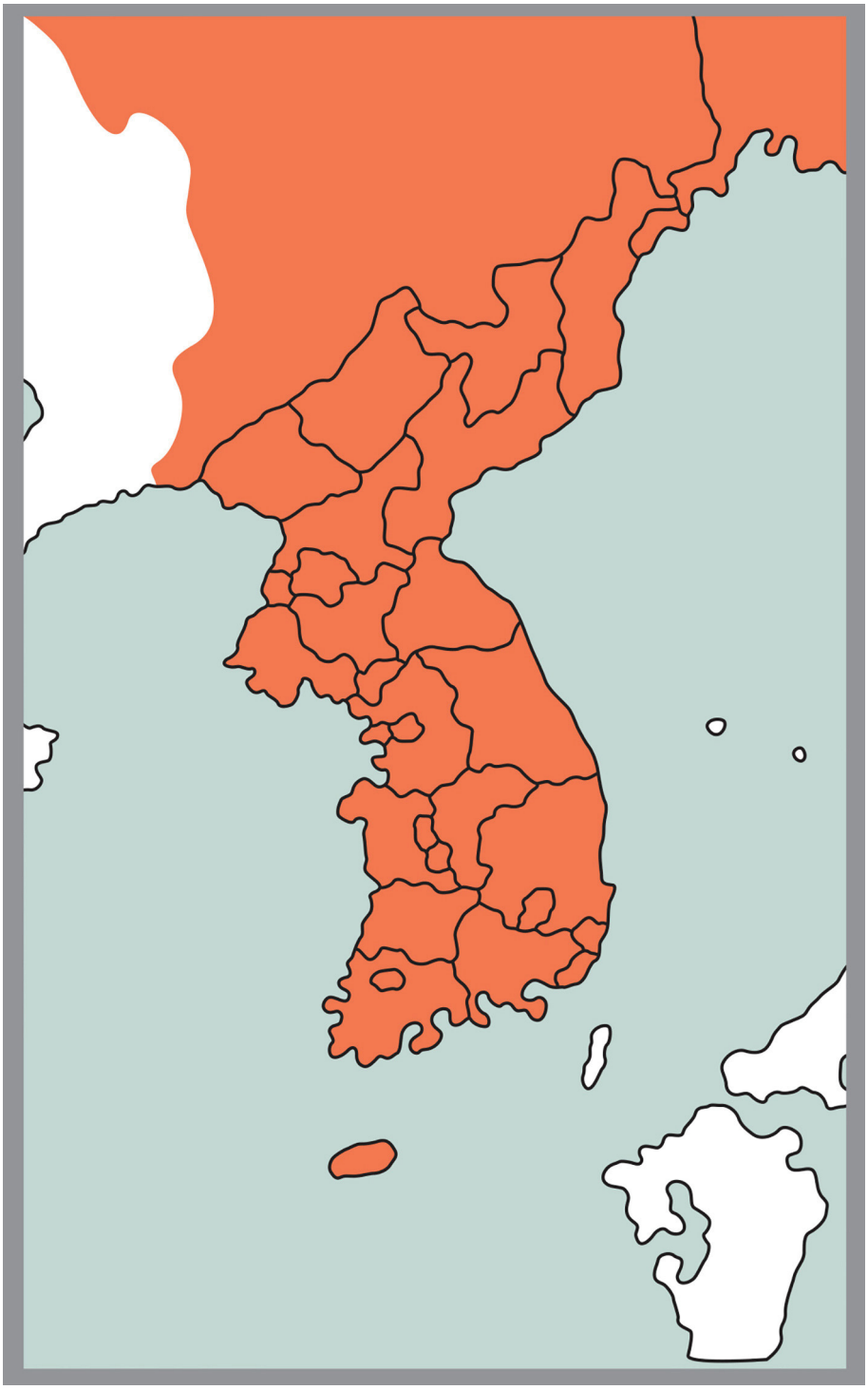

FIGURE 26. Range map of *Myotis petax* in Korea.

Conservation status: The Red Data Book of North Korea lists *M. longicaudatus* as 'Rare' (MAB National Committee of DPR Korea 2002).

Myotis ikonnikovi Ognev, 1912—Ikonnikov's Myotis

Myotis ikonnikovi Ognev, 1912 p.477; Type locality- Ussuri region, Russia; Kuroda, 1938 p.96; Ellerman & Morrison-Scott, 1951 p.141; Won, 1958 p.454; Won, 1967 p.315. Won, 1968 p.95; Corbet, 1978 p.48; Yoon, 1992 p.37; Han, 1994 p.45; Won & Smith, 1999 p.13; Yoon, 2010 p.21; Jo *et al*., 2012 p.251.

M. (*Selysius*) *mystacinus ikonnikovi*: Bianchi, 1917 p.80.

Range: *Myotis ikonnikovi* ranges throughout Korea, including Jeju Island (Won 1968; Jo *et al.* 2012; Fig. 28).

Remarks: *Myotis ikonnikovi* was previously considered a subspecies of *M. muricola* but was more recently elevated to a distinct species (Tsytsulina 2001). Since *M. ikonnikovi* is easily confused with *M. brandtii*, examination of *M. brandtii* in Korea might require reassessment as to the correct species. Synonyms of *M. ikonnikovi* include *M. yesoensis*, *M. hosonoi*, *M. ozensis* and *M. fujiensis* (Maeda 1994; Kawai 2009b).

Conservation status: The Red Data Books of North Korea and South Korea designated *M. ikonnikovi* as 'Rare' in North Korea and 'Least Concern' in South Korea (MAB National Committee of DPR Korea 2002; NIBR 2012).

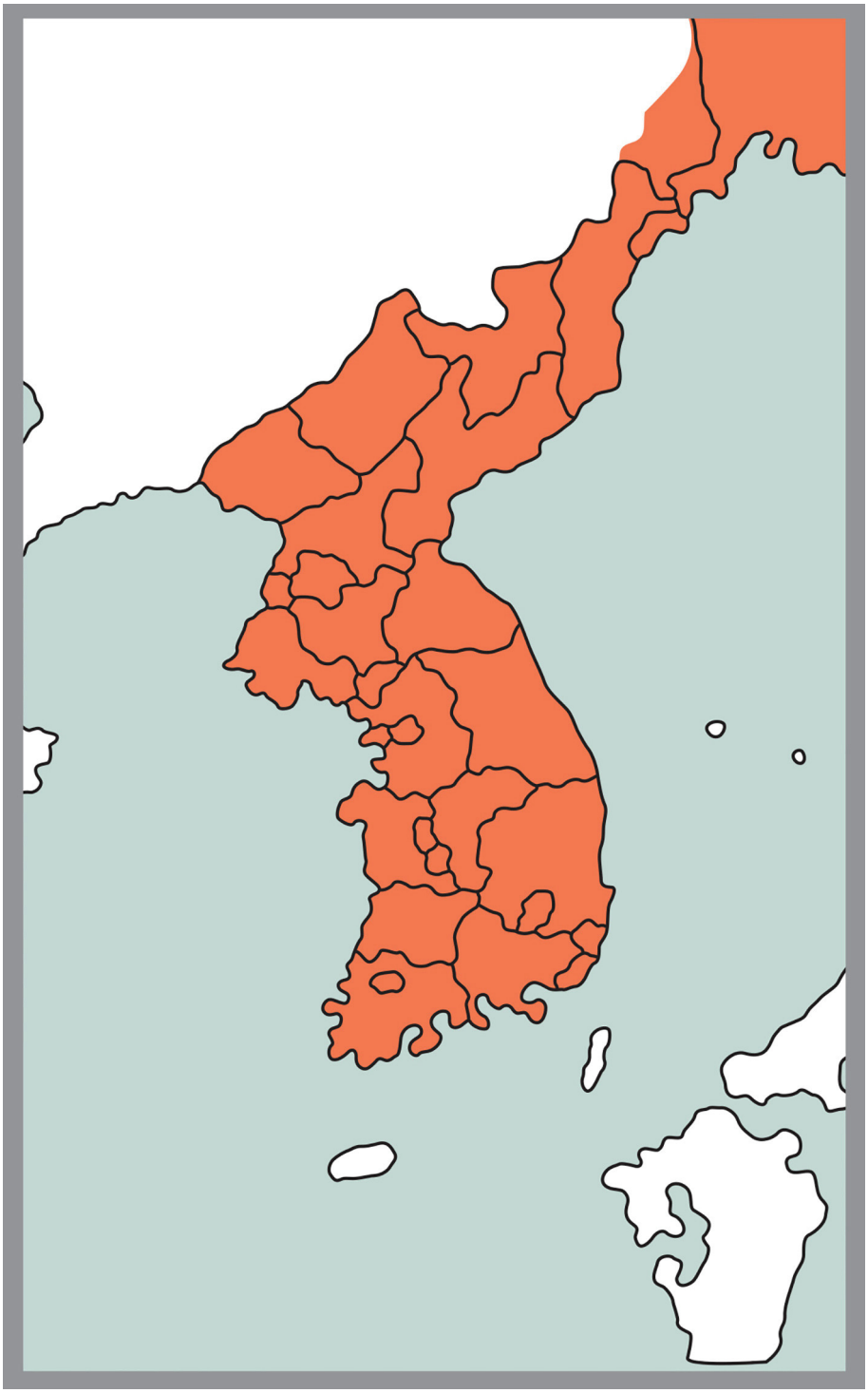

FIGURE 27. Range map of *Myotis longicaudatus* in Korea.

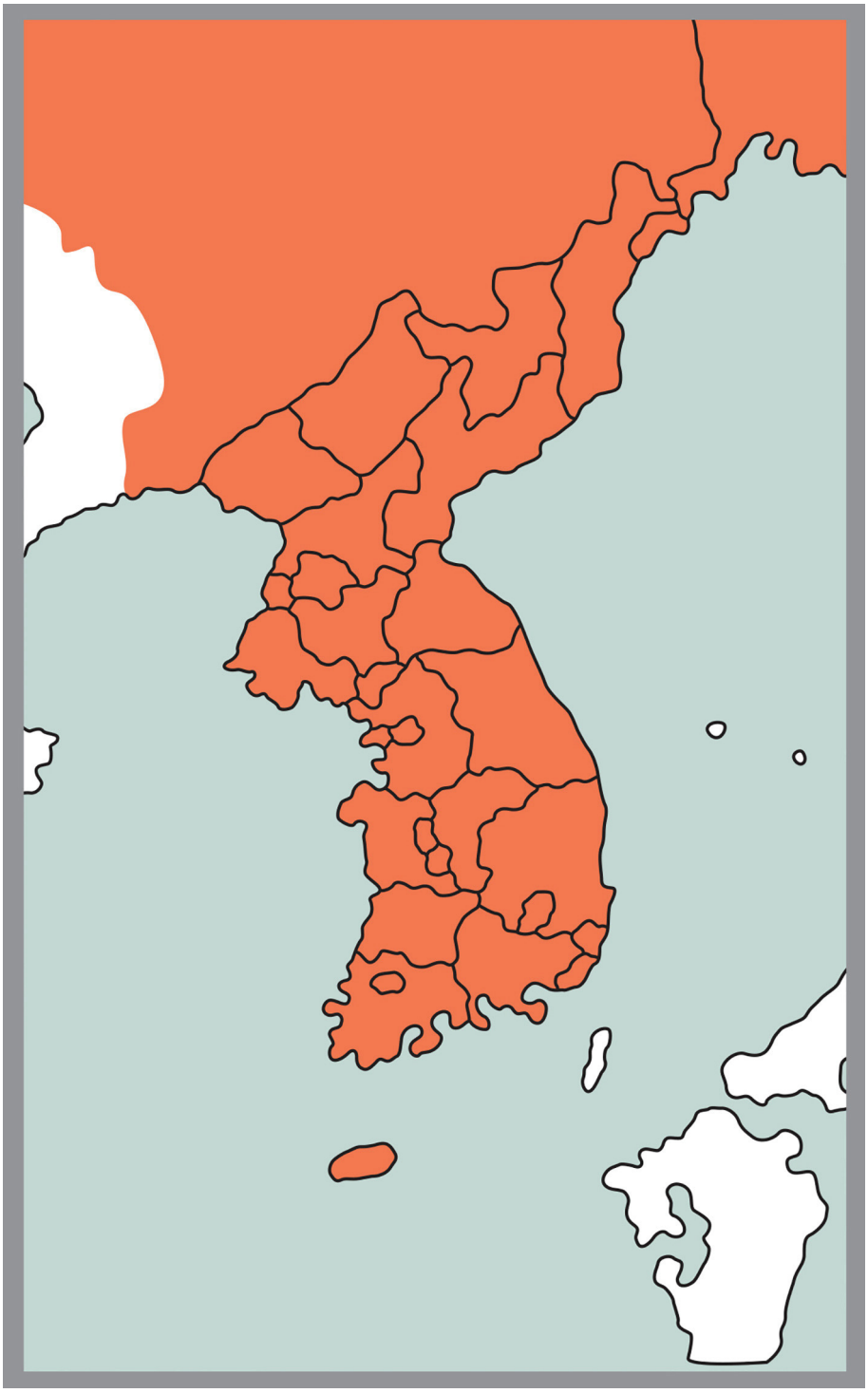

FIGURE 28. Range map of *Myotis ikonnikovi* in Korea.

Myotis sibiricus (Kastshenko, 1905)—Siberian Myotis

Vespertilio brandtii Eversmann, 1845 p.505; Type locality- Ural, Russia.
V. mystacinus sibiricus Kastshenko, 1905 p.25; Type locality- Tomsk, Russia.
Myotis mystacinus: Thomas, 1907a p.404 (Sakhalin, Russia); Ellerman & Morrison-Scott, 1951 p.138; Won, 1968 p.93; Corbet, 1978 p.47; Son, 2001 p.98; Yoon, 2004 p.53; Yoon, 2010 p.23.
M. mystacinus gracilis Ognev, 1927 p.145; Type locality- Vladivostok, Russia; Kuroda, 1938 p.95; Ellerman & Morrison-Scott, 1951 p.140; Won, 1967 p.311; Won, 1968 p.94; Yoon, 1992 p.35; Yoon, 2010 p.23.

M. gracilis: Won, 1958 p.454.
M. brandtii: Han, 1994 p.45; Won & Smith, 1999 p.13; Jo *et al.*, 2012 p.251.
M. sibiricus: Kruskop *et al*., 2012 p.1 (Asia).
M. (Aeorestes) sibirica: Kruskop, 2012 p.99 (Korea).

Range: The distribution of this common species covers the Korean Peninsula and Jeju Island (Yoon 2010; Fig. 29).

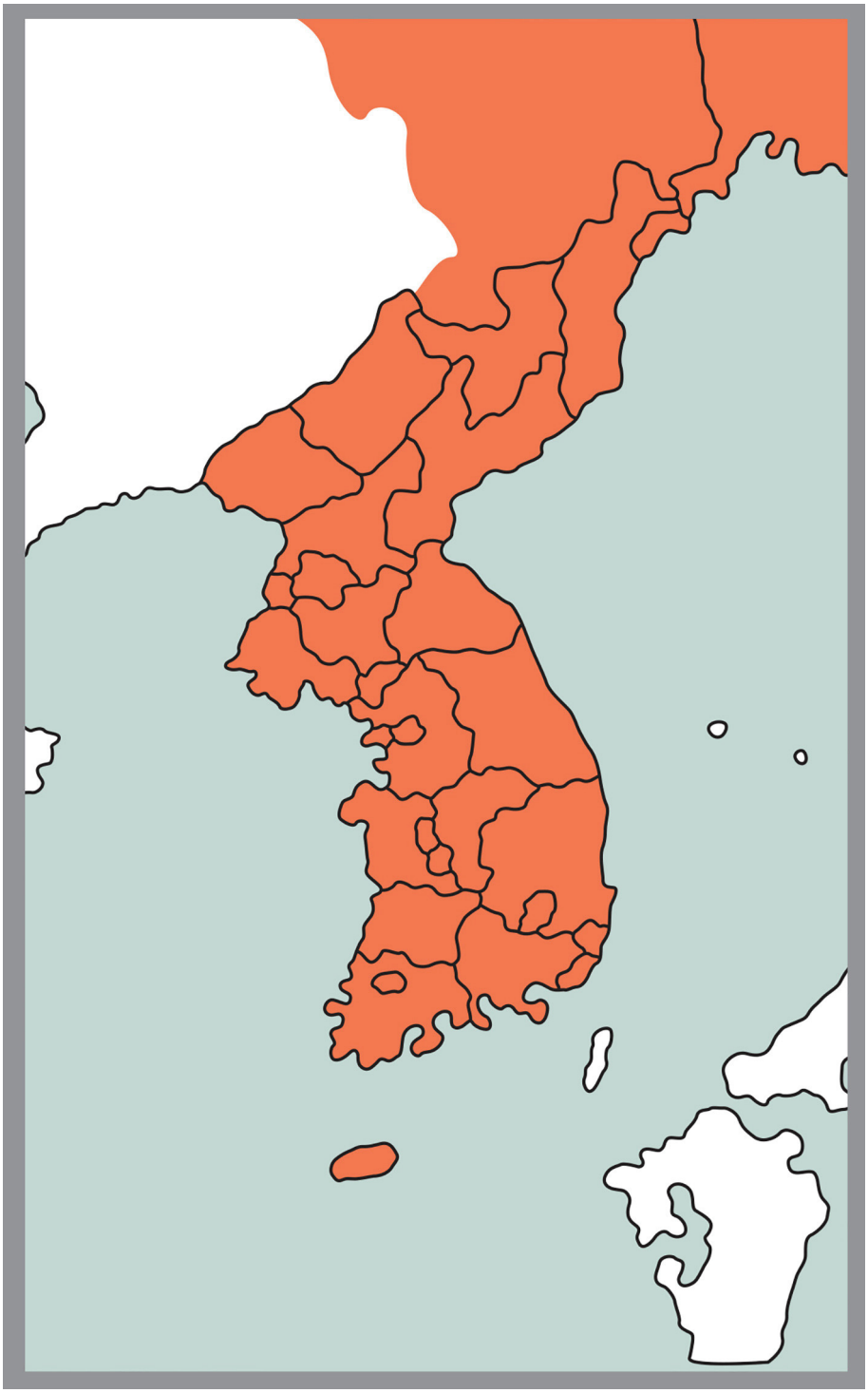

FIGURE 29. Range map of *Myotis sibiricus* in Korea.

Remarks: Korean populations were regarded as *M. mystacinus gracilis* Ognev, 1927 (Won 1967). Although Yoshiyuki (1989) classified the subspecies as a distinct species, *M. gracilis*, Koopman (1993) treated *M. gracilis* as a synonym of *M. brandtii*. Then, Yoon (2010) assigned Korean populations of this species to *M. mystacinus*

gracilis based on size and morphology of the teeth. However, the range of *M. mystacinus* is restricted to western Eurasia (Hutson *et al.* 2008) and DNA analysis supported a distribution of *M. brandtii* in eastern Asia (Kawai *et al.* 2003). Therefore, Korean subspecies of Siberian myotis subsumed to *M. brandtii* with two known subspecies, *M. brandtii brandtii* in Europe, Caucasus and western Siberia and *M. b. gracilis* in central and eastern Siberia, Mongolia, Korea, Manchuria, and Japan (Benda & Tsytsulina 2000; Tsytsulina 2001). Based on the dorsal profile of skull and morphology of the protoconules of premolar, Yoshiyuki (1989) elevated *gracilis* to a distinct species, and Horáček *et al*. (2000) provisionally kept *gracilis* as a species. Also, Kawai *et al.* (2006) supported the species *M. gracilis* because of great genetic distances (0.103–0.107) between *M. brandtii* from Europe and *M. b. gracilis* from Hokkaido, Japan. DNA analysis indicated that *M. mystacinus* and *M. ikonnikovi* as Old World *Myotis*, and both *M. brandtii* and *M. b. gracilis* as New World *Myotis* grouping with American *Myotis* spp. (Stadelmann *et al.* 2007). Kruskop *et al.* (2012) also supported a distinct species from eastern Asia based on molecular markers, but they gave priority to the first name *M. sibiricus* (Kastshenko, 1905) from Tomsk in central Siberia over *M. gracilis* from Vladivostok in Russian Far East, which is followed here.

Myotis davidii (Peters, 1869)—David's Myotis

Vespertilio davidii Peters, 1869 p.402; Type locality- Hebei, China.
Myotis davidii: Tate, 1947 p.84 (Beijing, China).
M. aurascens: Tsytsulina *et al.,* 2012 p.2 (Gangwon Province, Korea).

Range: The distribution of *M. davidii* presumably extends throughout Korea (Tsytsulina *et al*. 2012; Fig. 30). Although only two bats have been identified thus far as *M. davidii* in Yeongwol County, Gangwon Province, Korea, more discovery of *M. davidii* in Korea could occur due to specimens erroneously classified as *M. brandtii* because of morphological similarities between these two-cryptic species.

Remarks: Tsytsulina *et al.* (2012) subsumed *M. aurascens* in eastern Eurasia with samples from Korea previously identified as *M. mystacinus* (or *M. sibiricus*). However, Benda *et al*. (2012) considered *M. aurascens* from Korea as *M. davidii*, clustering together populations from Tuva, Russia and Kazakhstan (Benda *et al*. 2012).

Genus *Nyctalus* Bowditch, 1825

Two species of *Nyctalus* (Tribe Pipistrellini, Subfamily Vespertilioninae) occur in Korea.

Key to species of Genus *Nyctalus* in Korea

- Forearm 58–64 mm . . . . . *N. aviator*
- Forearm <50 mm . . . . . *N. furvus*

Nyctalus aviator Thomas, 1911—Bird-like Noctule

Nyctalus aviator Thomas, 1911a p.380; Type locality- Tokyo, Japan; Corbet, 1978 p.56; Han, 1994 p.45; Won & Smith, 1999 p.13; Son, 2001 p.116; Yoon, 2004 p.74; Yoon, 2010 p.60.
Vespertilio molossus Temminck, 1838 p.269.
N. maximus aviator: Kuroda, 1940 p.225.
N. lasiopterus aviator: Ellerman & Morrison-Scott, 1951 p.161; Won, 1958 p.456 Won, 1967 p.327; Won, 1968 p.106; Yoon, 1992 p.45.
N. lasiopterus: Won, 1968 p.105.

Range: The distribution of this species encompasses most of Korea, but the bird-like noctule remains rare (Yoon 2010; Fig. 31).

Remarks: Previously, *N. aviator* was considered a subspecies of *N. lasiopterus* in Korea (Won 1967, 1968).

Nyctalus lasiopterus and *N. aviator* are found respectively on the western and eastern sides of the Palearctic region and were previously considered as conspecific (Tate 1942, Imaizumi 1970). They are now mostly recognized as separate species (Corbet 1978, Maeda 1983, Simmons 2005). Samples from intermediate geographic locations between Europe and Japan are needed to determine if these two taxa should be treated as separate species or vicariant populations of the same species (Salgueiro *et al*. 2007).

Conservation status: IUCN recorded this species as 'Near Threatened' but the South Korean government registered *N. aviator* as a species of 'Least Concern' (NIBR 2012).

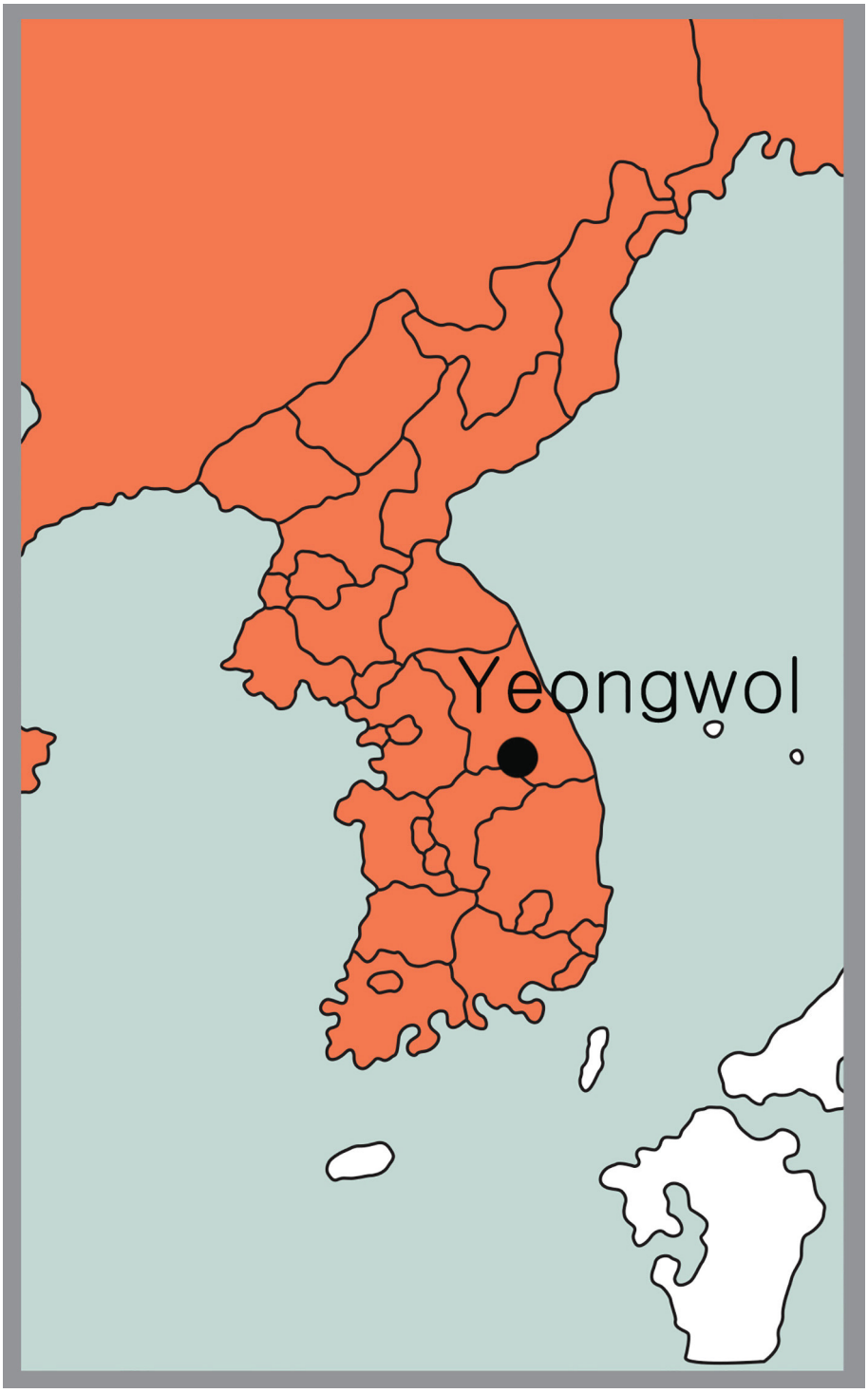

FIGURE 30. Range map of *Myotis davidii* in Korea.

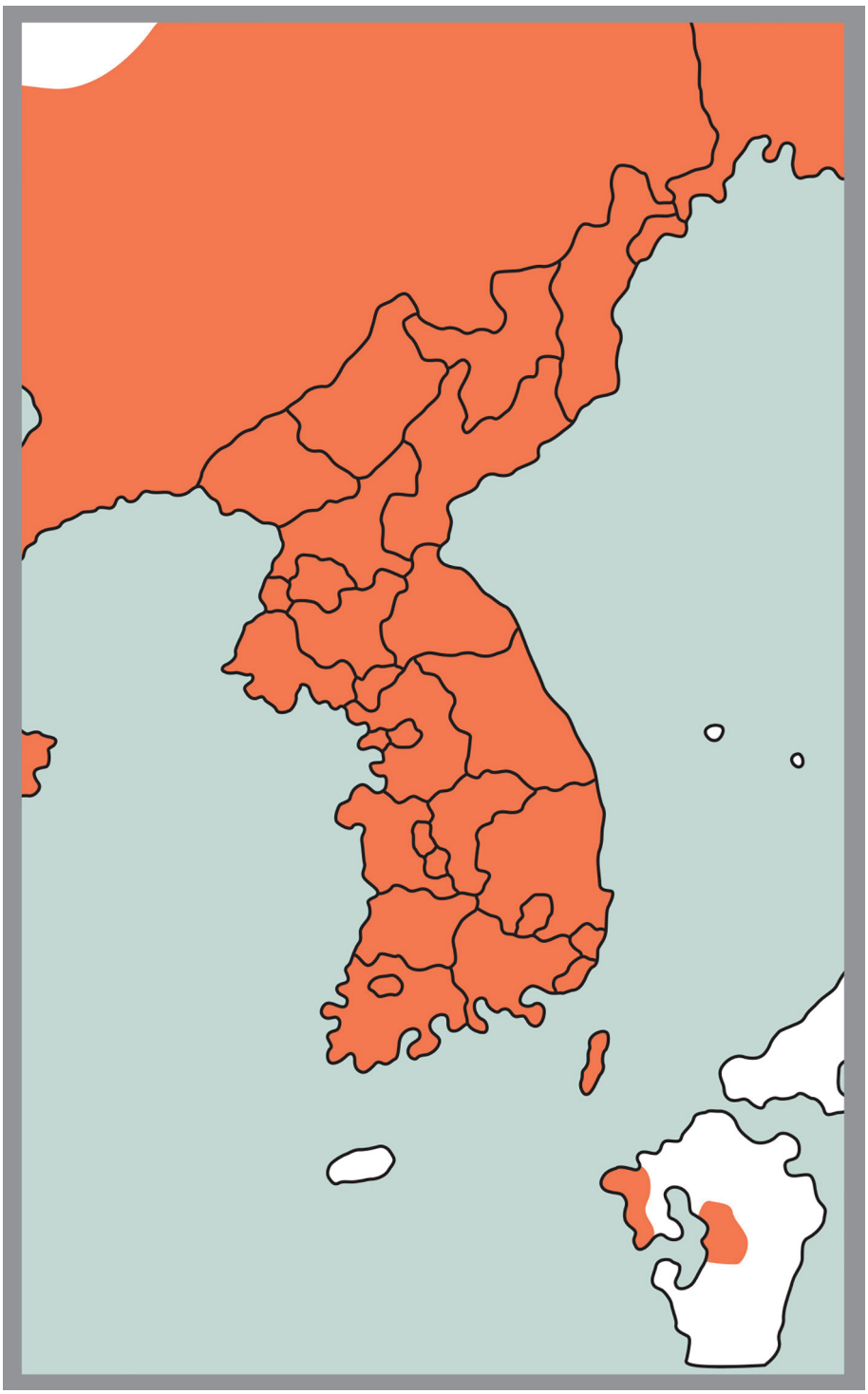

FIGURE 31. Range map of *Nyctalus aviator* in Korea.

Nyctalus furvus Imaizumi and Yoshiyuki, 1968—Japanese Noctule

Nyctalus furvus Imaizumi and Yoshiyuki, 1968 p.127; Type locality-Japan; Yoon, 2010 p.57.
Vespertilio noctula Temminck & Schlegel *in* Siebold, 1842 p.15.
N. noctula namiyei Kuroda, 1920 p.601.
V. aurijunctus Mori, 1928 p.477.
N. noctula montanus Kishida, 1934 p.26 (*Nomen nudum*).
N. noctula motoyoshii Kuroda, 1934b p.3 (*Nomen novum*); Kuroda, 1938 p.99; Won, 1958 p.456; Won, 1967 p.328; Won, 1968 p.108.

V. namiyei: Won, 1967 p.341.
N. noctula: Han, 1994 p.45; Son, 2001 p.117.

Range: Previous records of *N. furvus* clustered in northern Korea, but recent collections came mostly from central and southeastern Korea (Son 2001; Yoon 2010; Fig. 32).

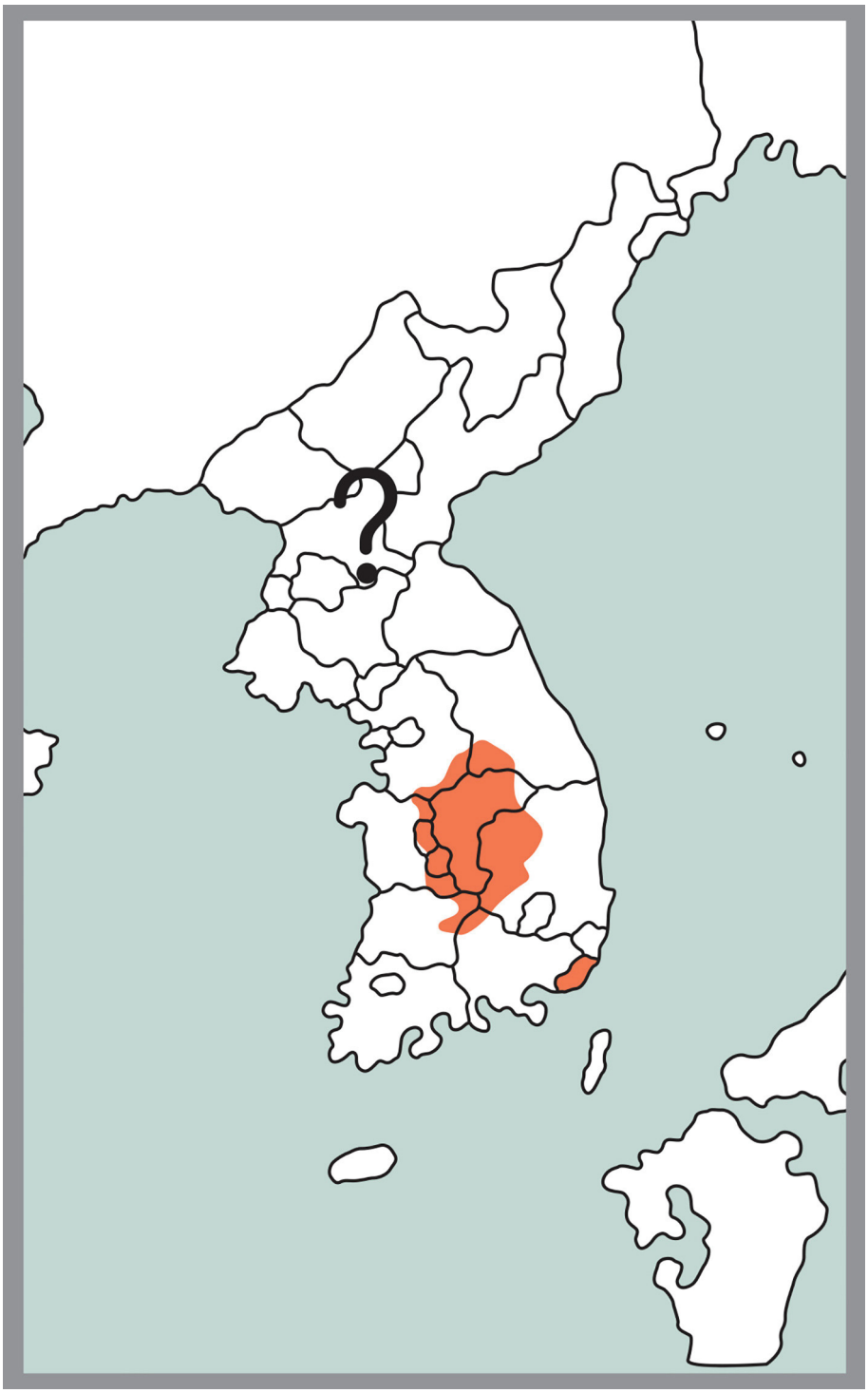

FIGURE 32. Range map of *Nyctalus furvus* in Korea.

Remarks: *Nyctalus noctula motoyoshii* is considered a synonym of *Nyctalus furvus* (Fukui 2009a). Formerly, two subspecies of *N. noctula* (*motoyoshii* and *namiyei*) were reported from Korea (Won 1967). Although Won (1967) considered *N. n. namiyei* as *Vespertilio namiyei* and Corbet (1978) changed *N. n. motoyoshii* to *V. superans,*

both subspecies were regarded as synonyms of *Vespertilio sinensis* (Fukui 2009a, b). Recently, the taxon *N. n. motoyoshii* was transferred from *V. sinensis* to *N. furvus* (Fukui 2009a). Although previous records of *N. n. motoyoshii* in Korea were doubtful (no voucher specimen; Won 1968), *N. furvus* has appeared on the list of Korean bats since the first record (or re-discovery) in 1995 (Yoon 2009). *Nyctalus n. namiyei* is considered a synonym of *Vespertilio sinensis.*

Conservation status: Maeda and Sano (2008) regarded *N. furvus* as an endemic species in Japan and listed the species as 'Vulnerable' based on Japanese populations. As in Japan, only a few records of *N. furvus* have been reported in Korea.

Genus *Vespertilio* Linnaeus, 1758

The two species of *Vespertilio* occur in Korea (Simmons 2005). With *Hypsugo, Vespertilio* represents the tribe Vespertilionini in the subfamily Vespertilionae.

Key to species of Genus *Vespertilio* in Korea

- Number of nipples 4; forearm 40~47 mm. . . . . *V. murinus*
- Number of nipples 2; forearm >50 mm. . . . . *V. sinensis*

Vespertilio murinus Linnaeus, 1758—Particolored Bat

Vespertilio murinus Linnaeus, 1758 p.32; Type locality- Uppsala, Sweden; Han, 1994 p.45; Won & Smith, 1999 p.14; Son, 2001 p.118; Yoon, 2004 p.77.
V. murinus murinus: Kuroda, 1938 p.101; Won, 1958 p.458; Won, 1967 p.342; Won, 1968 p.125; Yoon, 1992 p.46.

Range: A few records of *V. murinus* occur in the extreme northern Korean Peninsula (Kim *et al.* 2015), but no record exists in South Korea (Won & Smith 1999; Fig. 33).

Remarks: Populations in Korea were classified as the Subspecies *V. m. murinus* (Won 1968). Eastern populations were subsumed as *V. m. ussuriensis* with populations in northeastern China and Siberia (Wilson 2008). Kruskop *et al.* (2012) found that *V. murinus* had genetic uniformity (<1% cytochrome oxidase subunit 1 divergence) across the Palearctic distribution.

Vespertilio sinensis (Peters, 1880)—Asian Particolored Bat

Vesperus sinensis Peters, 1880 p.259; Type locality- Beijing, China; Simmons, 2005 p.498.
Vespertilio murinus superans Thomas, 1898 p.770; Type locality- Hebei, China; Kuroda, 1938 p.102; Tate, 1947 p.90.
Vespertilio superans: Ellerman & Morrison-Scott, 1951 p.152; Won, 1958 p.458; Won, 1967 p.344; Won, 1968 p.122; Corbet, 1978 p.58; Han, 1994 p.45; Won & Smith, 1999 p.15; Yoon, 2010 p.77.
Vespertilio superans superans: Corbet, 1978 p.58.

Range: The distribution of *V. sinensis* covers all Korea (Yoon 2010), but the Asian particolored bat appears more in northern Korea (Won 1968; Fig. 34). The species was locally abundant even around Seoul and Gyeonggi Province until the 1970s but is extremely rare in South Korea (Son 2001). This species was recently discovered in Busan, Geoje and Mungyeong, South Korea.

Remarks: This bat has a confusing taxonomy. *Vespertilio namiyei* was considered a subspecies of *V. sinensis* (Corbet 1978; Simmons 2005). *Vespertilio sinensis* was erroneously assigned to the Genus *Nyctalus* (Simmons 2005) and listed as a synonym of *N. noctula* (Corbet 1978; Koopman 1993). Some taxonomists insisted on the name *V. superans* (Yoon 2010). However, *V. sinensis* has priority as the oldest name for this species (Horácek 1997; Simmons 2005).

Conservation status: The Red Data Book for North Korea lists the species as 'Rare' (MAB National Committee of DPR Korea 2002), whereas, in South Korea it is listed as 'Least Concern' (NIBR 2012).

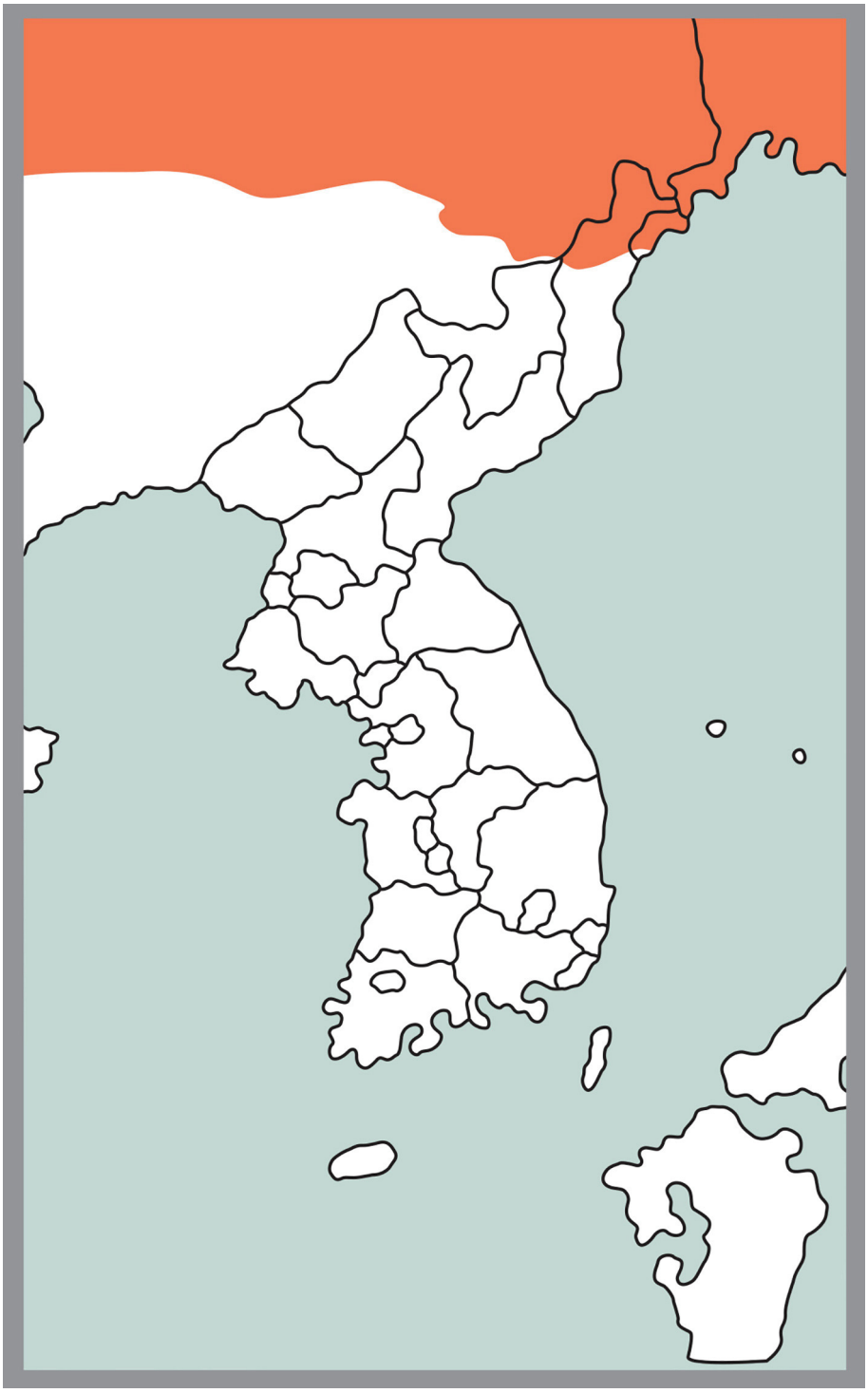

FIGURE 33. Range map of *Vespertilio murinus* in Korea.

Genus *Eptesicus* Rafinesque, 1820

Eptesicus represents the only genus of the Tribe Eptesicini, Subfamily Vespertilioninae in Korea. Three species were previously listed in Korea, but the presence of *E. kobayashii* Mori, 1928 lacks substantial support. *Eptesicus kobayashii* was reported as a new endemic species in 1928 based on three specimens from Pyeongyang. However, these samples became unavailable and prevented taxonomic research on this species. The uncertain taxonomic status of *E. kobayashii* led Koopman (1993, 1994) to propose it as a synonym of *E. bottae*. Based on morphological

similarities with *E. serotinus*, Horácek *et al*. (2000) suggested that the three Korean specimens might belong to the latter species. The collection of *E. kobayashii* ended after the 1920s. The assigned identity and purported record in 1979 remains questionable; thus, one must conclude that either these specimens were erroneously identified (in this case, *E. kobayashii* is not a valid taxon), or the species no longer occurs in Korea. Ellerman and Morrison-Scott (1951) listed *E. kobayashii* as *incertae sedis*. Because no specimen has been collected in about 100 years, the existence of this bat is questionable and listing of Kobayashi's serotine as a species in Korea seems unwarranted at this time. Kishida and Mori (1931) listed *E. rananensis* in northern Korea without any description or explanation. Ellerman and Morrison-Scott (1951) considered the species as a *nomen nudum.* Won (1968) delisted *E. rananensis* from the mammals of Korea. Therefore, we confirm only two species of *Eptesicus* in Korea.

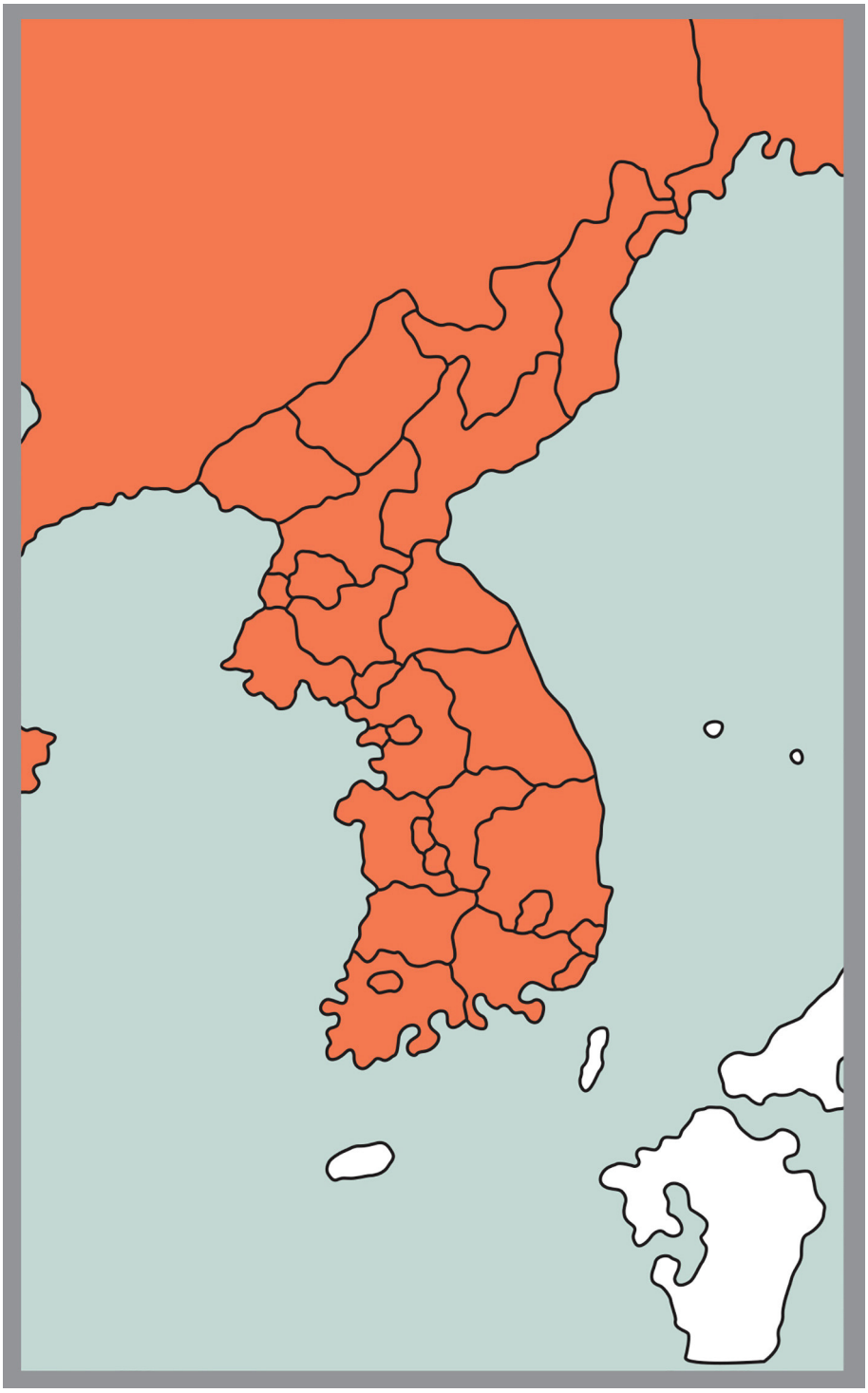

FIGURE 34. Range map of *Vespertilio sinensis* in Korea.

Key to species of Genus *Eptesicus* in Korea

- Forearm 37–45mm; sagittal and temporal crest developed . . . . . *E. nilssonii*
- Forearm 48–56mm; sagittal and temporal crest not developed . . . . . *E. serotinus*

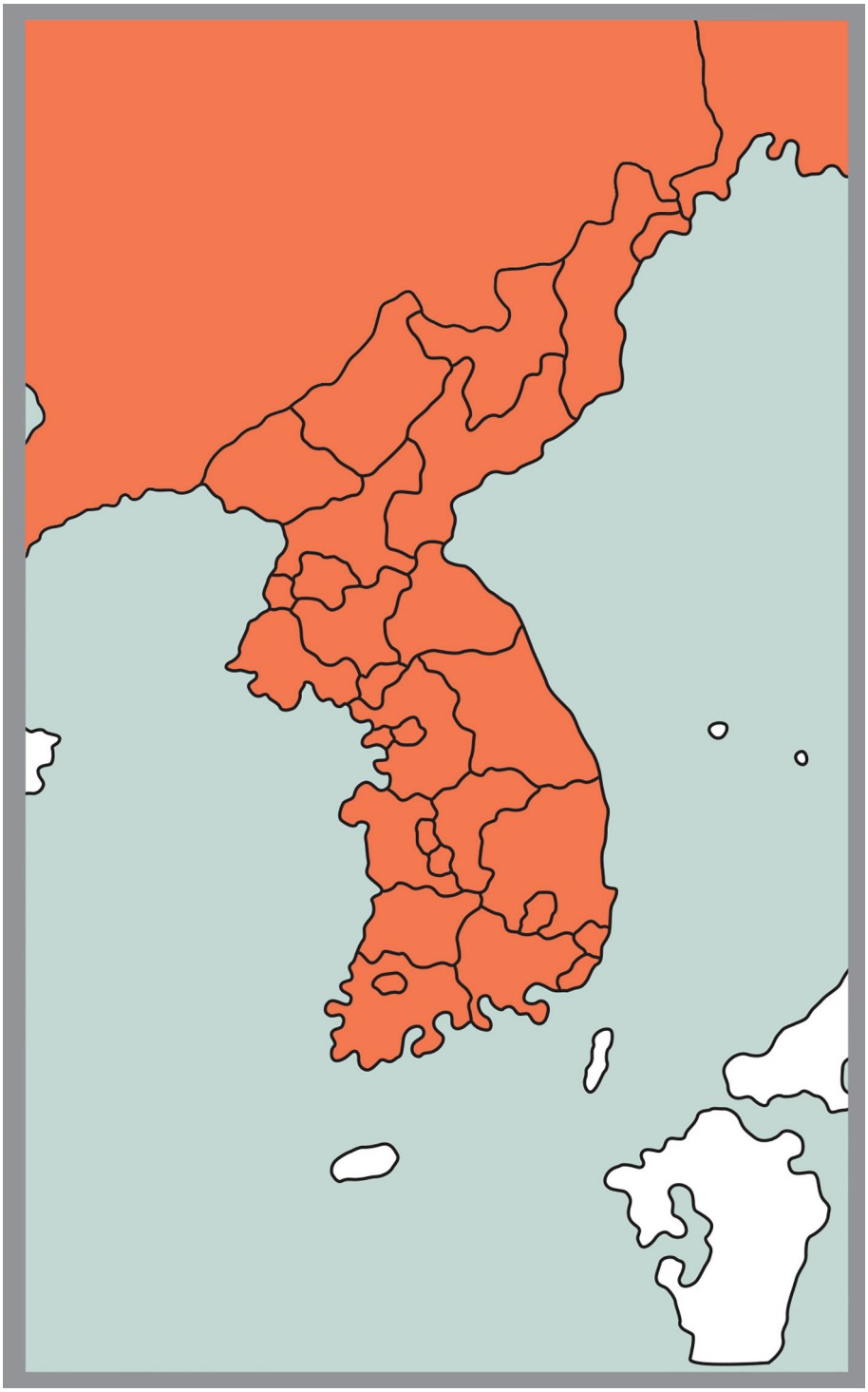

FIGURE 35. Range map of *Eptesicus nilssonii* in Korea.

Eptesicus nilssonii (Keyserling et Blasius, 1839)—Northern Bat

Vespertilio nilssonii Keyserling and Blasius, 1839 p.315; Type locality- Sweden.

Eptesicus nilssonii: Mori, 1928 p.293; Tate, 1947 p.90; Ellerman & Morrison-Scott, 1951 p.155; Won, 1968 p.118; Han, 1994 p.45; Won & Smith, 1999 p.11; Son, 2001 p.111; Yoon, 2004 p.81.
E. parvus Kishida, 1932 p.2; Type locality- northern Korea; Tate, 1947 p.91.
E. nilssonii parvus: Ellerman & Morrison-Scott, 1951 p.155; Won, 1958 p.457; Won, 1967 p.336; Won, 1968 p.120; Corbet, 1978 p.57 (doubtful); Yoshiyuki, 1989 p.168; Yoon, 1992 p.48; Yoon, 2010 p.65.

Range: The distribution of *E. nilssonii* ranges throughout the Korean Peninsula, but the species remains rare in southern Korea (Han *et al.* 2011; Fig. 35). The northern bat was first recorded in Lanam, Hamgyeongbuk Province and observed in the area surrounding Seoul and Gyeonggi Province (Won 1967; Son 2001; Kim *et al*. 2015).

Remarks: Only the Subspecies *Eptesicus nilssonii parvus* Kishida, 1932 was recognized for Korea (Won 1968; Yoon 2010). Although Hanák and Horáćek (1986) regarded this subspecies as an erroneous identification of *Pipistrellus savii*, Yoshiyuki (1989) classified *E. nilssonii* from Sakhalin and Hokkaido to *E. n. parvus*.

Eptesicus serotinus (Schreber, 1774)—Common Serotine

Vespertilio serotinus Schreber, 1774 p.167; Type locality- France.
Eptesicus serotinus pallens Miller, 1911 p.53; Type locality- Kansu, China; Ellerman & Morrison-Scott, 1951 p.157; Won, 1958 p.457; Won, 1967 p.334; Won, 1968 p.115; Corbet, 1978 p.57; Yoon, 1992 p.51; Yoon, 2010 p.71.
E. serotinus: Mori, 1928 p.391; Ellerman & Morrison-Scott, 1951 p.156; Won, 1968 p.115; Corbet, 1978 p.57; Han, 1994 p.45; Won & Smith, 1999 p.12; Son, 2001 p.113; Yoon, 2004 p.82; Yoon, 2010 p.68.
E. brachydigitus Mori, 1928 p.291; Type locality-Pyongyang, Korea.
E. coreensis Kishida *in* Kishida & Mori, 1931 p.378 (*Nomen nudum*).
E. serotinus brachydigitus: Ellerman & Morrison-Scott, 1951 p.158; Won, 1958 p.456; Won, 1967 p.332; Won, 1968 p.118; Yoon, 1992 p.51; Yoon, 2010 p.68.

Range: Since its nesting sites are mostly in buildings, the common serotine occurs mostly around villages throughout Korea (Han *et al.* 2011; Fig. 36).

Remarks: Two subspecies, *Eptesicus serotinus pallens* Miller, 1911 and *Eptesicus serotinus brachydigitus* Mori, 1928, were considered to occur in Korea (Won 1968; Yoon 2010). However, whether a geographic barrier separates the two subspecies remains unclear (Won & Smith 1999). Based on mtDNA analyses, Juste *et al.* (2013) suggested an elevation of the Subspecies *E. s. pachyomus* to a specific status as *E. pachyomus* (including *E. s. andersoni* and *E. s. pallens* in East Asia). Since Juste *et al*. (2013) used only one sample from Shanxi, China (not from Korea) as representing *E. s. pallens,* further studies including Korean samples are required for defining the taxonomy of Korean populations.

Genus *Pipistrellus* Kaup, 1829

With Genus *Nyctalus,* this genus represents Tribe Pipistrellini and Subfamily Vespertilioninae. All Korean species representing the Genus *Pipistrellus* are classified in the Subgenus *Pipistrellus*. Three species of *Pipistrellus* have been listed as inhabiting Korea, but the presence of one of them, *Pipistrellus pipistrellus* (Schreber, 1774) remains doubtful. Although *P. pipistrellus* was reported in central Korea (Ellerman & Morrison-Scott 1951; Won 1958, 1967), no available specimens or collection data exist; these reports possibly represent erroneous identifications (Corbet 1978). Therefore, we delisted *P. pipistrellus* from our list of the mammals of Korea and confirm two species of *Pipistrellus* in Korea.

Key to species of Genus *Pipistrellus* in Korea

- Dark brown pelage; light brown wing membrane; baculum strongly curved; posterior cusp of upper canine not prominent . . . . . *P. abramus*
- Reddish brown pelage; dark brown wing membrane; baculum almost straight; posterior cusp of upper canine prominent . . . . . *P. endoi*

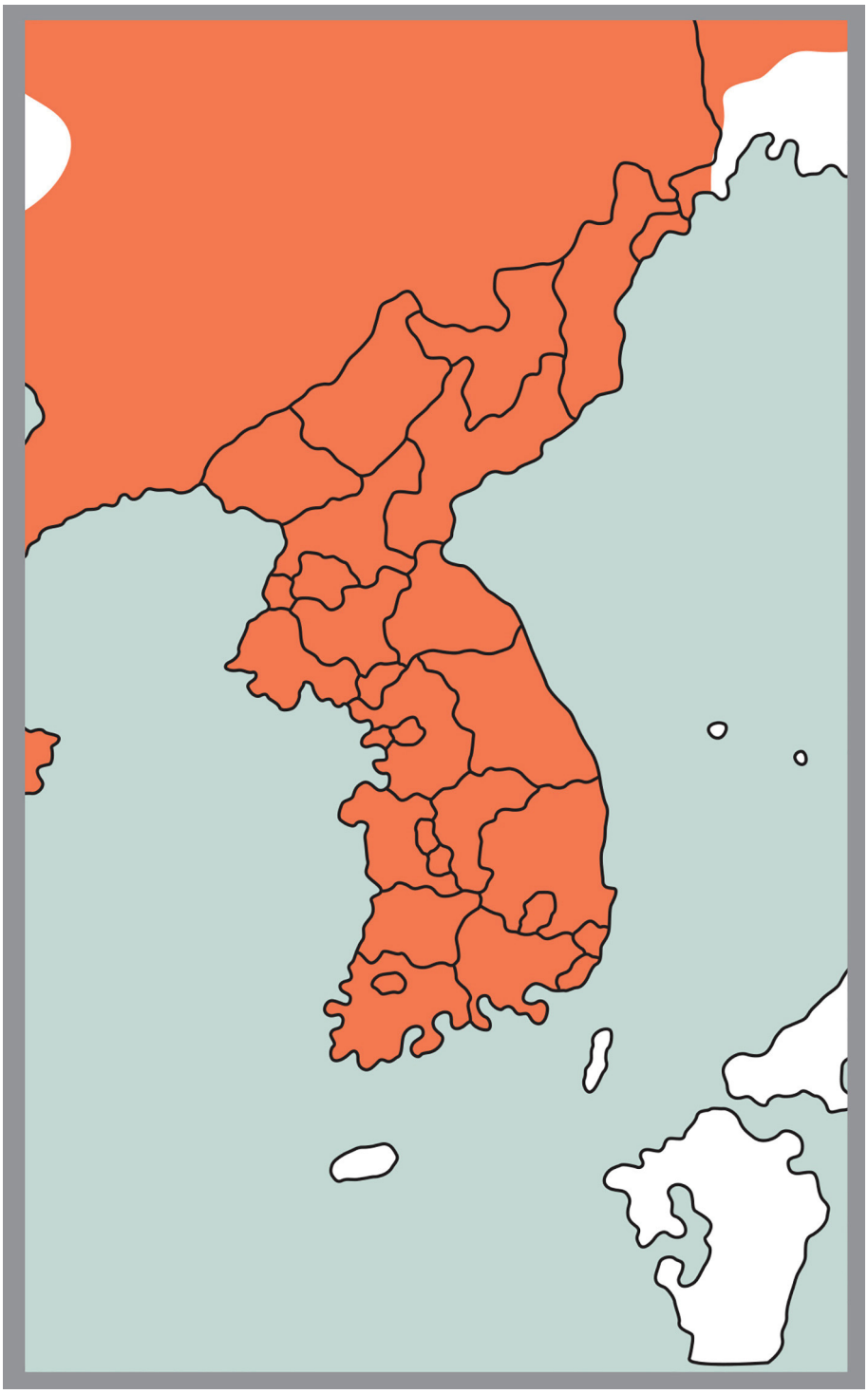

FIGURE 36. Range map of *Eptesicus serotinus* in Korea.

Pipistrellus abramus **(Temminck, 1838)—Japanese Pipistrelle**

Vespertilio abramus Temminck, 1838 p.232; Type locality- Nagasaki, Japan.
V. akokomuli Temminck, 1838 p.57: Type locality-Nagasaki, Japan.
Pipistrellus javanicus: Corbet, 1978 p.53; Han, 1994 p.45; Won & Smith, 1999 p.14.
P. abramus: Won, 1968 p.110; Yoon, 1992 p.43; Son, 2001 p.106; Yoon, 2010 p.48; Jo *et al.*, 2012 p.251.
P. abramus abramus: Won, 1958 p.455; Won, 1967 p.319.

Range: The distribution of *P. abramus* extends throughout Korea, including Jeju Island (Won & Smith 1999; Jo *et al*. 2012; Fig. 37).

Remarks: The species was formerly classified as a subspecies of *P. javanicus* (Won & Smith 1999) but was elevated to the species, *P. abramus* (Simmons 2005).

Conservation status: Japanese pipistrelles were once common in Korea, but populations substantially decreased since concrete houses became standard. The governments of Jeollanam Province and Gyeonggi Province designated this species as protected.

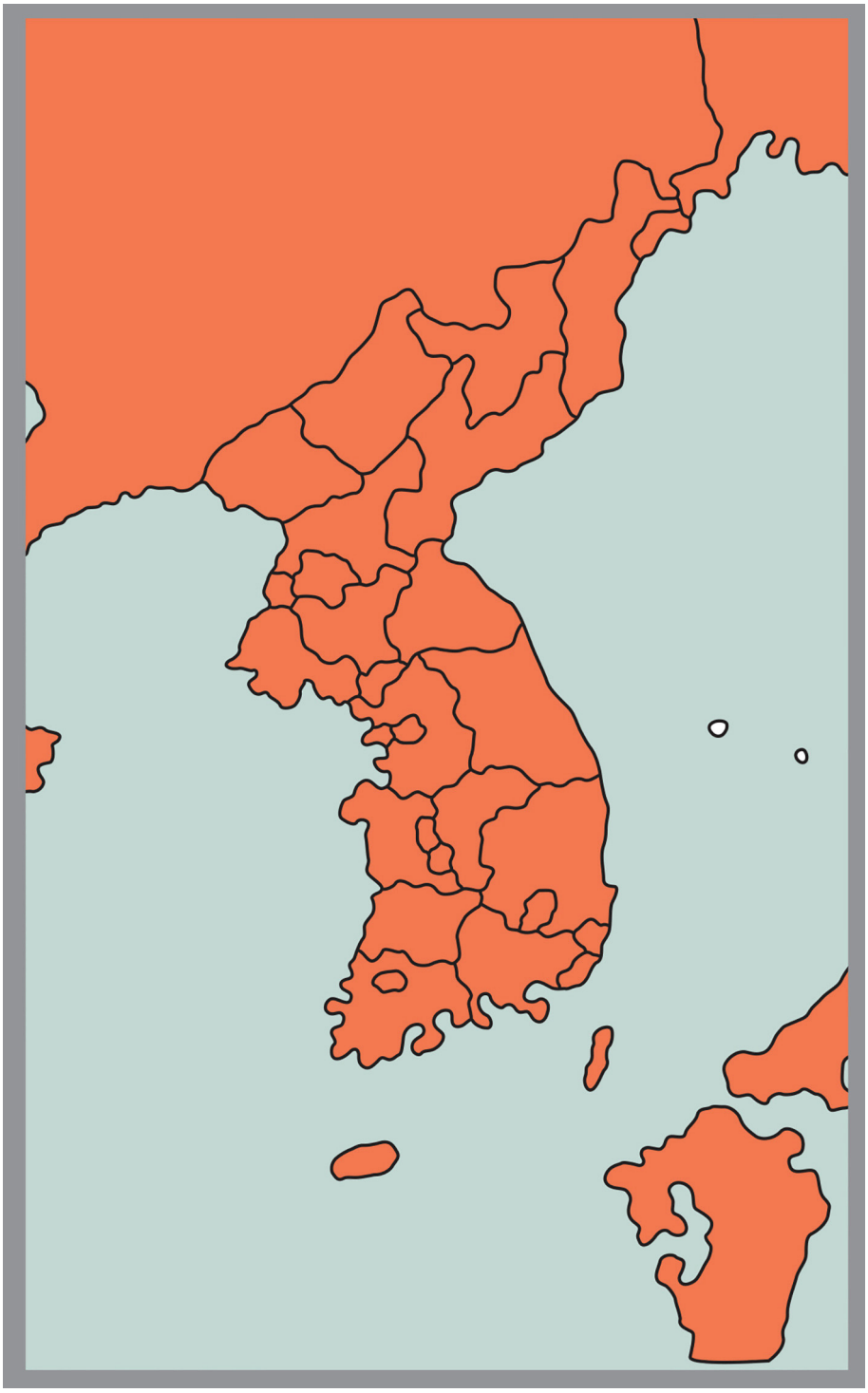

FIGURE 37. Range map of *Pipistrellus abramus* in Korea.

Pipistrellus endoi Imaizumi, 1959—Endo's Pipistrelle

Pipistrellus endoi Imaizumi, 1959 p.363; Type locality- Iwate, Japan; Son, 2001 p.108.

Range: Son (2001) collected one specimen near Masan, Gyeongsangnam Province in 1986.

Remarks: Since the first collection at the southeastern tip of Korea, near Japan (Son 2001), no other specimen of *P. endoi* has been collected in Korea. Therefore, without other specimens acquired in almost 30 years, we consider the species a vagrant. *Pipistrellus endoi* has been considered as an endemic bat in Japan (Kawai 2009a).

Conservation status: *Pipistrellus endoi* was listed 'Endangered' on the IUCN Red List (Maeda 2008).

Genus *Hypsugo* Kolenati, 1856

Hypsugo was once regarded as a Subgenus of *Pipistrellus* (Simmons 2005), although Horáček and Hanák (1986) viewed *Hypsugo* as a distinct genus (followed by Juste & Paunovic 2016). Genetic and karyological analyses did not support a close relationship between *Pipistrellus* and *Hypsugo* (Kruskop 2012). One species, *H. alaschanicus* occurs in Korea. With *Vespertilio, Hypsugo* represents the Tribe Vespertilionini in the Subfamily Vespertilionae.

Hypsugo alaschanicus (Bobrinskoj, 1926)—Alashanian Pipistrelle

Eptesicus alaschanicus Bobrinskoj, 1926 p.98; Type locality- Alashan Range, Mongolia.
Amblyotus velox Ognev, 1927 p.154; Type locality- Vladivostok, Russia
Pipistrellus savii coreensis Imaizumi, 1955 p.56; Won, 1958 p.455; Won, 1967 p.324; Won, 1968 p.111; Corbet, 1978 p.54.
P. savii velox: Won, 1958 p.455; Won, 1967 p.325.
P. savii: Won, 1968 p.111; Corbet, 1978 p.54; Han, 1994 p.45; Won & Smith, 1999 p.14; Son, 2001 p.109.
P. coreensis: Yoshiyuki, 1985 p.129; Yoon, 1992 p.44; Yoon, 2004 p.72; Yoon, 2010 p.52.
H. alaschanicus coreensis: Jo *et al.* 2012 p.251.

Range: *Hypsugo alaschanicus* ranges throughout the Korean Peninsula and Jeju Island (Yoon 2010; Jo *et al.* 2012; Fig. 38).

Remarks: Populations in Korea were recognized as the species *Hypsugo coreensis* (Imaizumi, 1955) (Yoon 2010). Although Yoshiyuki (1989) and Yoon (2010) treated *coreensis* as a distinct species, *Pipistrellus coreensis* or *Hypsugo coreensis*, respectively, Horácek *et al*. (2000) proposed that *coreensis* may represent a separate subspecies of *H. alaschanicus* instead of a distinct species. Although the geographic range of *H. a. velox* (Vladivostok, eastern Siberia, Hokkaido and Honshu) lies closer to *H. a. coreensis* (with which it shares similar habitats), the two subspecies have morphological differences in features of the braincase, teeth and color (Yoshiyuki 1989). *H. a. coreensis* has a larger braincase, more developed antero-internal cusp of P_4, and more reddish dorsal color than *H. a. velox* (Yoon 2010). On molecular grounds, *Hypsugo savii* in western Eurasia and *H. alaschanicus* in eastern Eurasia show a clear phylogeographic split (Datzmann *et al.* 2012). We followed Horácek *et al*. (2000) in listing this species.

Conservation status: The North Korean Government classified this species as 'Rare' (MAB National Committee of DPR Korea 2002).

Family MINIOPTERIDAE Dobson, 1875

Despite support for full familial status based on morphological data (Aggarwal & Sinha 1973; Mein & Tupinier 1977), this taxon has long been classified in the Subfamily Miniopterinae in the Family Vespertilionidae (Simmons 2005). Hoofer and Van Den Bussche (2003) and Miller-Butterworth *et al*. (2007) later elevated Miniopteridae to a distinct family based on molecular analysis, a distinction that has been confirmed through subsequent DNA-based studies (Lack & Van Den Bussche 2010; Lack *et al.* 2010).

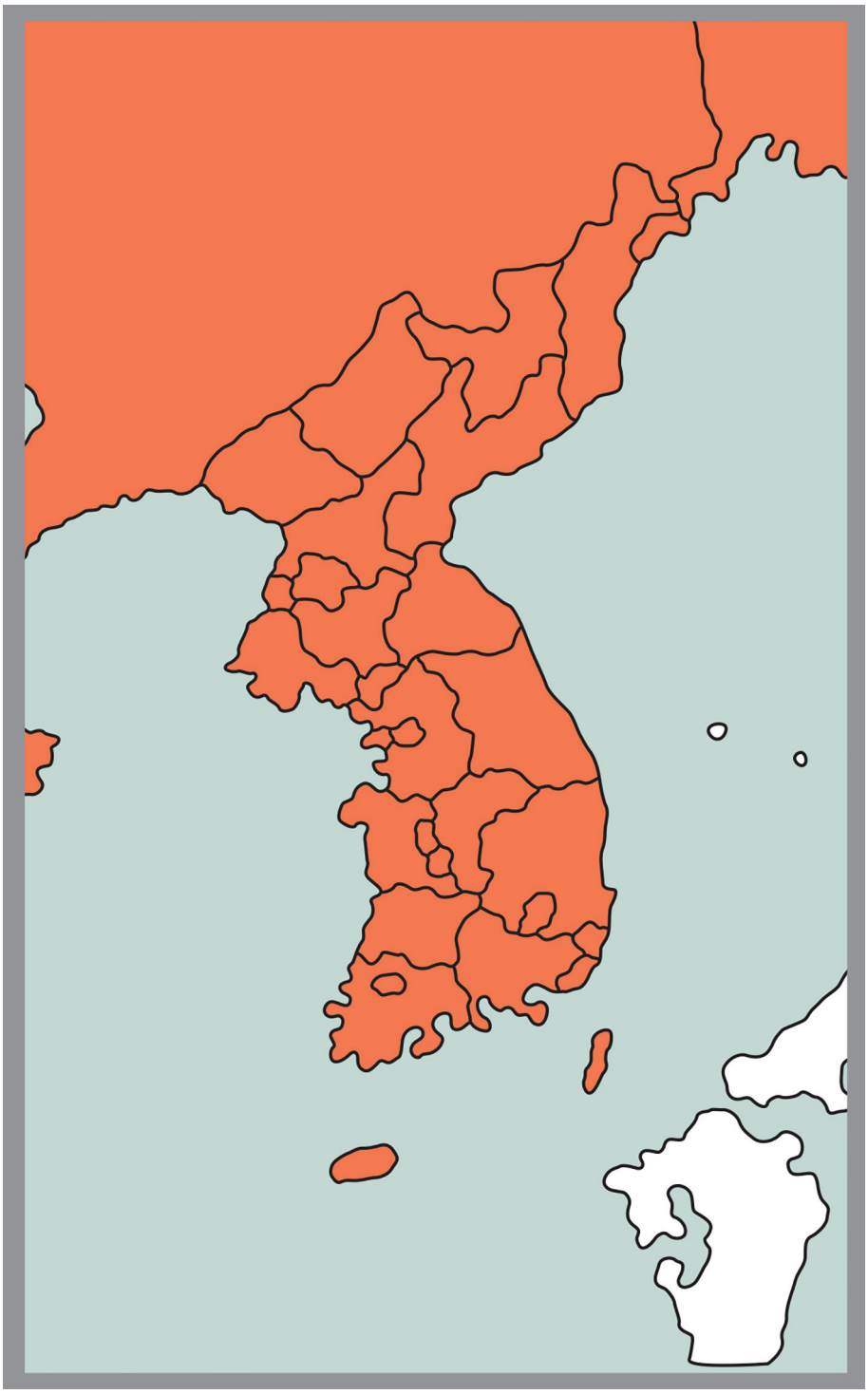

FIGURE 38. Range map of *Hypsugo alaschanicus* in Korea.

Genus *Miniopterus* Bonaparte, 1837

Miniopterus, a single genus in the Family Miniopteridae, has two species recorded in Korea. Since *M. fuscus* occurred only once at the southeastern tip of Korea, we consider the species as a vagrant from Japan (see below).

Key to species of Genus *Miniopterus* in Korea

- Forearm <45 mm, zygomatic width 8 mm; tail length 94% of head-body; height brain case 90% of breadth . . . . . *M. fuscus*
- Forearm >45 mm (45.5–49.5 mm), zygomatic width 8.8 mm; tail length 90% of head-body; height brain case 82% of breadth . . . . . *M. fuliginosus*

Miniopterus fuliginosus (Hodgson, 1835)—Eastern Bent-winged Bat

Vespertilio fuliginosa Hodgson, 1835 p.700; Type locality- Nepal.
Miniopterus schreibersii japoniae Thomas, 1905 p.338; Type locality- Miyazaki, Japan; Kishida & Mori, 1931 p.379; Kuroda, 1938 p.104.
M. schreibersii fuliginosus: Ellerman & Morrison-Scot, 1951 p.183; Won, 1958 p.459; Won, 1967 p.348; Won, 1968 p.127; Yoon, 1992 p.56; Yoon, 2010 p.86; Jo *et al*., 2012 p.252.
M. schreibersii: Won, 1968 p.127; Han, 1994 p.45; Won & Smith, 1999 p.15; Son, 2001 p.123; Yoon, 2004 p.90; Yoon, 2010 p.86.

Range: The distribution of this species ranges over the southern Korean Peninsula and Jeju Island (Son 2001; Fig. 39).

Remarks: *M. fuliginosus* was regarded as a subspecies of *M. schreibersii* and populations in Korea were considered *M. schreibersii fuliginosus* (Won 1967). Appleton *et al.* (2004) and Tian *et al.* (2004) split *M. schreibersii* into two distinct species using ND2 and cytochrome *b*, respectively. Therefore, *M. schreibersii* became assigned to Europe and *M. fuliginosus* earmarked for Asia (Šrámek *et al*. 2013). The closest taxon to *M. fuliginosus* is *M. magnate* rather than *M. schreibersii* (Kruskop *et al*. 2012). Although the Subspecies *M. f. chinensis* occurs in extreme southern Primorye, Russia-Korean border area (Kruskop 2012), the subspecific status of populations in Korea have rarely been studied.

Conservation status: The Red Data Book of North Korea lists this species as 'Rare'.

Miniopterus fuscus Bonhote, 1902—Southeast Asian Long-fingered Bat

Miniopterus fuscus Bonhote, 1902 p.626; Type locality- Okinawa, Japan; Son, 2001 p.125; Jo *et al.*, 2012 p.252.

Range: Only one female captured on 8 July 1986 on Jeju Island (Son 2001).

Remarks: The individual from Jeju Island is considered a vagrant from Japan (Son 2001). This species has seldom been listed as a mammal from Korea.

Conservation status: The IUCN Red List considers *M. fuscus* as 'Endangered'.

ORDER CARNIVORA Bowdich, 1821

The Order Carnivora in Korea contains 25 species, 18 genera, and six families. Unfortunately, most large- and medium-sized carnivores are now extirpated, or their status is uncertain in Korea. Despite the high possibility of extinction, we include the large felids, canids and sea lion in our list. There continues to be a possibility that a few individuals persist or move from Russian Far East into northern Korea.

Key to families of Carnivora in Korea

1 Limbs not modified; various tail lengths; carnassial well developed 2
- Limbs modified to flippers; tail short; carnassials absent 5
2 Tail longer than hind foot (except Lynx); last upper molar not the longest; shearing ridge or cusps present 3
- Tail shorter than 50% of hind foot length; last upper molar elongated anteroposteriorly (longest tooth); sharp shearing ridge or cusps absent on molars . . . . . Ursidae
3 Front foot 5 toes; hind foot 4 toes 4

- All feet with 5 toes . . . . . Mustelidae
4 Claws retractable . . . . . Felidae
- Claws not retractable……..……..... Canidae
5 Hind limbs rotated forward; pinnae small; postorbital process well developed……..... Otariidae
- Hind limbs always point posteriorly; pinnae absent; postorbital process absent…..…… Phocidae

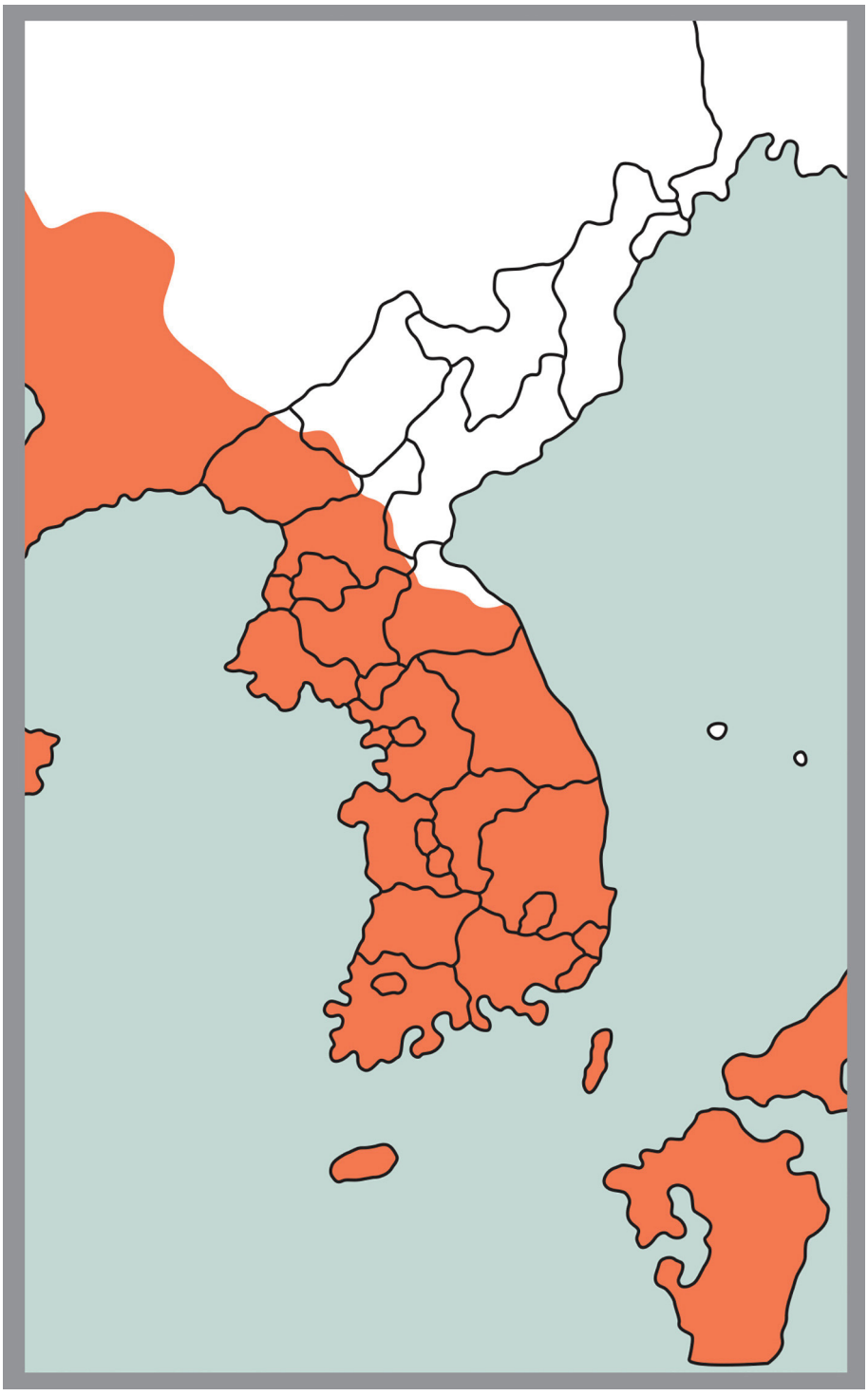

FIGURE 39. Range map of *Miniopterus fuliginosus* in Korea.

Family URSIDAE Fischer, 1817

The Family Ursidae contains two species of the Genus *Ursus* in Korea. While *Ursus thibetanus* occurs throughout

Korea, a northern species, *U. arctos*, has limited occupancy in areas north of Mt. Geumgang, despite a Pleistocene fossil record (12,500 yrs BP) in southern Korea. Both species have experienced excessive hunting pressures for gall bladders.

Genus *Ursus* Linnaeus, 1758

Among the four species of *Ursus,* two species inhabit Korea. While *U. arctos* inhabited northeastern Korea, *U. thibetanus* became dispersed over the country. Currently, both species have an endangered status.

Key to species of Genus *Ursus* in Korea

- Ear short, rounded; hair covers proximal pad front paw (half of sole); pelage brown . . . . . *U. arctos*
- Ear long, tufted; no hair on front paw pad (sole); pelage black, white band across chest . . . . . *U. thibetanus*

Ursus arctos Linnaeus, 1758—Brown Bear

Ursus arctos Linnaeus, 1758 p.47; Type locality- Sweden; Won, 1968 p.271; Han, 1994 p.46; Won & Smith, 1999 p.17; Oh, 2004a p.165.
U. lasiotus Gray, 1867 p.301; Type locality- interior of northern China.
Melanarctos cavifrons Heude, 1901 p.1; Type locality- northwestern Manchuria.
U. cavifrons: Kishida & Mori, 1931 p.379.
U. arctos lasiotus: Kuroda, 1938 p.31; Ellerman & Morrison-Scott, 1951 p.238; Won, 1958 p.440; Won, 1967 p.122; Won, 1968 p.273.
U. arctos arctos: Yoon, 1992 p.99.

Range: The distribution of *U. arctos* covers most northern alpine habitats and extends to the southern boundary at Mt. Geumgang (Kim *et al.* 2015; Fig. 40). Although this bear species was recorded around Mt. Baekdu until the 1980s, the current presence in the Mt. Geumgang and Mt. Baekdu areas in North Korea remains uncertain.

Remarks: The Subspecies *U. a. lasiotus* Gray, 1867, Ussuri brown bear (or Amur brown bear, black grizzly or horse bear) in northeastern Asia traditionally included the Korean Peninsula.

Conservation status: North Korea designated two brown bear habitats (Ryongrim, Jagang Province and Gwanmobong, Hamgyeongbuk Province) as Natural Monuments in 1980. The Red Data Book of North Korea lists this species as 'Vulnerable' (MAB National Committee of DPR Korea 2002). Populations in China and Mongolia are protected by CITES Appendix I and Russian populations are protected by Appendix II.

Ursus thibetanus G. [Baron] Cuvier, 1823—Asian Black Bear

Ursus thibetanus G. Cuvier, 1823 p.325; Type locality- Assam, India; Won, 1968 p.276; Han, 1994 p.46; Won & Smith, 1999 p.17.
Selenarctos ussuricus Heude, 1901 p.2; Type locality- Ussuri, Russia.
S. thibetanus wulsini Howell, 1928 p.115; Type locality- Chihli, Hebei, China (not Chiri/or Jiri, Korea; often, Korean bear scientists confused Chiri with Chihli).
U. ussuricus: Kishida & Mori, 1931 p.379.
U. thibetanus ussuricus: Kuroda, 1939 p.32; Won, 1958 p.440; Won, 1967 p.127; Won, 1968 p.277.
S. thibetanus ussuricus: Ellerman & Morrison-Scott, 1951 p.239; Yoon, 1992 p.98.
S. thibetanus: Oh, 2004a p.162.

Range: Despite unofficial reports of Asian black bears, wild populations in South Korea can be considered extirpated. However, bear farms now exist throughout the country, and several bears from these farms escape every year. A restoration project with nonindigenous bears implemented in 2001 at Mt. Jiri National Park had limited success. A natural population of black bears existed on Mt. Myohyang in the 2000s and even the isolated and

heavily human-populated Mt. Guwol had a population (W. Duckworth, IUCN, 2015, pers. comm.). Populations of black bears also reside in the Mt. Baekdu and Mt. Geumgang areas of North Korea (Kim *et al.* 2015; Fig. 41).

Remarks: The subspecific name of black bears in the Korean Peninsula has traditionally been *U. t. ussuricus* Heude, 1901, Ussuri black bear.

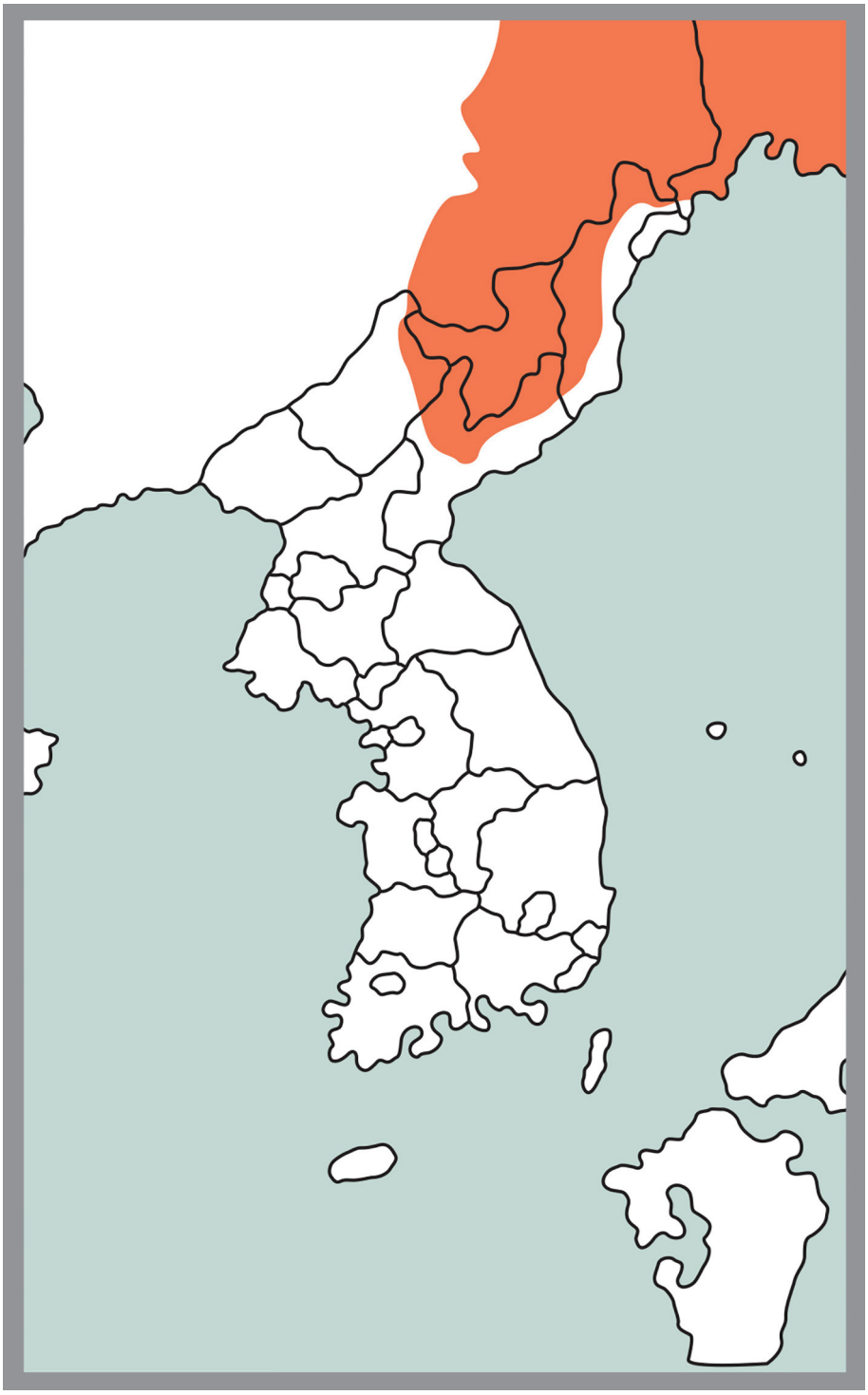

FIGURE 40. Range map of *Ursus arctos* in Korea.

Conservation status: The South Korean Government designated the Asian black bear as a Natural Monument in 1982 and an endangered species in 1997. For the recovery project in South Korea, bears were released in 2001 from a bear farm near Seoul. These bears had a recall in 2004 due to a dispute about their origin. Since 2004, bears from a bear orphanage in Russia, bears from a bear farm in China, and bears from Pyongyang Zoo in North Korea

have been released. According to genetic analysis, these three sources belonged to the same subspecies (*U. t. ussuricus*) as the indigenous inhabitant of Korea (Kim *et al.* 2011b). The NIBR (2012) considered South Korean populations as 'Endangered', and North Korea classified this species as 'Vulnerable'. *Ursus thibetanus* is also protected by CITES Appendix I.

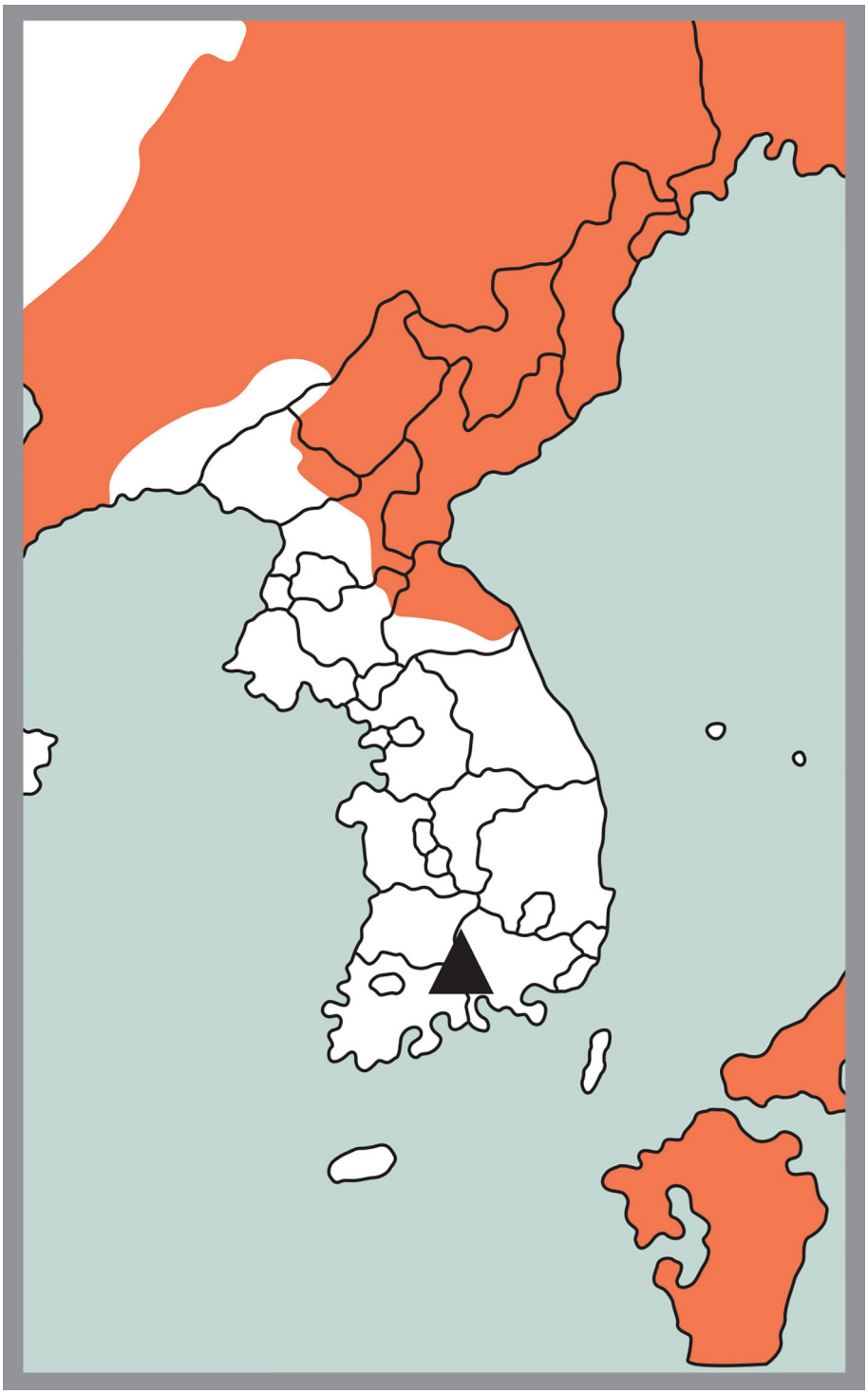

FIGURE 41. Range map of *Ursus thibetanus* in Korea.

Family MUSTELIDAE Fischer, 1817

Since the exclusion of the Mephitidae, Wozencraft (2005) recognized two Subfamilies, Lutrinae and Mustelinae within the Family Mustelidae. Four genera and nine species of mustelids occur in Korea.

Key to genera of Mustelidae in Korea

1	Feet webbed; tail thick; Premolars 4/3	Lutra
-	Feet without web	2
2	Conspicuous pinnae; Premolars 4/4	Martes
-	Pinnae not conspicuous; Premolars 3/3	3
3	Bold black strip from eye to ear; stout body shape	Meles
-	Body slender; hind foot <70 mm	Mustela

Genus *Lutra* Brisson, 1762

This genus represents the Subfamily Lutrinae and has three recognized species: *Lutra lutra* occupies most of Eurasia, *L. sumatrana* occurs in southeastern Asia, and the extinct *L. nippon* was endemic to Japan. A single species, *L. lutra* lives throughout the Korean Peninsula and littoral islands.

Lutra lutra (Linnaeus, 1758)—Eurasian Otter

Mustela lutra Linnaeus, 1758 p.45; Type locality- Uppsala, Sweden.
Lutra lutra lutra: Kishida & Mori, 1931 p.380; Kuroda, 1938 p.24; Won, 1967 p.98; Won, 1968 p.303; Yoon, 1992 p.111.
L. lutra: Won, 1958 p.437; Won, 1968 p.302; Han, 1994 p.46; Won & Smith, 1999 p.18; Oh, 2004a p.183.

Range: The distribution of *L. lutra* ranges over most of the Korean Peninsula and adjacent coastal islands with fresh water, except Jeju and Ulleung islands (Jo *et al.* 2017c; Fig. 42). Although the first otter on Jeju Island was reported on 10 January 2018, we did not include Eurasian otter habitat on Jeju Island. Since one female otter was road-killed at a gas station in an urban area without a natural aquatic system, we assumed that the female otter accidentally arrived on a fish truck at a nearby supermarket. The species inhabits some remote islands such as Heuksan Island and re-occurred on Tsushima Island (50 km from the Korean Peninsula) Japan in 2017 after its extirpation in the 1980s.

Remarks: One subspecies, *L. l. lutra*, is thought to inhabit the Korean Peninsula (Yoon 1992).

Conservation status: Both the South and North Korean governments designated *Lutra lutra* as a Natural Monument. Also, the Ministry of Environment in South Korea recognized the Eurasian otter as an Endangered Species in 1998. Both the North and South Korean Red Data books list *L. lutra* as a 'Vulnerable' species (MAB National Committee of DPR Korea 2002; NIBR 2012). CITES lists *L. lutra* on Appendix I.

Genus *Martes* Pinel, 1792

The genera *Martes, Meles,* and *Mustela,* represent the Subfamily Mustelinae in Korea. Analyses of mtDNA indicated a paraphyletic status for the Genus *Martes,* with *M. pennanti* being closer to *Gulo gulo* than other species of *Martes* (Stone & Cook 2002). Three Subgenera, *Martes, Charronia,* and *Pekania,* are recognized (Wozencraft 2005). Three species of *Martes* inhabit the Korean Peninsula; *M. flavigula* classified in the Subgenus *Charronia* and the other two species in the Subgenus *Martes.*

Key to species of Genus *Martes* in Korea

1	Tail 2/3 of head-body length; neck yellow; chin white; face and ears black	*M. flavigula*
-	Tail <2/3 of head-body length	2
2	Summer neck pelage yellow; ears yellow or white; face and chin black (white in winter pelage); tail 50% of head-body length	*M. melampus*
-	Neck brownish-black; neck patch pale, not sharply demarcated; tail 40% of head-body length	*M. zibellina*

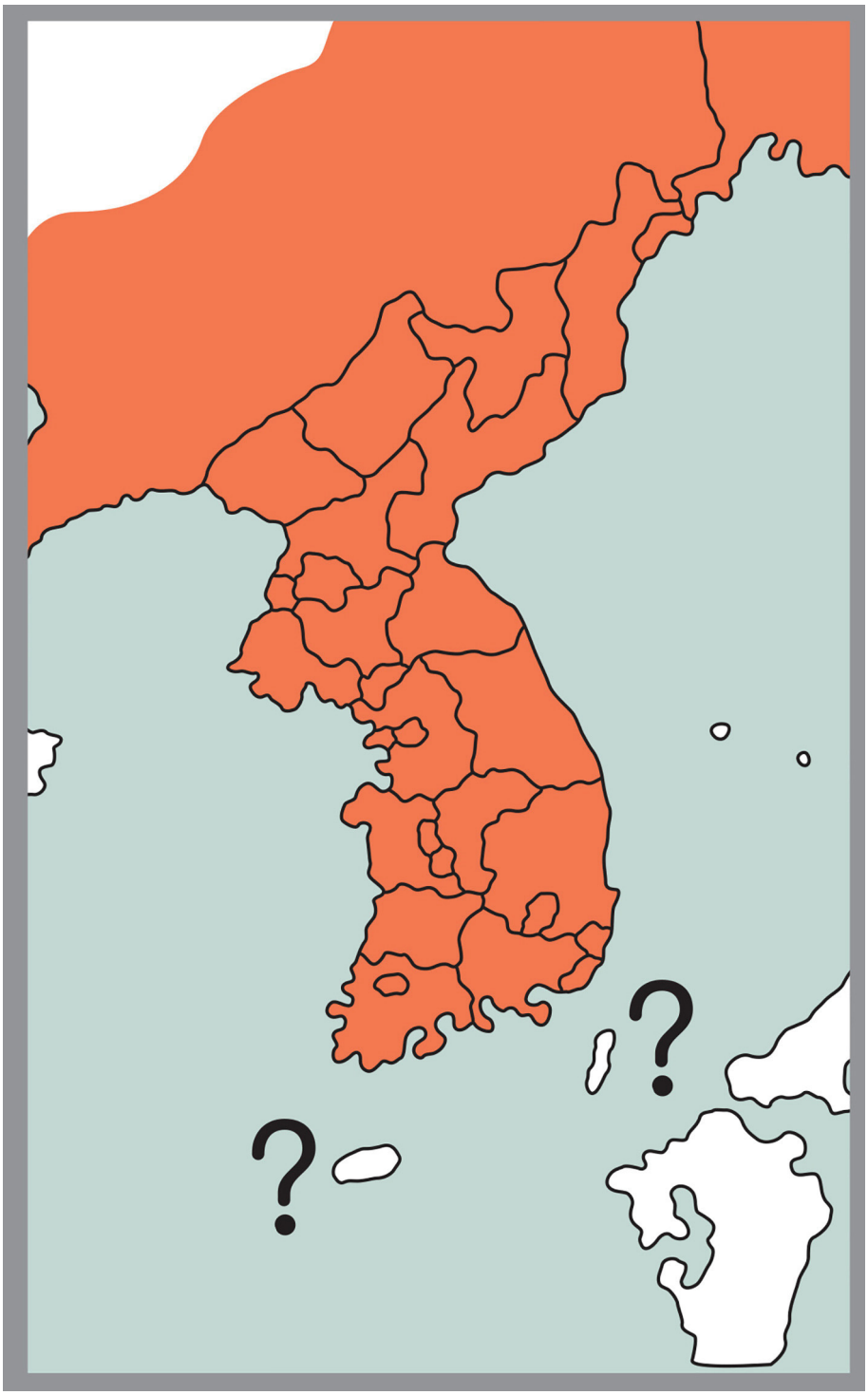

FIGURE 42. Range map of *Lutra lutra* in Korea.

Martes flavigula (Boddaert, 1785)—Yellow-throated Marten

Mustela flavigula Boddaert, 1785 p.88; Type locality- Nepal.
Viverra aterrima Pallas, 1811 p.81; Type locality- Between Ussuri River and Amur River, East Siberia.
Charronia flavigula koreana Mori, 1922a p.610; Type locality- Gwangneung (near Seoul); Kishida & Mori, 1931 p.380; Kuroda, 1938 p.26; Tate, 1947 p.147; Won, 1958 p.438; Won, 1967 p.106.
C. flavigula borealis: Kishida & Mori, 1931 p.380; Kuroda, 1938 p.26.
Martes flavigula: Ellerman & Morrison-Scott, 1951 p.249; Won, 1968 p.295; Corbet, 1978 p.174; Han, 1994 p.46; Won & Smith, 1999 p.18; Oh, 2004a p.178.

Martes flavigula aterrima: Ellerman & Morrison-Scott, 1951 p.250; Yoon, 1992 p.108.
C. flavigula aterrima: Won, 1958 p.437; Won, 1967 p.104
Martes flavigula koreana: Won, 1968 p.295; Yoon, 1992 p.108; Oh, 2004a p.179.
Martes flavigula flavigula: Corbet, 1978 p.174.

Range: The distribution of *Martes flavigula* ranges over the Korean Peninsula, except on remote islands (Fig. 43).

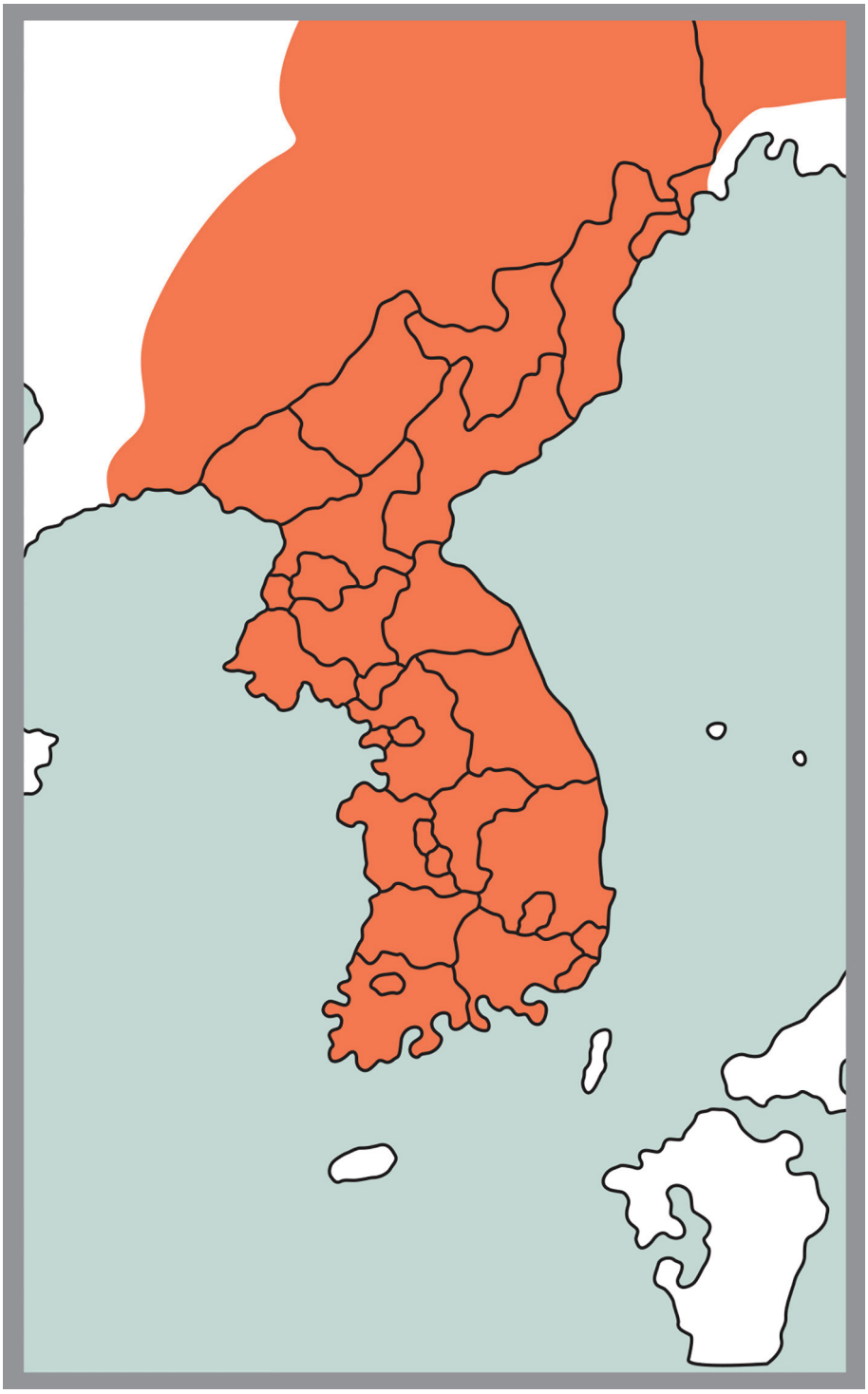

FIGURE 43. Range map of *Martes flavigula* in Korea.

Remarks: Two subspecies, *M. f. koreana* and *M. f. aterrima*, were recognized in Korea (Won 1967). The distribution of *M. f. koreana* covers most of Korea, whereas, *M. f. aterrima* occupies northern Korea (Won 1967). Wozencraft (2005) subsumed *M. f. koreana* as a synonym of *M. f. borealis.* Although *M. f. borealis* was regarded as

a junior synonym of *M. f. aterrima* (Heptner *et al.* 1967), Wozencraft (2005) listed *M. f. borealis* as a distinct subspecies. Thus, the one subspecies inhabiting Korea is *M. f. borealis.*

Conservation status: The Ministry of Environment of South Korea designated the yellow-throated marten as an endangered species in 1997. The Red Data Book of North Korea listed *M. flavigula* as 'Rare' (MAB National Committee of DPR Korea 2002). The Red Data Book of South Korea registered *M. flavigula* as 'Vulnerable' (NIBR 2012).

Martes melampus (Wagner, 1841)—Japanese Marten

Mustela melampus Wagner *in* Schreber, 1840 p.229; Type locality- Japan.
Martes melampus coreensis Kuroda and Mori, 1923 p.27; Type locality- Cheonan, Chungcheongnam Province, Korea; Kuroda, 1938 p.27; Ellerman & Morrison-Scott, 1951 p.247; Won, 1958 p.438; Won, 1967 p.108; Won, 1968 p.297; Corbet, 1978 p.173; Yoon, 1992 p.106.
Martes coreensis: Kishida & Mori, 1931 p.381.
Martes melampus: Ellerman & Morrison-Scott, 1951 p.247; Won, 1968 p.297; Corbet, 1978 p.173; Han, 1994 p.46; Won & Smith, 1999 p.18; Oh, 2004a p.174.

Range: *Martes melampus* was first discovered in Cheonan City, in central Korea (Won 1967), and until late 1960s, several individuals had been identified annually in Pyongyang fur factories, where furbearers were collected throughout North Korea (Won 1968; Fig. 44). Japanese martens and sables are mostly collected at timber harvesting sites in Yaggang-do. The trapping ratio of the sable is 10 times greater than the Japanese marten (Kim *et al.* 2015).

Remarks: Heptner *et al*. (1967) listed *M. melampus* as a subspecies of *M. zibellina*. However, genetic analysis showed an apparent interspecific difference between *M. melampus* and *M. zibellina* (Kurose *et al*. 1999; Murakami *et al*. 2004; Inoue *et al*. 2010). Kuroda and Mori (1923) reported *M. m. coreensis* from three specimens collected in central Korea (Cheonan, Seonghwan, and Seoul). Except for one collected by an American soldier in 1957 (Won 1967), all records after the Korean War came from North Korea (Won 1968). Despite records from Korea, some mammalogists regarded *M. melampus* as endemic to Japan (Masuda 2009).

Conservation status: The North Korean Government banned hunting of *M. melampus* and designated it and its habitat in Beakam County, Ryanggang Province as a Natural Monument. The Red Data Book of North Korea listed *M. melampus* as a 'Vulnerable' species.

Martes zibellina (Linnaeus, 1758)—Sable

Mustela zibellina Linnaeus, 1758 p.46; Type locality- northern part of Tobol'sk Province, Russia.
Martes zibellina coreensis Kishida, 1927b p.130; Type locality- Korea (Without complete diagnosis).
Martes zibellina hamgyenensis Kishida, 1927c p.509 (*Nomen novum*); Kishida & Mori, 1931 p.380; Kuroda, 1938 p.28; Ellerman & Morrison-Scott, 1951 p.249; Won, 1967 p.111; Won, 1958 p.438; Won, 1968 p.291; Yoon, 1992 p.107; Oh, 2004a p.176.
Martes zibellina: Won, 1968 p.291; Corbet, 1978 p.173; Han, 1994 p.46; Won & Smith, 1999 p.19; Oh, 2004 p.176.

Range: *M. zibellina* was once common and distributed from central to North Korea (Fig. 45). Recently, sables became restricted to high mountains in northeastern Korea (Jin & Ouh 1990; Won & Smith 1999). However, the North Korean government has seldom implemented surveys to monitor populations. Historically, prime habitat and large populations of sables occurred in Gapsan County, Ryanggang Province.

Remarks: Two subspecies, *M. z. hamgyenensis* and *M. z. coreensis,* were recognized in the Korean Peninsula (Won 1967). The two subspecies were considered synonyms of *M. z. kamtchadalica* (Wozencraft 2005). However, Heptner *et al.* (1967) considered the Korean population as a *M. z. arsenjevi* without precise justification.

Conservation status: The North Korean government banned hunting for this species in 1959. The montane habitat with *M. zibellina* in Bocheon County, Ryanggang Province was designated a Natural Monument in 1973. Also, two more sites of occurrence of *M. zibellina* (Samjiyeon County and Beakam County) became Natural Monuments in 1980. The Red Data Book of North Korea classified this species as 'Endangered' (MAB National Committee of DPR Korea 2002).

Genus *Meles* Brisson, 1762

Meles, formerly known as a monotypic genus, is currently composed of three species, *M. anakuma* in Japan, *M. leucurus* in continental Asia and *M. meles* in Europe.

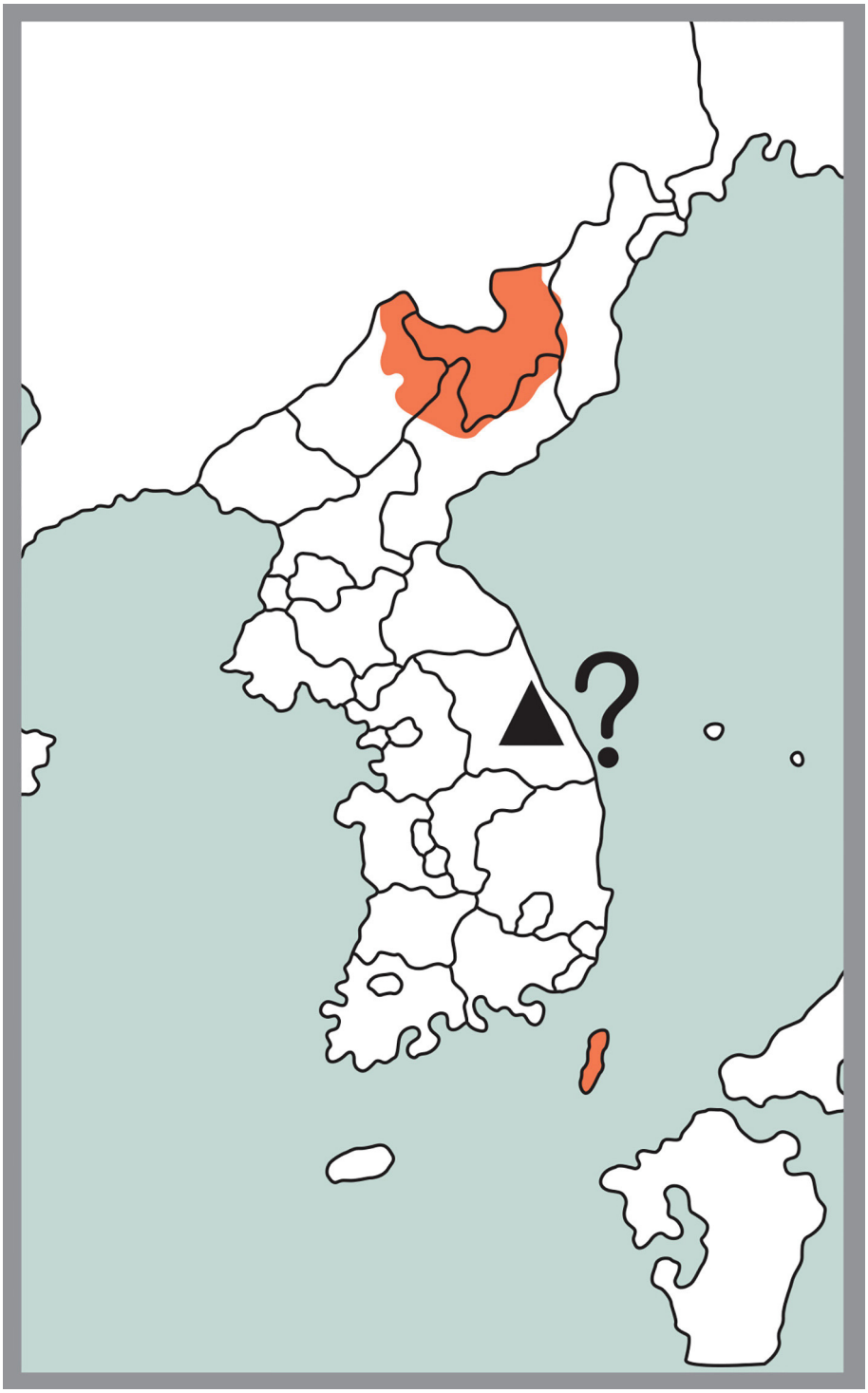

FIGURE 44. Range map of *Martes melampus* in Korea.

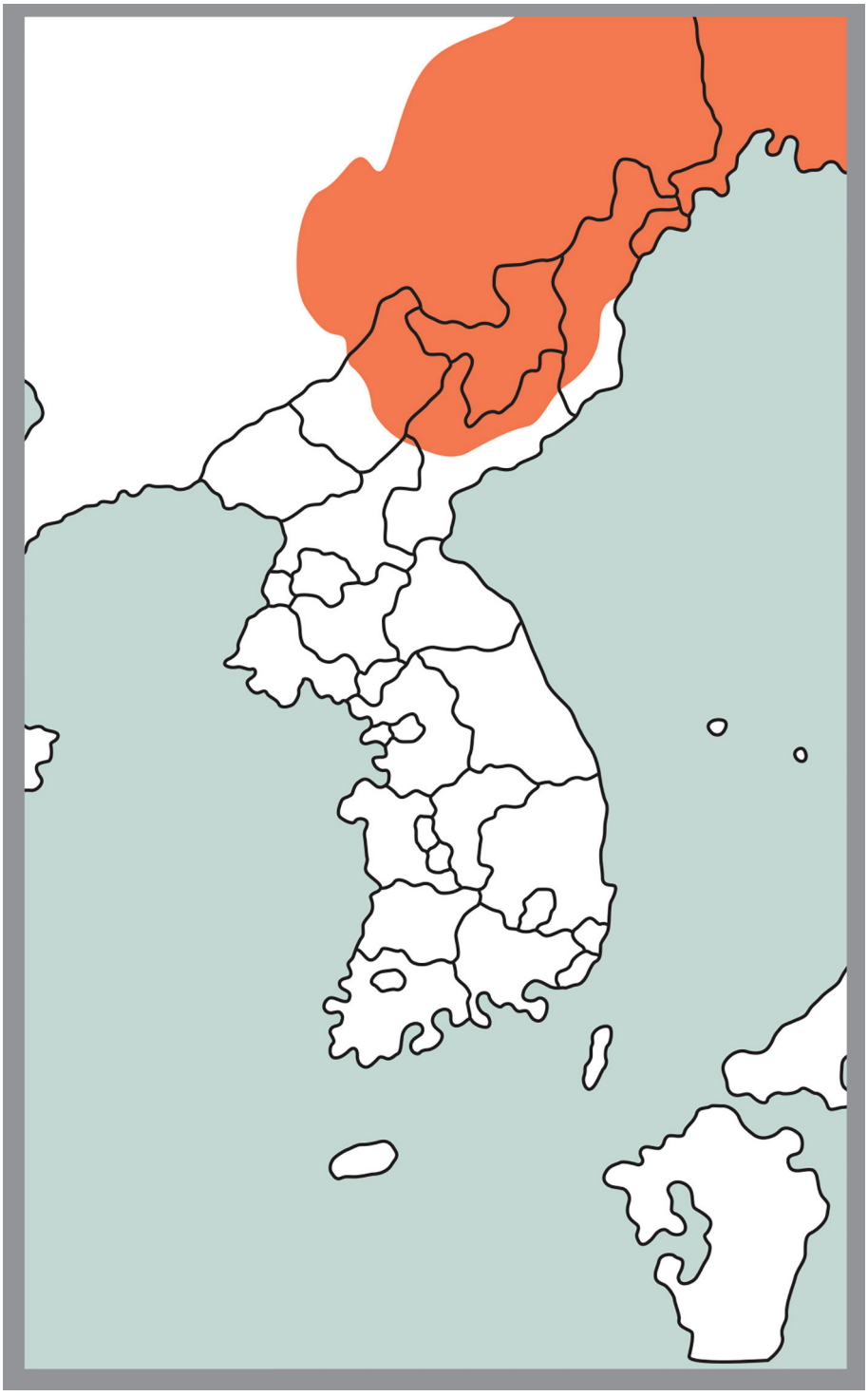

FIGURE 45. Range map of *Martes zibellina* in Korea.

Meles leucurus (Hodgson, 1847)—Asian Badger

Taxidia leucurus Hodgson, 1847b p.763; Type locality- Tibet.
Meles melanogenys Allen and Andrews, 1913 p.433; Type locality- Musan, Korea; Kishida & Mori, 1931 p.380; Kuroda, 1938 p.25.
M. meles melanogenys: Ellerman & Morrison-Scott, 1951 p.273; Won, 1958 p.437; Won, 1967 p.103; Yoon, 1992 p.109.
M. meles: Ellerman & Morrison-Scott, 1951 p.271; Won, 1968 p.299; Corbet, 1978 p.175; Han, 1994 p.46; Won & Smith, 1999 p.18; Oh, 2004a p.180.

M. meles amurensis: Tate, 1947 p.154; Won, 1968 p.299.
M. leucurus: Jo *et al.,* 2012 p.252.

Range: The Asian badger inhabits the Korean Peninsula and Jeju Island (Fig. 46).

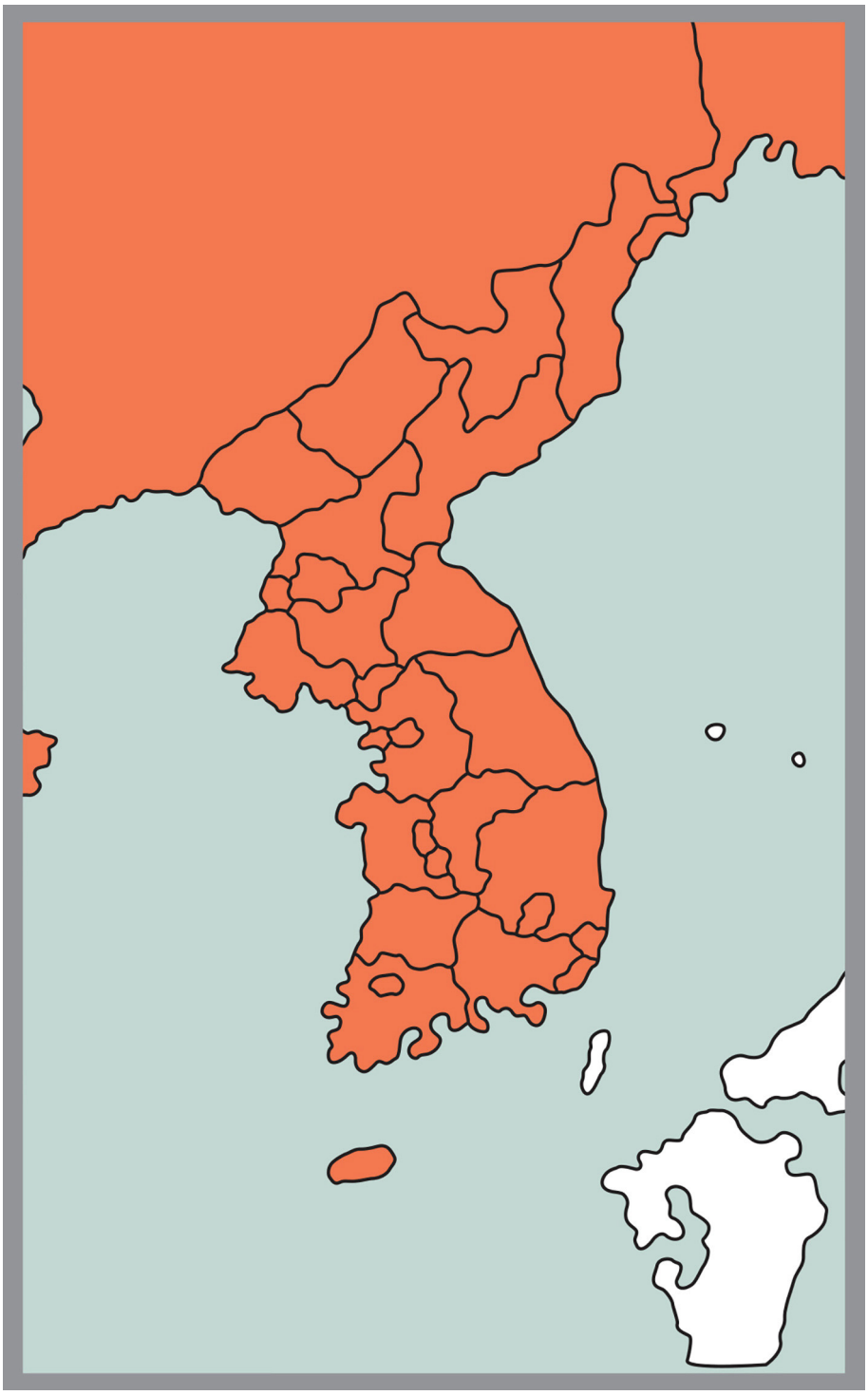

FIGURE 46. Range map of *Meles leucurus* in Korea.

Remarks: Because the species was treated as *M. meles* for a long time, the name *M. meles* became frequently used in Korea. Based on DNA analysis (Tashima *et al.* 2011), the species complex of the Eurasian badger was divided into four lineages, Japanese (*M. anakuma*); western Eurasian (*M. meles meles* European subspecies); Caucasian (*M. meles canascens* Transcaucasian subspecies); and eastern Eurasian (*M. leucurus*). Abramov and Puzachenko (2006) delineated two subspecies, *M. l. leucurus* and *M. l. amurensis,* based on morphometric analysis;

the Korean badger was regarded as *M. l. amurensis*. However, Koh *et al*. (2014b) rejected the species status of *M. anakuma* and considered *M. leucurus* a monotypic species.

Conservation status: Since traditional medicine began using gall bladders of this badger as a substitute for bear gall bladders, *M. leucurus* populations have decreased. Seoul, Ulsan, and Jeollanam Province designated this species as provincially protected since 2002. *Meles leucurus* in South Korea is listed 'Near Threatened' (NIBR 2012).

Genus *Mustela* Linnaeus, 1758

Two species, *Mustela nivalis* and *M. sibirica,* commonly occur in Korea. Recently, *M. eversmanii* was reported around Pyongyang, the capital of North Korea. We also included *M. altaica* due to the high probability of its presence in northern Korea.

Key to species of Genus *Mustela* in Korea

1	Head-body length <200 mm; tail length 30 mm	*M. nivalis*
-	Head body length >150 mm; tail length >30 mm	2
2	limbs and tip of tail black	*M. eversmanii*
-	limbs and tail yellow	3
3	Head-body length >275 mm; tail length 50% head-body length; lips and chin white enclosed by dark pelage on face	*M. sibirica*
-	Head-body length <275 mm; tail length 33% head-body length; no dark pelage on face	*M. altaica*

Mustela nivalis Linnaeus, 1766—Least Weasel

Mustela nivalis Linnaeus, 1766 p.69; Type locality- Sweden; Ellerman & Morrison-Scott, 1951 p.256; Won, 1968 p.282; Han, 1994 p.46; Won & Smith, 1999; p.19; Oh, 2004a p.169.
M. nivalis mosanensis Mori, 1927 p.28; Type locality- Yeonam (near Musan), Korea; Kuroda, 1938 p.29; Ellerman & Morrison-Scott, 1951 p.258; Won, 1958 p.438; Won, 1967 p.113; Won, 1968 p.283.
M. pygmaea mosanensis: Kishida & Mori, 1931 p.380.
M. nivalis nivalis: Corbet, 1978 p.169; Yoon, 1992 p.102.

Range: Previously, mammalogists thought the least weasel in Korea had a distribution limited to the northeastern Korean Peninsula (Won 1968). However, although very rare, the least weasel is now found throughout most of the Korean Peninsula (NIBR 2012; Fig. 47).

Remarks: The least weasel is recognized in Korea as the Subspecies *M. n. mosanensis* (Won 1968). Corbet (1978) relegated most populations in Eurasia, including *M. n. mosanensis*, to a synonym of *M. n. nivalis* Linnaeus, 1766. Abramov and Baryshnikov (2000) identified 19 subspecies and confirmed one subspecies, *M. n. mosanensis,* in the Korean Peninsula, despite difference in coloration between northern and southern Korea. Specimens from northern Korea showed *nivalis*-coloration in which the winter coat turns completely white; however, southern population showed *vulgaris*-coloration with incomplete white coloration in winter coats (Choi & Choi 2007).

Conservation status: The North Korean government designated habitat of *M. nivalis* in the Mayang District, Musan County, Hamgyeongbuk Province as a Natural Monument in 1980. *M. nivalis* in South Korea are regarded as 'Vulnerable' (NIBR 2012) and in North Korea as 'Rare' (MAB National Committee of DPR Korea 2002).

Mustela eversmanii Lesson, 1827—Steppe Polecat

Mustela eversmanni Lesson, 1827 p.144; Type locality- Orenburg Oblast, Russia; Kim et al., 2015 p.162.

Range: Only one individual was caught at Mt. Daeseon, Pyongyang in 1996 (Kim et al. 2015; Fig. 48). Since Pyongyang is a capital city of North Korea and far from general distribution of *M. eversmanii*, it's uncertain

whether the population is indigenous or feral. Additional collections in the geographic range of this semiarid habitat dweller are needed to determine the distribution on the Korean Peninsula.

Conservation status: North Korean red data book listed and assessed steppe polecat as data deficient in 2016.

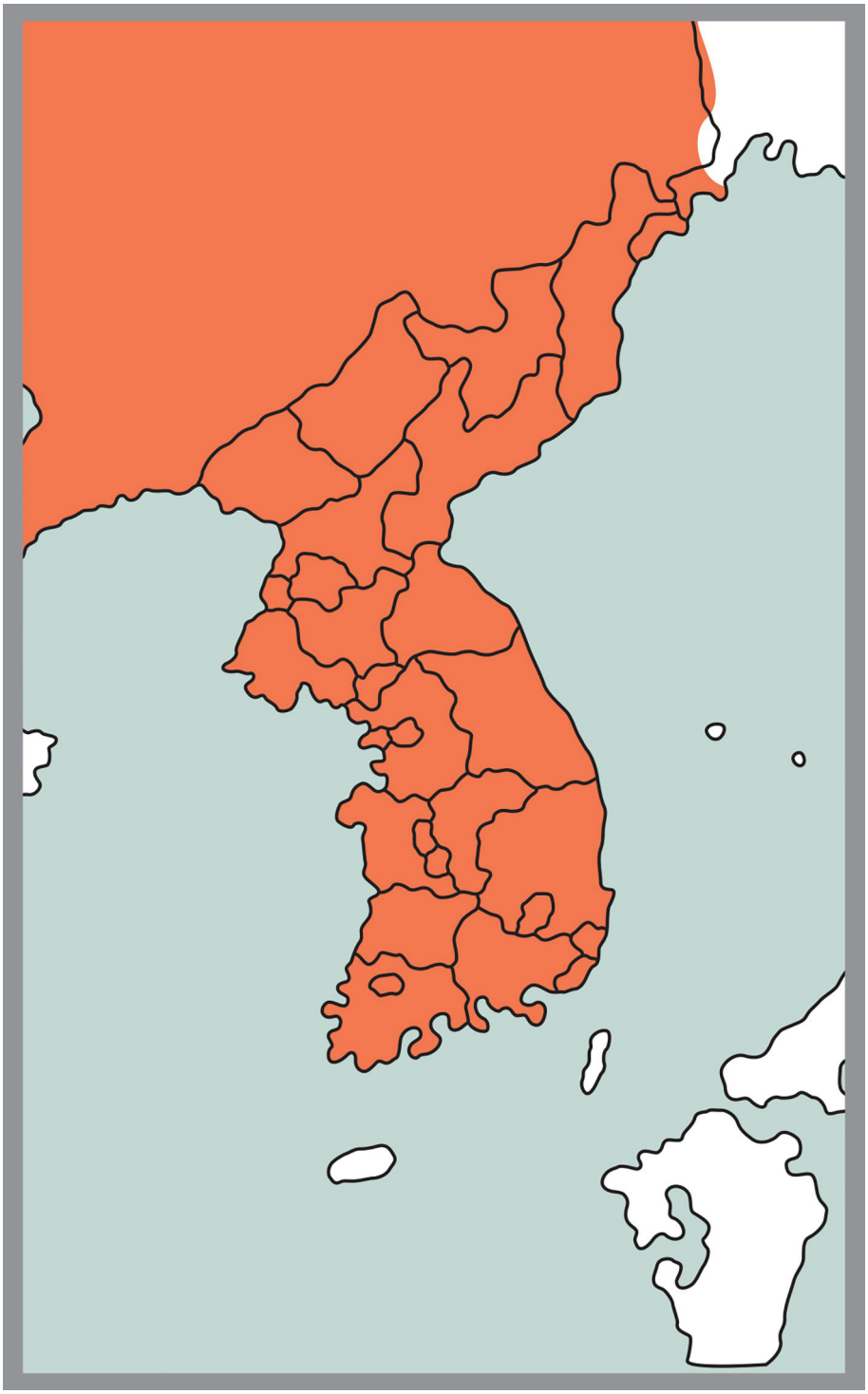

FIGURE 47. Range map of *Mustela nivalis* in Korea.

Mustela sibirica Pallas, 1773—Siberian Weasel

Mustela sibirica Pallas, 1773 p.701; Type locality- Siberian mountains (west Altai); Won,1968 p.285; Corbet, 1978 p.170; Han, 1994 p.46; Won & Smith, 1999 p.19; Oh, 2004a p.172.
Lutreola quelpartis Thomas, 1908b p.53; Type locality- Jeju Island.

M. manchurica Brass, 1911 p.490; Type locality- Manchuria.
Kolonocus sibiricus coreanus Domaniewski, 1926 p.55; Type locality- Seoul, Korea.
K. sibiricus katsurai: Kishida & Mori, 1931 p.380 (northern Korea; *Nomen nudum*).
K. sibiricus peninsulae Kishida and Mori, 1931 p.380 (most of Korean peninsula; *Nomen nudum*).
K. sibiricus quelpartis: Kishida & Mori, 1931 p.380 (Jeju Island); Corbet, 1978 p.170.
M. sibirica manchurica: Kuroda, 1938 p.30; Won, 1958 p.439; Won, 1967 p.114; Won,1968 p.285; Corbet, 1978 p.170; Yoon, 1992 p.102.
M. sibirica coreana: Kuroda, 1938 p.30; Tate, 1947 p.149; Ellerman & Morrison-Scott, 1951 p.262; Won, 1958 p.439; Won, 1967 p.116; Won, 1968 p.289; Yoon, 1992 p.194.
M. sibirica quelpartis: Kuroda, 1938 p.31; Ellerman & Morrison-Scott, 1951 p.261; Won, 1958 p.439; Won, 1967 p.121; Won, 1968 p.290; Yoon, 1992 p.105; Jo *et al.*, 2012 p.252.

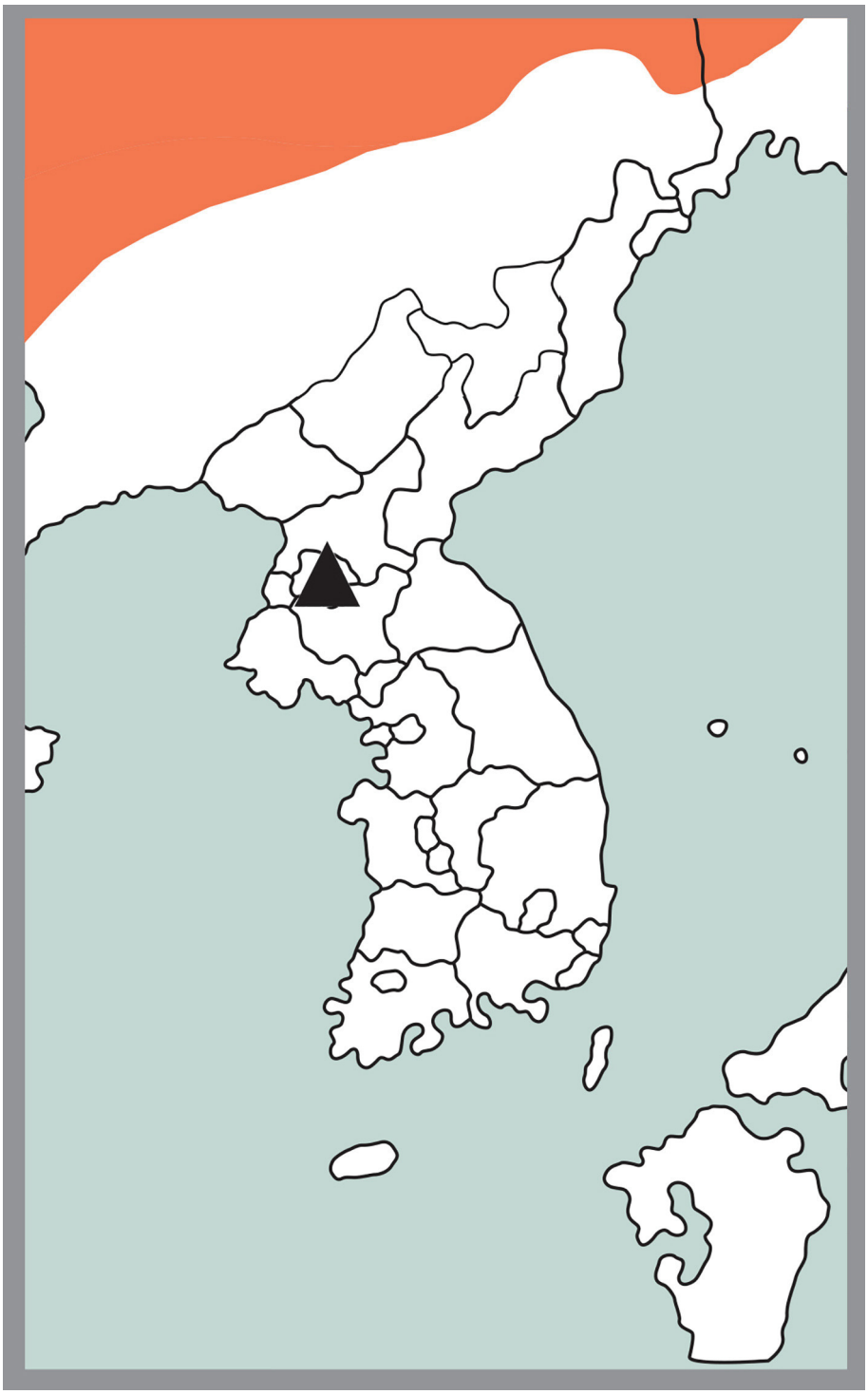

FIGURE 48. Range map of *Mustela eversmanii* in Korea.

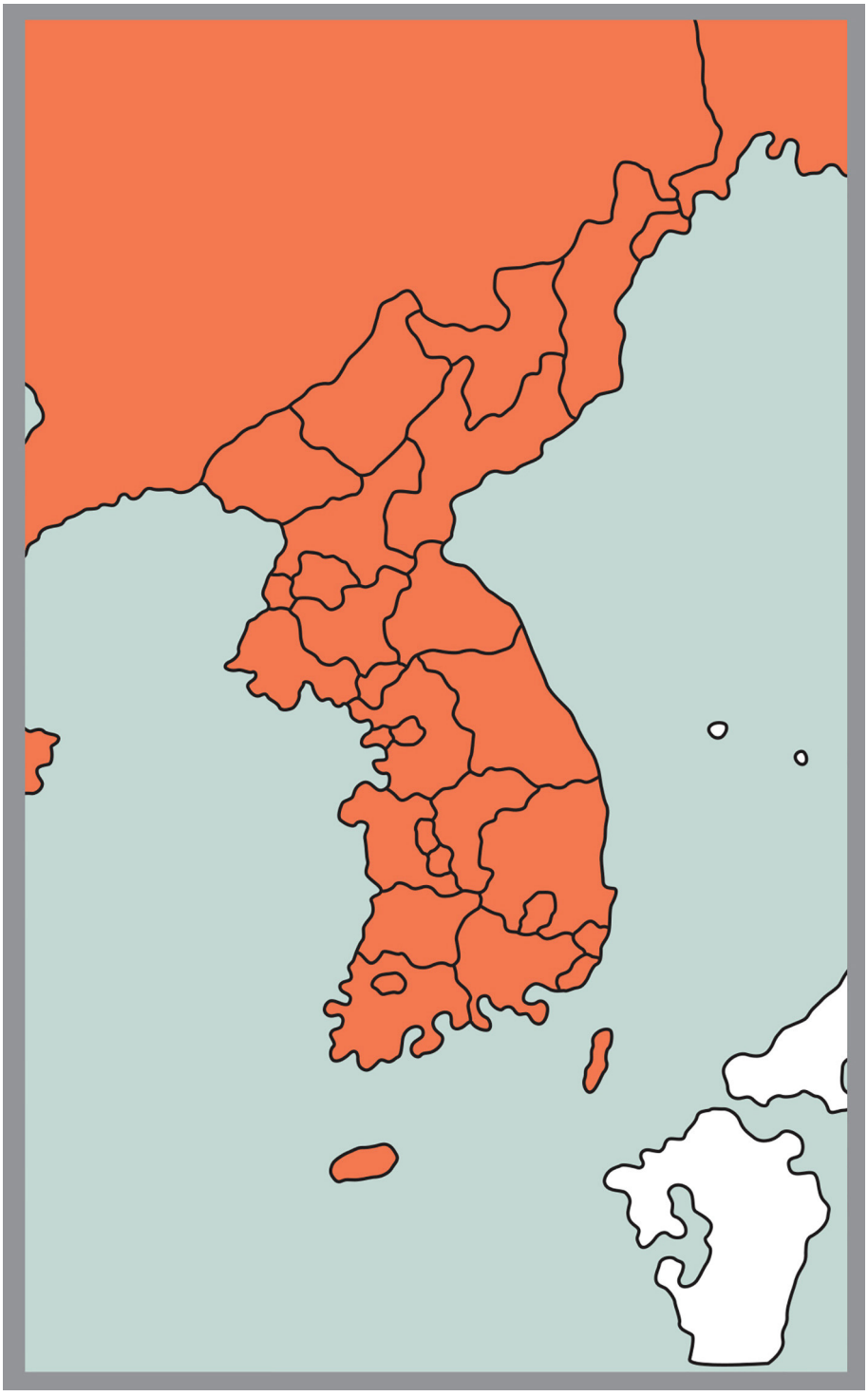

FIGURE 49. Range map of *Mustela sibirica* in Korea.

Range: The distribution of *Mustela sibirica* covers the Korean Peninsula from urban areas of Seoul to high mountains, where it is common (3rd National Nature-Environmental Survey 2006–2013 unpublished electronic data; Fig. 49).

Remarks: Won and Smith (1999) described three subspecies, a northern population, *M. s. manchurica*, a southern population, *M. s. coreana,* and an isolated population on Jeju Island, *M. s. quelpartis* for the Siberian weasel in Korea. *Mustela s. coreana* was later synonymized with *M. s. manchurica* (Corbet 1978), which included: a peninsula subspecies, *M. s. manchurica* Brass, 1911; the subspecies on Jeju Island, *M. s. quelpartis* Thomas, 1908, Quelpart kolonok. Also, Abramov (2005) confirmed *M. s. quelpartis* as a valid subspecies by morphometric

comparison with populations of the Korean Peninsula and *M. itatsi* in Japan. However, Koh *et al*. (2012c) found that the subspecies *quelpartis* was not genetically distinct from the subspecies of the Korean Peninsula; thus, they did not support the current classification based on pelage color variation.

Conservation status: Ulsan, Daejeon, and Gwangju Metropolitan governments designated *M. sibirica* as a Provincially Protected Species.

Mustela altaica Pallas, 1811—Mountain Weasel

Mustela altaica Pallas, 1811 p.98; Type locality- Altai mountain; Heptner *et al*., 1967 p.1042; Nowak, 1999 p.705; Han, 1994 p.46; Won & Smith, 1999 p.19.
Kolonocus alpinus raddei: Ognev, 1931 p.734 (p.554 in English translated edition).
M. altaica raddei: Corbet, 1978 p.169 (probably Manchuria and Korea).

Range: Despite no collection of specimens from Korea, it is highly conceivable that *M. altaica* inhabits at least extreme northeastern Korea based on collections of the species at the border between China, Russia, and North Korea (Won & Smith 1999). The most likely location for the presence of *M. altaica* in Korea would be Hamgyeongbuk Province, nearby to collection sites of the species in China and Russia (Fig. 50). Although the IUCN distribution map of *M. altaica* includes the Korean Peninsula, Abramov *et al*. (2008) regarded that the inclusion of North Korea within the geographic range as needing confirmation.

Remarks: Since Ognev (1928) suggested the occurrence of *M. altaica* in Korea, this species gained a place on the list of mammals of Korea. The quasi absence of mammalian faunal surveys in North Korea together with the confusion of *M. altaica* with *M. sibirica,* have hampered the assessment of the distribution of the species in Korea.

Conservation status: Not considered at risk by Korean institutions.

Family FELIDAE Fischer, 1817

The Family Felidae in Korea has four species representatives grouped into three genera. Except for the small-sized *Prionailurus bengalensis*, the other three species of medium or large-sized cats are considered extirpated in South Korea, and their presence in North Korea remains uncertain. Allen and Andrews (1913) reported the snow leopard (*Uncia uncia*) in Korea, but no further record has confirmed that the species exists in Korea. Other than the report by Allen and Andrews (1913), no other record placed the snow leopard in Korea, Manchuria, or Siberia, Allen and Andrews (1913) reported the species was frequently caught by natives, but the natives may have confused the tiger with leopards. Therefore, the record of snow leopard by Allen and Andrews (1913) in Korea is regarded as an erroneous identification. We did not include the snow leopard in our list because over 100-years have elapsed since the supposedly report of the species in Korea.

Key to genera of Felidae in Korea

1	Head-body length >1 m	*Panthera*
-	Head-body length <1 m	2
2	Tail short; ears tufted; tip of tail black	*Lynx*
-	Tail long; ears not tufted; white spot back of ears; White and black stripes nose to forehead; tail spotted	*Prionailurus*

Genus *Panthera* Oken, 1816

The Genus *Panthera* belongs to the Subfamily Pantherinae. Although two species were previously common in Korea, they became extirpated in South Korea and their status in North Korea remains uncertain.

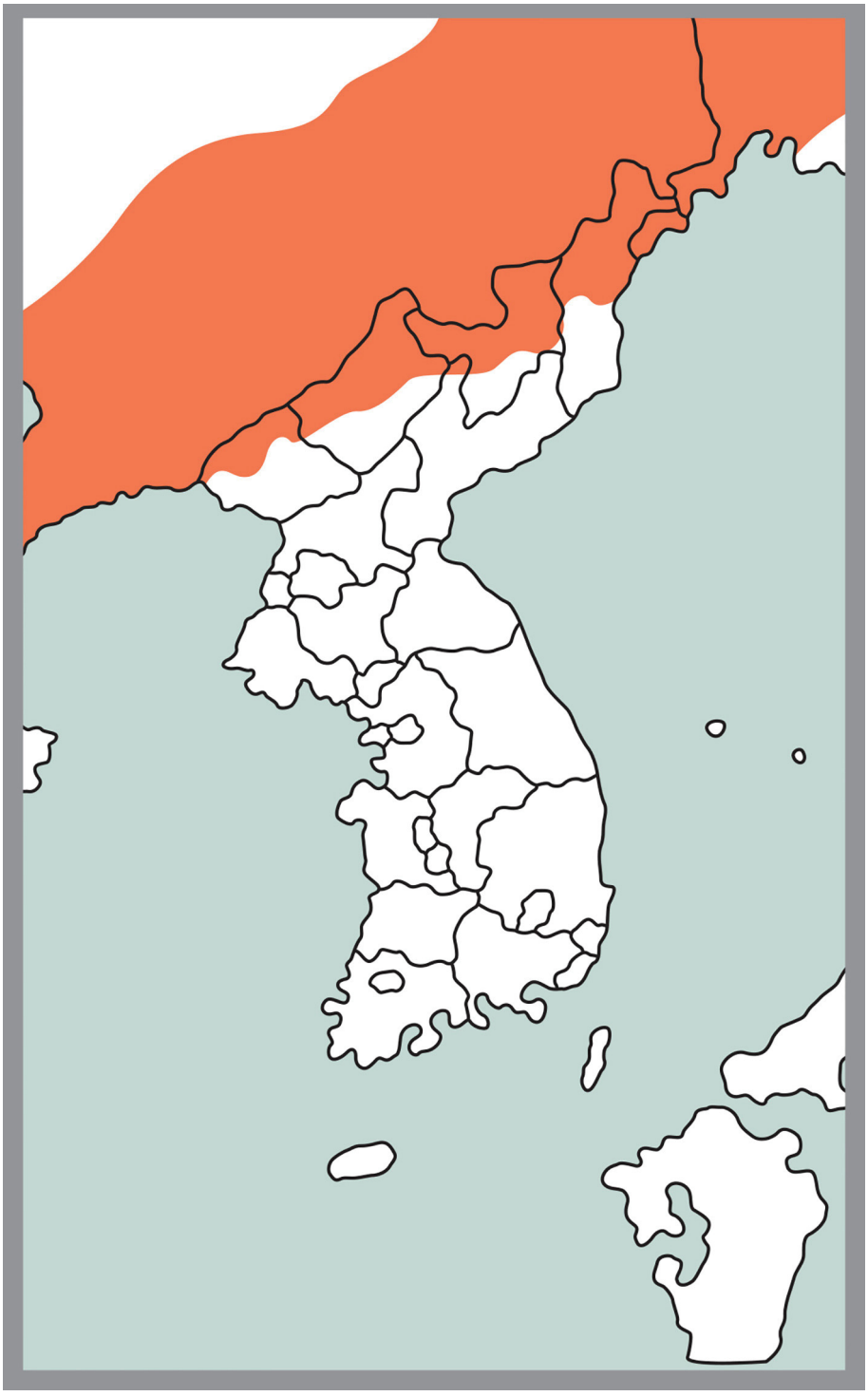

FIGURE 50. Range map of *Mustela altaica* in Korea.

Key to species of Genus *Panthera* in Korea

- Pelage with spots in clusters or ringed spots; skull length <250 mm and width <170 mm . . . . . *P. pardus*
- Pelage striped; skull length >250 mm; skull width >170 mm. . . . . .*P. tigris*

Panthera pardus (Linnaeus, 1758)—Leopard

Felis pardus Linnaeus, 1758 p.41; Type locality- Indiis (Egypt); Won, 1968 p.311.
F. orientalis Schlegel, 1857 p.23; Type locality- Korea.
F. villosa Bonhote, 1903 p.475; Type locality- Amur Bay, East Siberia.
Pardus orientalis: Kishida & Mori, 1931 p.379.
F. pardus orientalis: Kuroda, 1938 p.40; Won, 1958 p.442; Won, 1967 p.147; Won, 1968 p.312.
Panthera pardus orientalis: Tate, 1947 p.194; Ellerman & Morrison-Scott, 1951 p.316; Yoon, 1992 p.115.
Panthera pardus: Corbet, 1978 p.184; Han, 1994 p.46; Won & Smith, 1999 p.20; Oh, 2004a p.158.

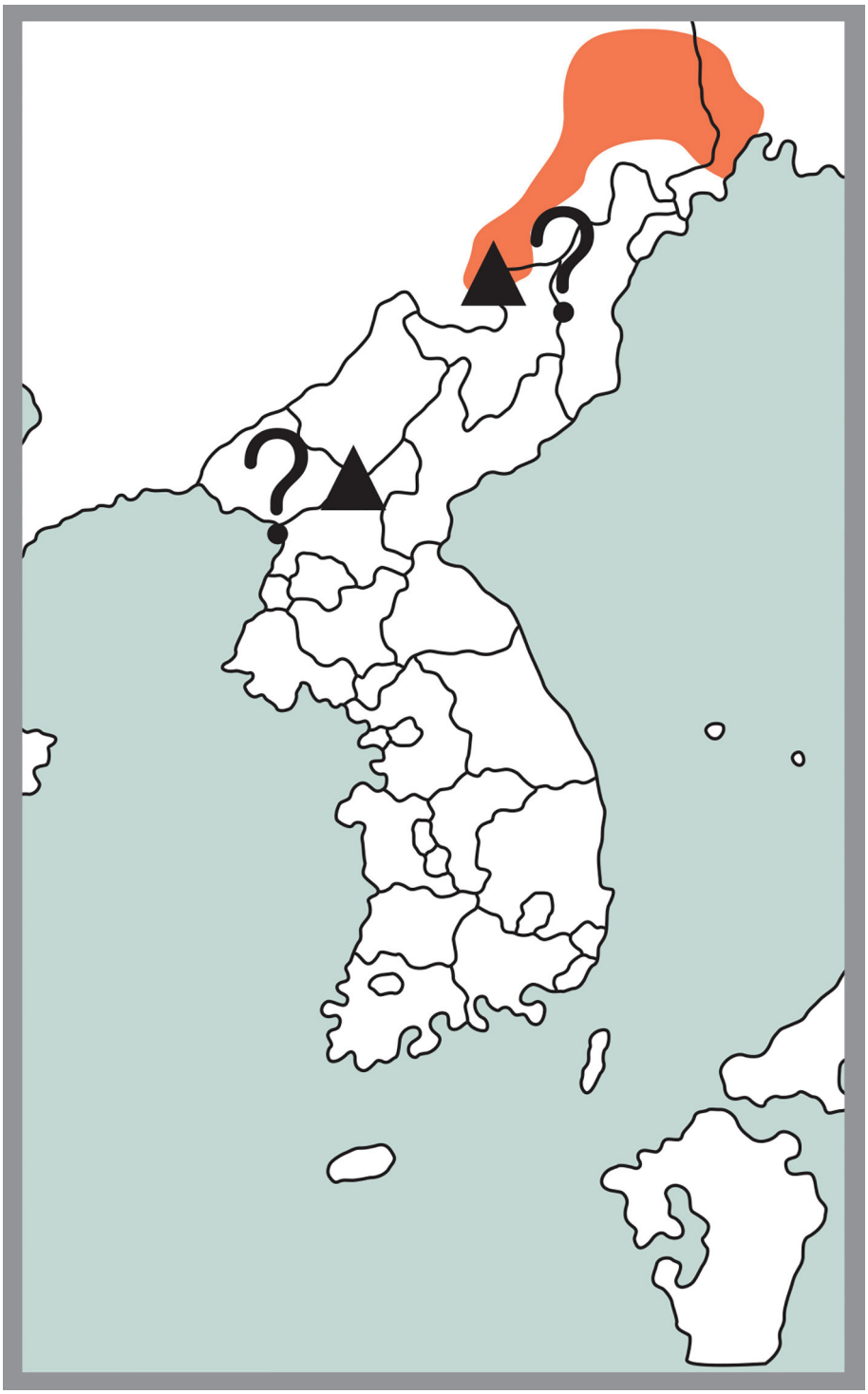

FIGURE 51. Range map of *Panthera pardus* in Korea.

Range: The original distribution of the leopard in Korea extended throughout the peninsula (Jo & Baccus 2016). Until the 1990s, a few leopards remained in extreme northern North Korea (Kim *et al*. 2015; Fig. 51). The only official North Korean government report (Korean Central News Agency 17 March 2009) on the status of this species in North Korea reported occurrences in Mt. Myohyang Nature Reserve, Hyangsan County in 2009.

Remarks: Leopards from Korea, Far East Russia, and northeastern China are classified under *Panthera pardus orientalis* (Schlegel, 1857).

Conservation status: North Korea classified populations as 'Vulnerable'. The Ministry of Environment in South Korea listed *P. pardus* as an endangered species in 1997. Despite several unofficial reports of leopards, *P. pardus* became extinct at least in South Korea, and the NIBR (2012) declared *P. pardus* in South Korea as 'Regionally Extinct'. The status of this species in North Korea remains unknown. Radio telemetry studies confirmed that populations exist in the Primorye region of southeastern Russia and Jilin Province of northeast China (Uphyrkina *et al.* 2002; Miquelle & Goodrich 2009). Leopards cross between Russia, China and North Korea across the Duman River despite a high and long wire fence marking the boundary (Nam 2005). However, North Korea has seldom monitored leopards or their habitats along that part of the border in the mountains (Nam 2005). Unfortunately, wildlife surveys rarely occur in this region. This subspecies was classified and has remained classified as 'Critically Endangered' since 1996 by the IUCN; the species is protected by CITES Appendix I.

Panthera tigris (Linnaeus, 1758)—Tiger

Felis tigris Linnaeus, 1758 p.41; Type locality- Bengal; Won, 1968 p.315.
F. tigris coreensis Brass, 1904 p.4; Type locality- Korea; Kuroda, 1938 p.40; Won, 1958 p.442; Won, 1967 p.148; Won, 1968 p.315.
Tigris mikodoi Satunin, 1915 p.16; Type locality- Korea (*Nomen nudum*).
Panthera tigris coreensis: Kishida & Mori, 1931 p.379; Tate, 1947 p.194; Ellerman & Morrison-Scott, 1951 p.318.
P. tigris longipilis: Tate, 1947 p.193 (Mongolia, Manchuria, Korea and Siberia).
P. tigris altaica: Corbet, 1978 p.184; Yoon, 1994 p.118.
P. tigris: Corbet, 1978 p.184; Han, 1994 p.46; Won & Smith, 1999 p.21; Oh, 2004a p.160.

Range: The original distribution of the tiger ranged over all the Korean Peninsula. The population declined significantly during the Japanese incursion (1910–1945). Whether tigers remain in South Korea has been the subject of much discussion. Although some mammalogists believe that a few individuals might remain around Mt. Baekdu, no hard evidence has confirmed their presence (Fig. 52). American soldiers reported tigers in the demilitarized zone (DMZ), even white tigers, but these purported sightings lack supporting evidence (Brady 2008). Although Kim *et al.* (2015) reported tigers in Mt. Baekdu, the supporting evidence for tigers in North Korea is currently lacking.

Remarks: Recent mtDNA analyses resulted in *coreensis* being a synonym of *P. t. altaica* (Lee et *al.* 2012).

Conservation status: The Ministry of Environment of South Korea listed *P. tigris* as an endangered species in 1997. Also, the North Korean Government selected three tiger habitats (Mt. Baekdu, Mt. Chuae and Wagal-peak) as Natural Monuments in 1981. The tiger became extinct in South Korea, and the status remains uncertain in North Korea (Jo & Baccus 2016). Since tigers still inhabit areas of Far East Russia just north of the border with North Korea, the possibility of tigers crossing the Duman River into Korea still exists. The North Korean Government listed this species as 'Endangered', and the Red Data Book for South Korea registered the tiger as 'Regionally Extinct' (MAB National Committee of DPR Korea 2002; NIBR 2012). This species is listed on CITES Appendix I.

Genus *Lynx* Kerr, 1792

Lynx was previously regarded as a Subgenus of *Felis* (Corbet 1978), but we followed the molecular taxonomy of Johnson *et al.* (2006) and Wozencraft (2005). A single species *L. lynx* represents this genus in Korea.

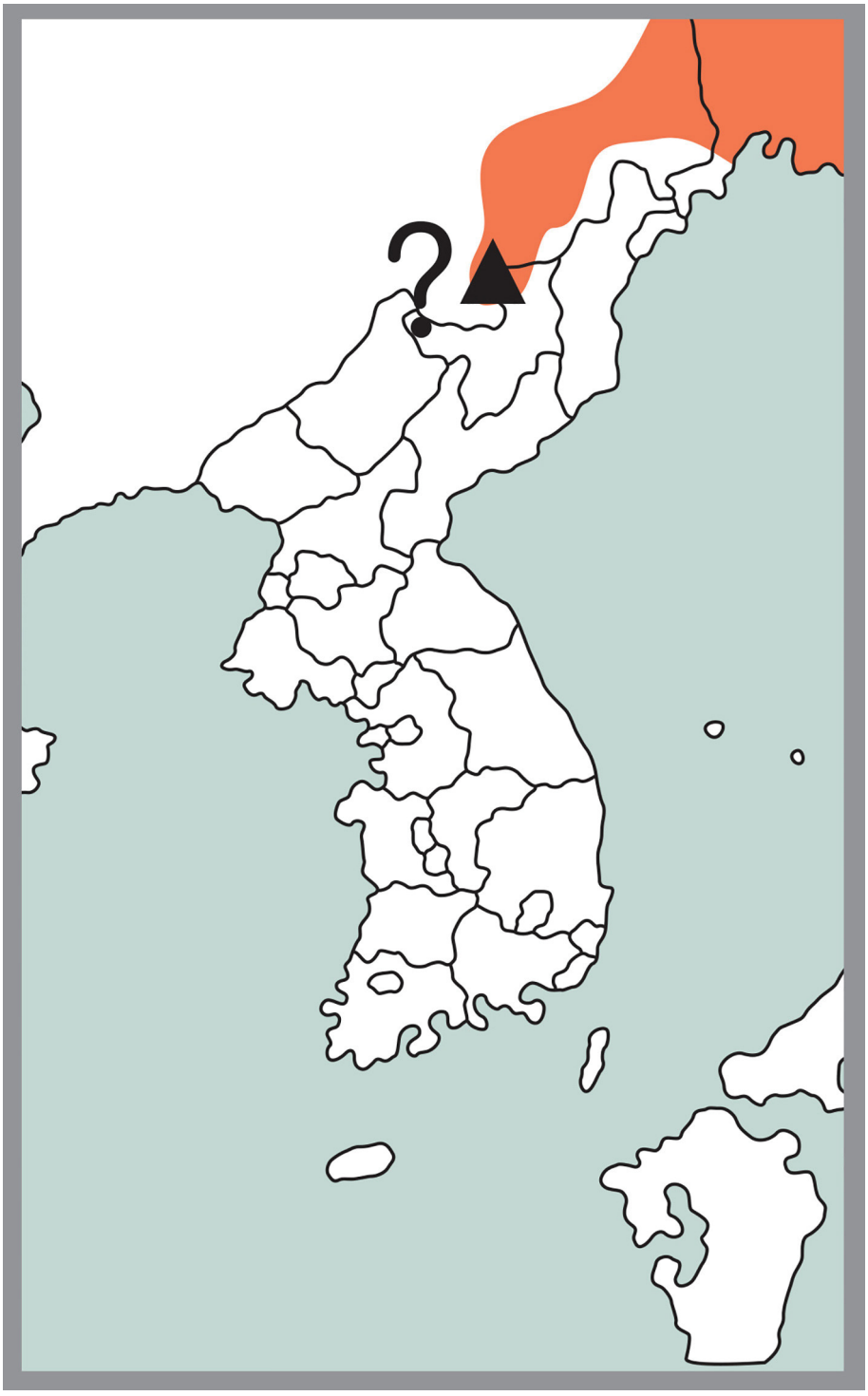

FIGURE 52. Range map of *Panthera tigris* in Korea.

Lynx lynx (Linnaeus, 1758)—Eurasian Lynx

Felis lynx Linnaeus, 1758 p.43; Type locality- Southern Sweden.
Felis cervaria Temminck, 1827 p.106; Type locality- Northern Asia.
Lynx lynx borealis: Kuroda *in* Uchida, 1927 p.37.
L. borealis: Kishida & Mori, 1931 p.379.
L. lynx cervaria: Won, 1958 p.442; Won, 1967 p.152.
F. lynx cervaria: Kuroda, 1938 p.40; Won, 1968 p.320.

F. lynx lynx: Yoon, 1992 p.113
L. lynx: Han, 1994 p.46; Won & Smith, 1999 p.20; Oh, 2004a p.154.

Range: The distribution of the Eurasian lynx formerly covered the northwestern Korean Peninsula (Kim *et al.* 2015; Fig. 53). Only two lynx records from the 1910s at Guseong City, Pyeonganbuk Province and in the 1930s at Deokcheon City, Pyeongannam Province documented its presence in Korea (Won 1968). Recent records of lynx in North Korea are from Sinheung-gun and Baekam-gun in the 1990s (Kim *et al.* 2015). Unofficial records around the DMZ from South Korea cannot be validated (Yoo 2000). Historically, *L. lynx* has always been considered rare in Korea.

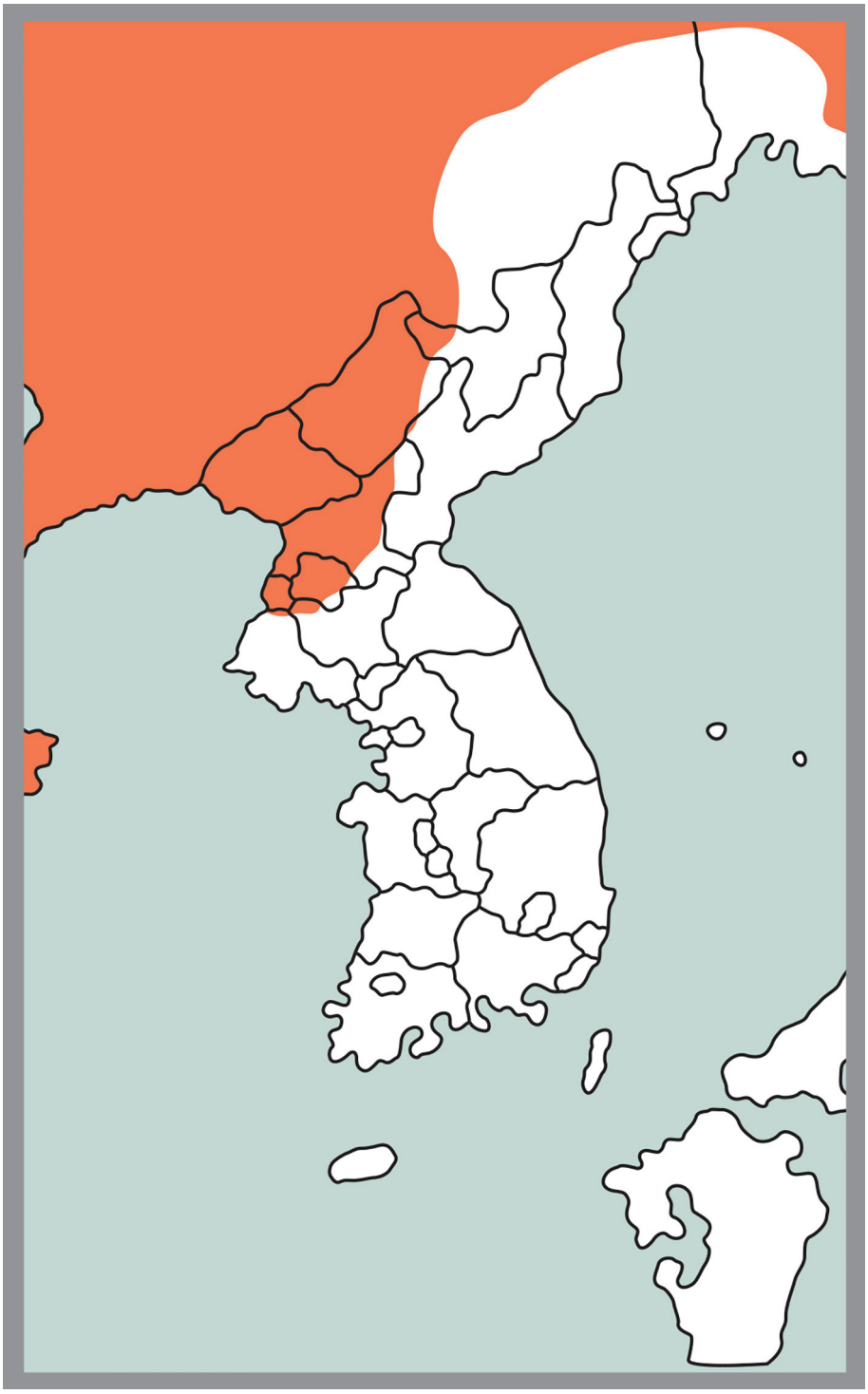

FIGURE 53. Range map of *Lynx lynx* in Korea.

Remarks: The populations in Korea were once regarded as *L. l. cervaria* (Won 1968), but this taxon remains uncertain since it became a synonym of *L. l. lynx* (Won & Smith 1999). Heptner and Sludskii (1972) recorded *Lynx lynx stroganovi* Heptner, 1969 in Manchuria close to Korea. Without any geographic barriers, *L. l. cervaria* from Korea and *L. l. stroganovi* from Machuria could be the same subspecies.

Conservation status: The Red Data Book of North Korea lists the Eurasian lynx as a 'Vulnerable' species (MAB National Committee of DPR Korea 2002). The Ministry of Environment in South Korea designated *L. lynx* as an endangered species in 2005. Although the Eurasian lynx was reported only in extreme northern Korea, *L. lynx* was considered as 'Regionally Extinct' in South Korea and became a candidate for a 'restoration project' (NIBR 2012; Jo & Baccus 2016).

Genus *Prionailurus* Severtzov, 1858

Prionailurus was regarded as a subgenus of *Felis* (Corbet 1978). Based on molecular phylogeny by Johnson *et al.* (2006), *Prionailurus* was separated from *Felis*. We followed Wozencraft (2005). One species, *P. bengalensis* inhabits Korea.

Prionailurus bengalensis (Kerr, 1792)—Leopard Cat

Felis bengalensis Kerr *in* Linnaeus, 1792 p.151; Type locality- southern Bengal; Ellerman & Morrison-Scott, 1951 p.312; Corbet, 1978 p.183; Oh, 2004a p.156.
F. euptilura Elliot, 1871 p.761; Type locality- northwestern Siberia; Won, 1968 p.307.
F. microtis Milne-Edwards, 1871 p.221; Type locality- northeastern China; Kishida & Mori, 1931 p.379.
F. manchurica Mori, 1922b p.609; Type locality- Mukden (Shenyang), Manchuria.
F. bengalensis manchurica: Tate, 1947 p.189; Won, 1958 p.442; Won, 1967 p.145.
F. euptilura microtis: Won, 1968 p.307.
F. bengalensis euptilura: Corbet, 1978 p.183; Yoon, 1992 p.115.
Prionailurus bengalensis: Han, 1994 p.46; Won & Smith, 1999 p.20.

Range: Leopard cats occur throughout Korea except in the remote islands and Jeju Island, where the species became extinct in the 1930s–1940s (Fig. 54).

Remarks: Populations in Korea were classified as one subspecies, *P. b. euptilurus* (or *euptilura*) Elliott, 1871. Heptner (1971) considered *euptilura* a distinct species, but this was generally not followed (e.g., Wozencraft 2005).

Conservation status: The South Korean government delisted *P. bengalensis* as a game species in 1965 and the Ministry of Environment designated the species an endangered species in 1998. The Red Data Book of South Korea lists *P. bengalensis* as 'Vulnerable' (NIBR 2012).

Family CANIDAE Fischer, 1817

Four species of canids classified into four different genera inhabited Korea. Except for *Nyctereutes procyonoides*, the status of the other three species remains uncertain in North Korea, but they have become extinct in South Korea.

Key to genera of Canidae in Korea

1	Black cheeks conspicuously contrasting with color of pelage; short ears do not reach eyes	*Nyctereutes*
-	Cheeks not black ; ears reach eyes	2
2	Head-body length >800 mm; shoulder height >450 mm	3
-	Head-body length <800 mm; shoulder height <450 mm; ears pointed; tail length almost thrice foot length	*Vulpes*
3	Reddish dorsal color with white ventral pelage; 6 upper and lower cheek teeth	*Cuon*
-	Grayish brown dorsal color; 7 lower cheek teeth	*Canis*

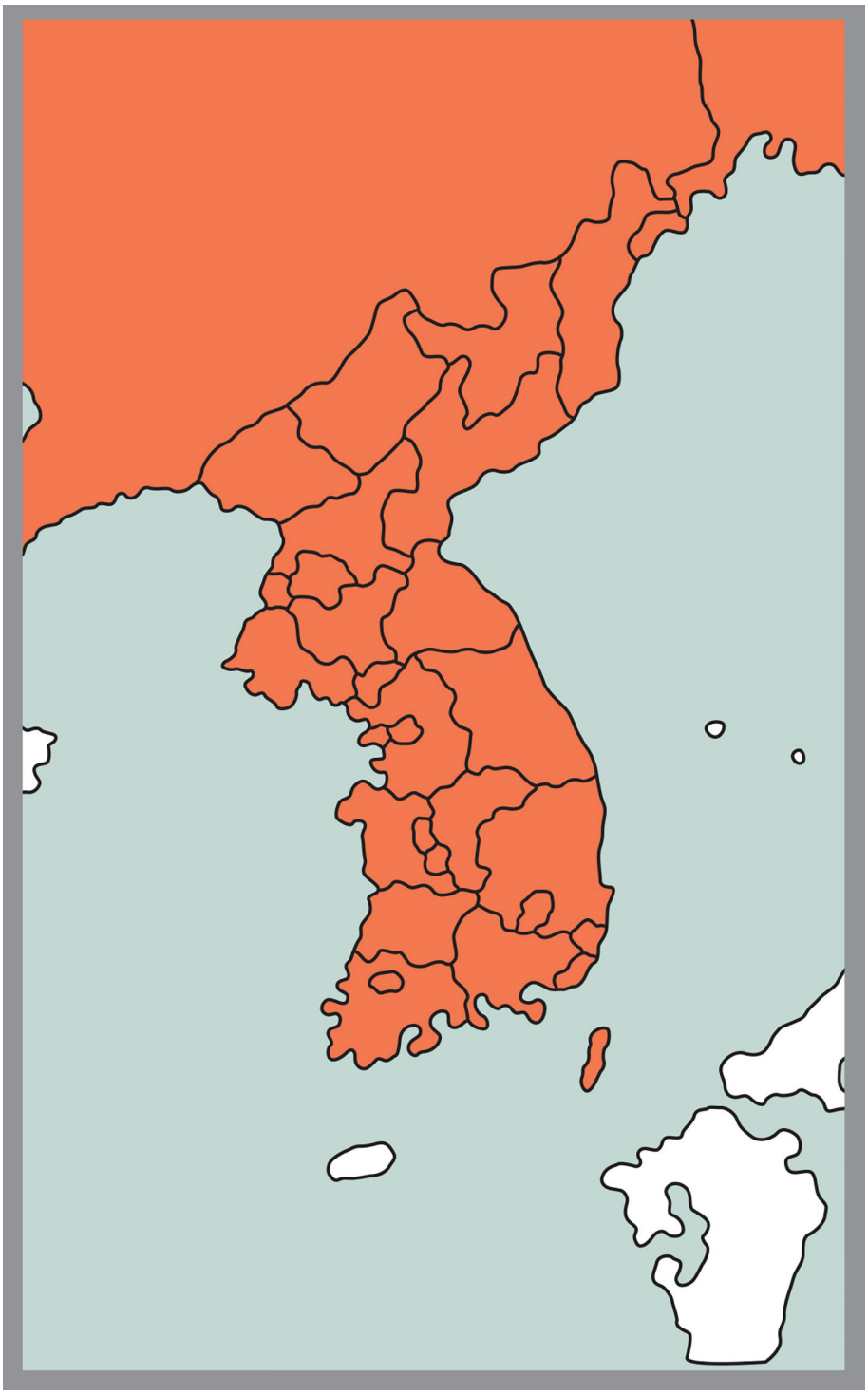

FIGURE 54. Range map of *Prionailurus bengalensis* in Korea.

Genus *Nyctereutes* Temminck, 1838

Nyctereutes, the only canid with abundant populations throughout Korea, is a monospecific genus.

Nyctereutes procyonoides (Gray, 1834)—Raccoon Dog

Canis procyonoides Gray, 1834 p.2; Type locality- Canton (Guangzhou), China.
Nyctereutes ussuriensis Matschie, 1908 p.178; Type locality- Ussuri, Russia.
N. koreensis Mori, 1922b p.607; Type locality- Uijeongbu (near Seoul), Korea; Kishida & Mori, 1931 p.379.
N. procyonoides koreensis: Kuroda, 1938 p.35; Tate, 1947 p.163; Ellerman & Morrison-Scott, 1951 p.233; Won, 1958 p.441; Won, 1967 p.138; Won, 1968 p.267; Yoon, 1992 p.95.
N. procyonoides ussuriensis: Kuroda, 1938 p.35; Won, 1958 p.441; Won, 1967 p.135; Won, 1968 p.263; Yoon, 1992 p.94.
N. procyonoides: Won, 1968 p.263; Han, 1994 p.46; Won & Smith, 1999 p.16; Oh, 2004a p.148.
N. procyonoides procyonoides: Corbet, 1978 p.164.

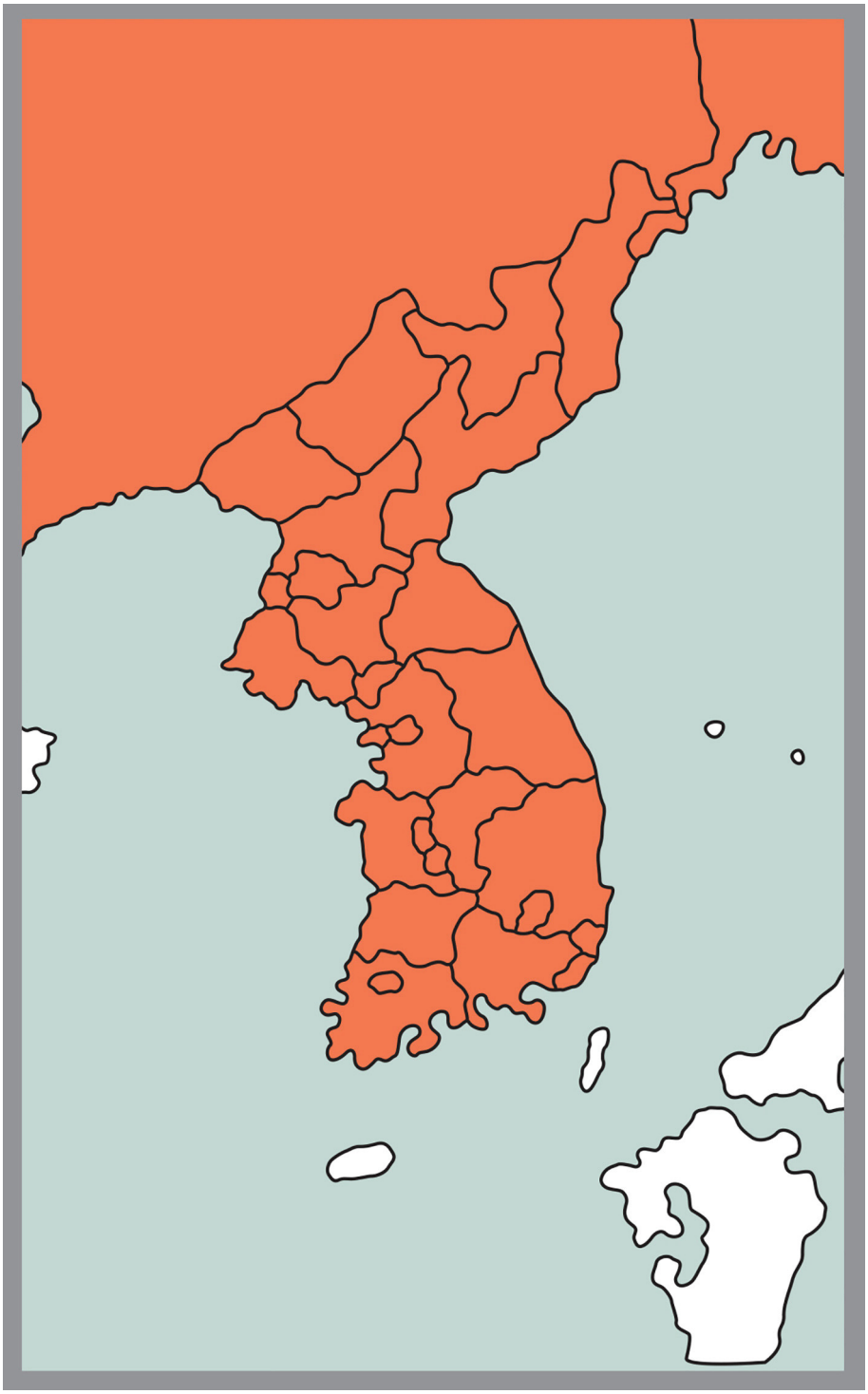

FIGURE 55. Range map of *Nyctereutes procyonoides* in Korea.

Range: Raccoon dogs range throughout Korea except in remote islands (3rd National Nature-Environmental Survey 2006–2013 unpublished electronic data; Fig. 55).

Remarks: Two allopatric subspecies of raccoon dogs have been recognized in the Korean Peninsula, including *N. p. ussuriensis* Matschie, 1907 in the north and *N. p. koreensis* Mori, 1922 in the south (Won 1967). However, no geographic barriers or morphological differences were observed between the two subspecies. Based on cytochrome *b* analyses, populations in Korea clustered with populations of raccoon dogs from Russia and northeastern China (*N. p. ussuriensis;* Kim *et al.* 2013a).

Genus *Vulpes* Frisch, 1775

A single species, *V. vulpes* occurred in Korea.

Vulpes vulpes (Linnaeus, 1758)—Red Fox

Canis vulpes Linnaeus, 1758 p.40; Type locality- Sweden.
Vulpes peculiosa Kishida, 1924 p.4; Type locality- Korean Peninsula; Kishida & Mori, 1931 p.380.
V. kyomasai Kishida and Mori, 1929 p.82; Type locality- Hamgyeongbuk Province, Korea; Kishida & Mori, 1931 p.380; Kuroda, 1938 p.34; Ellerman & Morrison-Scott, 1951 p.229 (*Incertae sedis*); Won, 1968 p.261.
V. vulpes peculiosa: Kuroda, 1938 p.34; Ellerman & Morrison-Scott, 1951 p.229; Won, 1958 p.440; Won, 1967 p.132; Won, 1968 p.258; Yoon, 1992 p.93.
V. vulpes: Howell, 1929 p.24 (a skin of red fox from Korea); Won, 1968 p.256; Corbet, 1978 p.163; Han, 1994 p.46; Won & Smith, 1999 p.16; Oh, 2004a p.151.

Range: The original distribution of the red fox covered the Korean Peninsula (Jo & Baccus 2015). Although one dead red fox was discovered in Yanggu County, Gangwon Province in South Korea in 2004, the animal probably escaped from a fur farm in the area (Jo & Baccus 2015). A small population may remain in northern and northeastern areas of North Korea (Won & Smith 1999), but little evidence corroborated the presence of red foxes in North Korea other than two individuals from the Gaemagowon (Yu *et al*. 2012; Fig. 56).

Remarks: Red foxes in Korea were described under the subspecies *V. v. peculiosa* Kishida, 1924. Analyses of cytochrome *b* gene indicated that red foxes inhabiting South Korea represented both Eurasian and North Pacific lineages, implying at least two recent immigrations (Yu *et al*. 2012).

Conservation status: The Ministry of Environment in South Korea designated the red fox as an Endangered Species in 1997. A restoration plan began in 2012 with the release of captive-raised foxes, after the species became extirpated (Jo & Baccus 2015).

Genus *Cuon* Hodgson, 1838

Cuon is a monospecific genus. Despite morphological similarities with *Canis*, *Cuon* has shorter tooth-row with the absence of M_3 teeth (Corbet 1978).

Cuon alpinus (Pallas, 1811)—Dhole

Canis alpinus Pallas, 1811 p.34; Type locality- Amur, Russia.
Cuon alpinus: Kishida & Mori, 1931 p.379; Kuroda, 1938 p.37; Ellerman & Morrison-Scott, 1951 p.233; Won, 1968 p.268; Han, 1994 p.46; Won & Smith, 1999 p.15.
Cuon alpinus alpinus: Won, 1968 p.268; Yoon, 1992 p.97.

Range: The original distribution of the dhole ranged throughout the Korean Peninsula (Jo & Baccus 2015). Presence of dholes around Mt. Baekdu (3 individuals observed in 1988 at Chail-peak Plateau) in extreme northeastern Korea were reported until the 1990s (Jin & Ouh 1990; Fig. 57), but the current status of dholes remains uncertain.

Remarks: The populations of northeastern Asia -including Korea- were classified as *C. a. alpinus* (Pallas, 1811).

Conservation status: The North Korean government designated *C. alpinus* as an Endangered Species (MAB National Committee of DPR Korea 2002; Democratic People's Republic of Korea 2007). The South Korean population became exterminated before the 1970s, with no conservation action taking place in South Korea (Jo & Baccus 2015). All populations of northeastern Asia are considered extinct (Venkataraman & Johnsingh 2004). CITES lists the species on Appendix II.

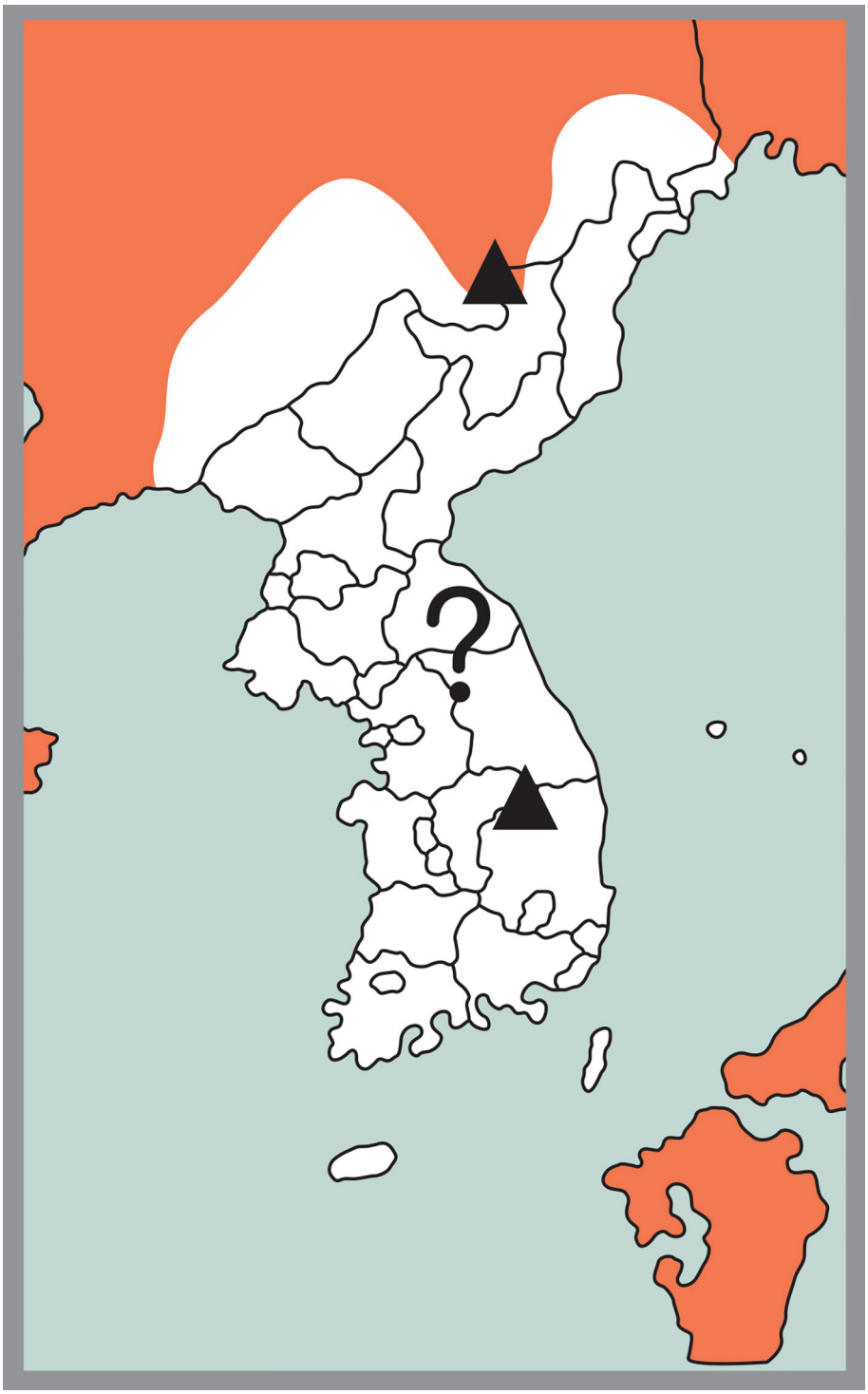

FIGURE 56. Range map of *Vulpes vulpes* in Korea.

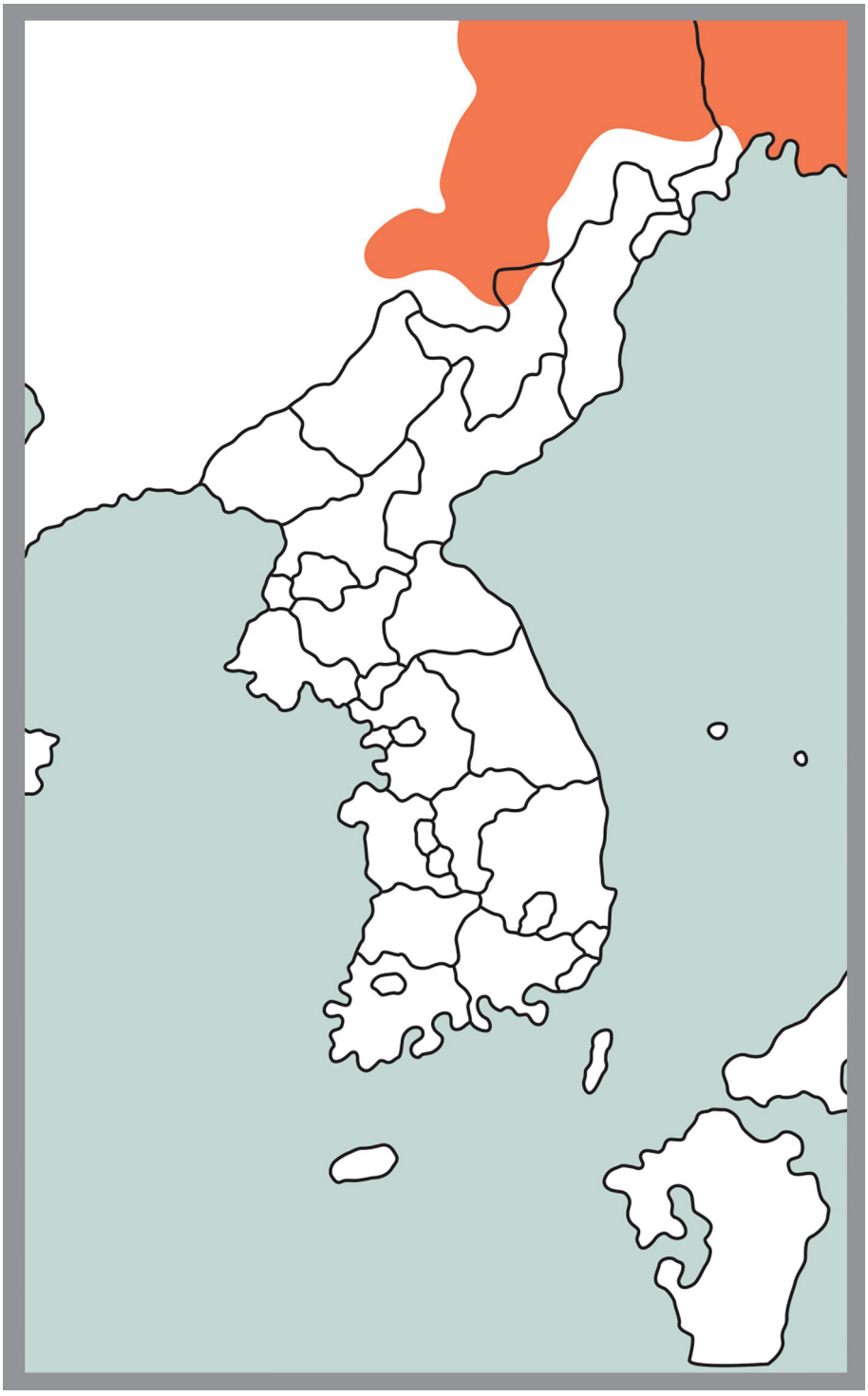

FIGURE 57. Range map of *Cuon alpinus* in Korea.

Genus *Canis* Linnaeus, 1758

A single species *C. lupus* occurred in Korea.

Canis lupus Linnaeus, 1758—Eurasian Wolf

Canis lupus Linnaeus, 1758 p.39; Type locality- Sweden; Ellerman & Morrison-Scott, 1951 p.218; Won, 1968 p.249; Corbet, 1978 p.161; Han, 1994 p.46; Won & Smith, 1999 p.15; Oh, 2004a p.147.

Lupus laniger Hodgson, 1847a p.474; Type locality- Tibet
C. chanco Gray, 1863 p.94; Type locality- Chinese Tartary.
C. lupus coreanus Abe, 1923 p.383; Type locality- Korea; Kishida & Mori, 1931 p.379.
C. lupus laniger: Kuroda, 1938 p.36.
C. lupus chanco: Tate, 1947 p.160; Ellerman & Morrison-Scott, 1951 p.219; Won, 1958 p.441; Won, 1967 p.139; Won, 1968 p.251; Yoon, 1992 p.91.

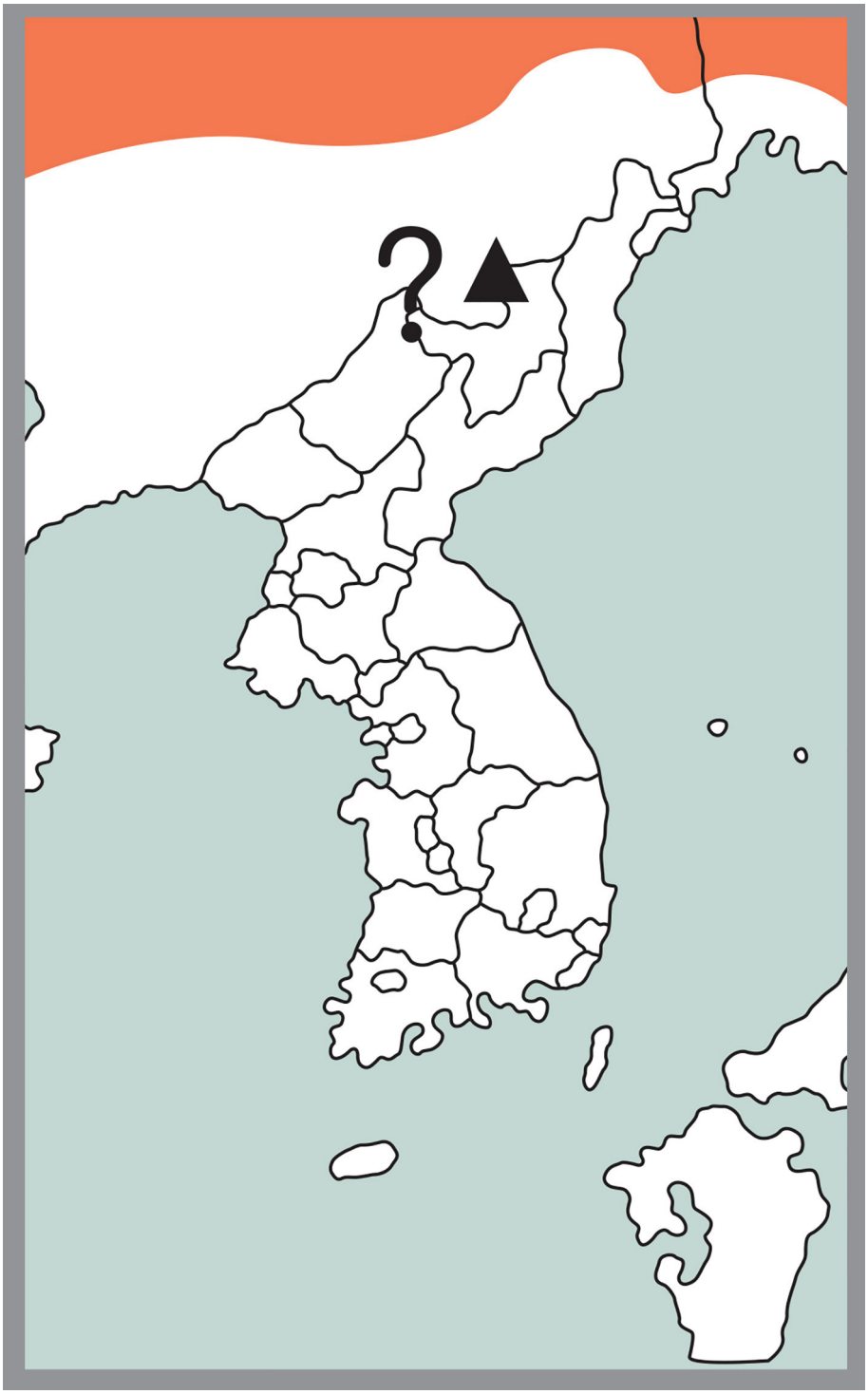

FIGURE 58. Range map of *Canis lupus* in Korea.

Range: The original distribution of the Eurasian wolf extended throughout the Korean Peninsula (Jo & Baccus 2015). The population declined severely during the Japanese incursion (1910–1945). Several individuals were recorded around Mt. Baekdu until the 1990s (Jin & Ouh 1990), but their current status is uncertain (Fig. 58).

Remarks: The Korean wolf was first classified as *C. l. coreanus* Abe, 1923, which then was synonymized with *C. l. chanco* (Won 1967). However, the designation of *C. l. chanco* as a synonym of *C. l. lupus* was disputed, because *C l. chanco* was the name for the Tibetan wolf with a distribution in Central Asia. Although wolves in Korea were classified as *C. l. chanco*, Korea was outside the distribution compared to the countries listed within the distribution. Abe (1936) stated that *C. l. coreanus* in the Korean Peninsula was clearly different from the continental form. Recent mtDNA results indicated that coreanus is a synonym of the subspecies *C. l. lupus* Linnaeus, 1758 (Aggarwal *et al*. 2003, 2007).

Conservation status: The Red Data Book of South Korea listed *C. lupus* as 'Regionally Extinct' (NIBR 2012). Since wild populations had almost reached extirpation, the North Korean Government classified this species as 'Vulnerable' (MAB National Committee of DPR Korea 2002). In 1997, the Ministry of Environment designated *C. lupus* as an endangered species in South Korea. The wolf became exterminated in South Korea and across most of North Korea in the last century (Jo & Baccus 2015). *C. lupus* has protection under CITES Appendix II.

Family OTARIIDAE Gray, 1825

The families Otariidae, Phocidae, and Odobenidae once composed the particular Order Pinnipedia. These three aquatic families have close affinities with the Superfamily Musteloidae (Nyakatura & Bininda-Emonds 2012). Three genera and three species inhabit the waters of Korea. However, *Zalophus japonicus* is now considered extinct, despite a number of several unconfirmed observations (see below).

Key to genera of Korean Otariidae

1 Pelage soft with dense underfur; the number of upper cheek teeth 6 . . . . . *Callorhinus*
- Pelage harsh without underfur. 2
2 Five upper cheek teeth; length of mature males >300 cm; length of mature females >200 cm; postorbital process nearly square shaped (Fig. 59). . . . . *Eumetopias*
- Six (sometimes five) upper cheek teeth; length of mature males <300 cm, length of mature females <200 cm; postorbital process triangular and points posteriorly . . . . . *Zalophus*

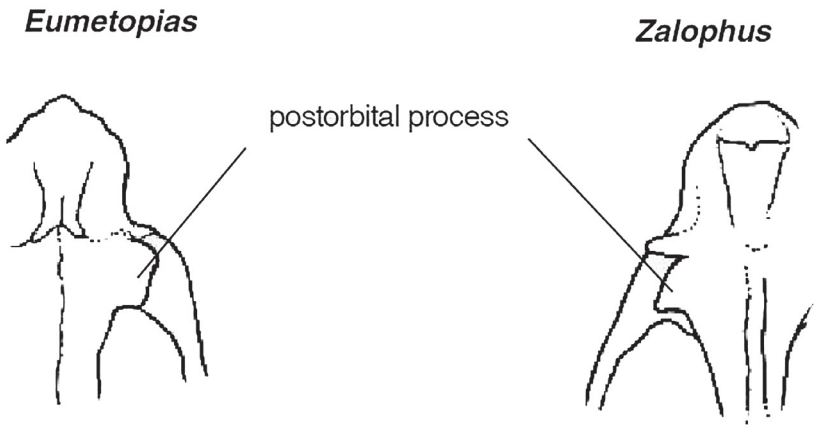

FIGURE 59. Postorbital process of *Eumetopias* and *Zalophus.*

Genus *Callorhinus* J. E. Gray, 1859

This monospecific genus inhabits the North Pacific Ocean.

Callorhinus ursinus (Linnaeus, 1758)—Northern Fur Seal

Phoca ursina Linnaeus, 1758 p.37; Type locality- Bering Island.
Callorhinus curilensis Jordan and Clark *in* Jordan *et al.*, 1899 p.3; Type locality- Kuriles.
Otoes ursinus: Kuroda, 1938 p.22.
C. ursinus: Ellerman & Morrison-Scott, 1951 p.322; Won, 1958 p.436; Won, 1967 p.94; Won, 1968 p.331; Won & Smith, 1999 p.29; Kim 2004 p.190.
C. ursinus curilensis: Ellerman & Morrison-Scott, 1951 p.322.

Range: The long migratory route for *C. ursinus* courses mostly along the eastern coast and sometimes the southern shore of the Korean Peninsula (Fig. 60). This species frequently occurs on Dok-Island. Often, fishermen incidentally catch northern fur seals in the East Sea during winter.

Remarks: Marine biologists have long recognized the monotypy of *Callorhinus ursinus*. Mitochondrial DNA and microsatellite data identified a weak population structure across the extensive range of this taxon (Dickerson *et al*. 2010).

Conservation status: North Korea made *C. ursinus* and their habitat in Uam Ri, Hamgyeongbuk Province a Natural Monument. The Ministry of Environment of South Korea designated *C. ursinus* as an Endangered Species in 1997. Also, the Ministry of Land, Transports and Maritime Affairs named the northern fur seal a protected marine species in 2007.

Genus *Eumetopias* Gill, 1866

Eumetopias is a monospecific genus inhabiting in coastal regions of North Pacific Ocean.

Eumetopias jubatus (Schreber, 1776)—Steller Sea Lion, northern sea lion

Phoca jubata Schreber, 1776 p.300; Type locality- north part of Pacific (Bering islands, Russia).
Otaria stelleri Lesson *in* Saint-Vincent, 1828 p.420: Type locality- Northern Pacific Ocean.
E. jubata: Kuroda, 1938 p.23; Ellerman & Morrison-Scott, 1951 p.323; Won, 1958 p.436; Won, 1967 p.96.
E. jubatus: Won, 1968 p.326; Kim, 2004 p.187.

Range: *Eumetopias jubatus* occurs along the eastern coast of Korea in winter and early spring (Fig. 61).

Remarks: *E. j. jubatus* forms an Asian stock, and a western Steller sea lion group as an Alaskan stock (Berta & Churchill 2012). The case for recognition of the two subspecies rests largely on genetic evidence (mtDNA and microsatellites; Baker *et al*. 2005).

Conservation status: The conservation status of the northern fur seal has recently become confusing. The Ministry of Environment of South Korea designated *E. jubatus* as an Endangered Species in 1997. However, the Ministry of Environment announced in 2012 the delisting of the species from the endangered species list because *E. jubatus* had become extirpated in the waters of Korea. Then the government withdrew the declaration of delisting after one male occurred on Jeju Island. Also, the Ministry of Land, Transports and Maritime Affairs designated this species a Protected Marine Species in 2007.

Genus *Zalophus* Gill, 1866

Zalophus was regarded as a monospecific genus. Currently, three species are recognized as, *Z. californianus* in eastern North Pacific Ocean, *Z. japonicus* in western North Pacific Ocean, and *Z. wollebaeki* in eastern South Pacific Ocean (Wozencraft 2005).

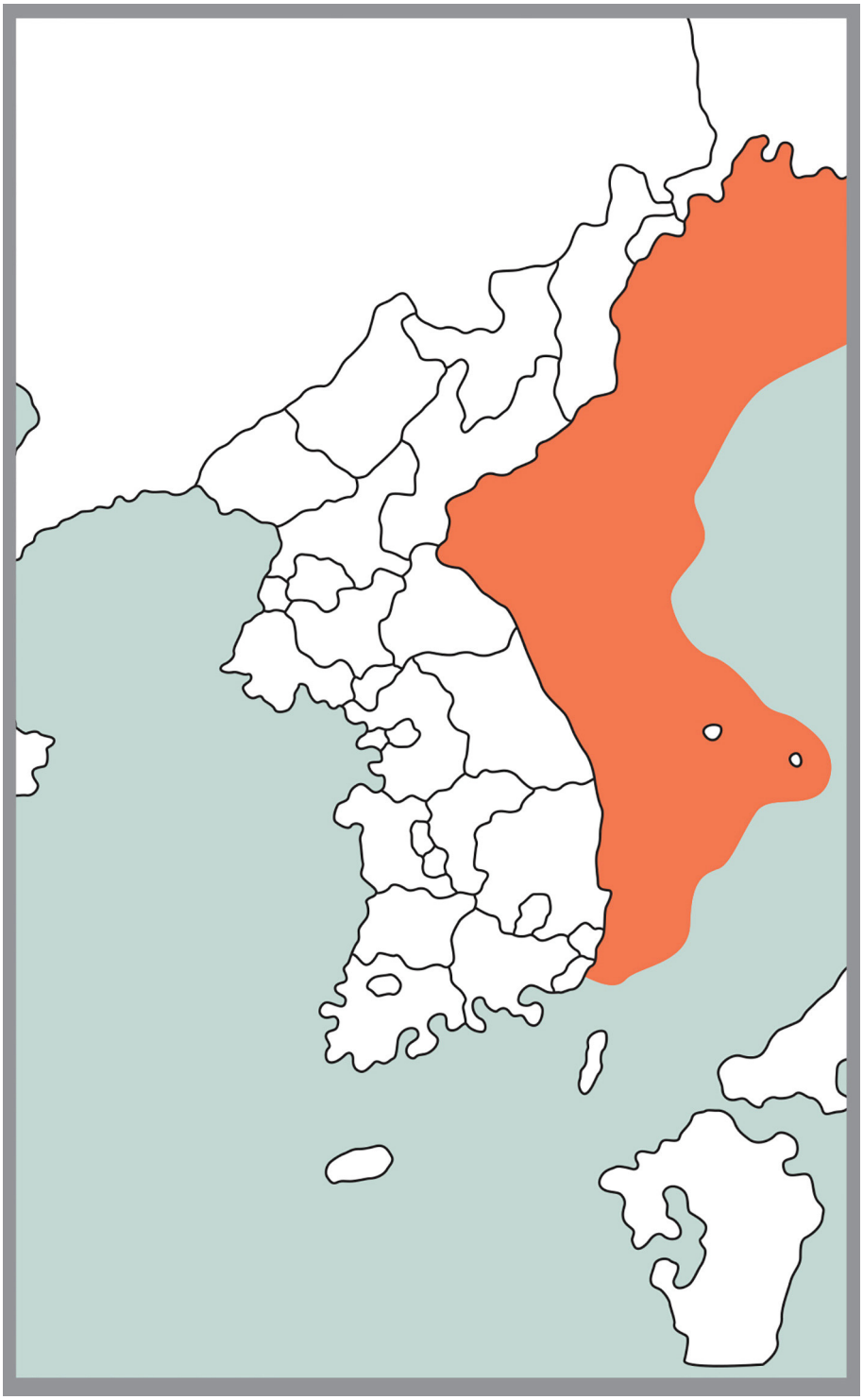

FIGURE 60. Range map of *Callorhinus ursinus* in Korea.

Zalophus japonicus **(Peters, 1866)—Japanese Sea Lion (extinct)**

Otaria japonica Peters, 1866 p.668; Type locality- Japan.
Zalophus lobatus: Kuroda, 1938 p.23.
Z. californianus: Won, 1968 p.329; Corbet, 1978 p.186; Won & Smith, 1999 p.29; Kim, 2004 p.188.
Z. californianus japonicus: Kim, 2004 p.189.

Range: Historically, the distribution of *Z. japonicus* extended in the East Sea with the main breeding site at Ulleung-Island and Dok-Island (Association of Natural Parks in Korea 1978). Fifty to 60 individuals were reported on Dok-Island in 1951 (Rice 1998) and one pup was found on Dok-Island in 1959. The last individual was observed on Dok-Island in 1973 (Association of Natural Parks in Korea 1978; Fig. 62).

Remarks: Many authors considered *Z. japonicus* as a subspecies of *Z. californianus*. Rice (1998) argued for the retention of *Z. californianus*, *Z. japonicus*, and *Z. wollebaeki* as distinct species. Based on new studies of skull morphology, Brunner (2004) also argued for distinct species status. Wolf *et al*. (2007) used molecular data (mtDNA, microsatellites and SNPs) to advocate recognition of the California, Japanese and Galapagos sea lions as separate species (Berta & Churchill 2012).

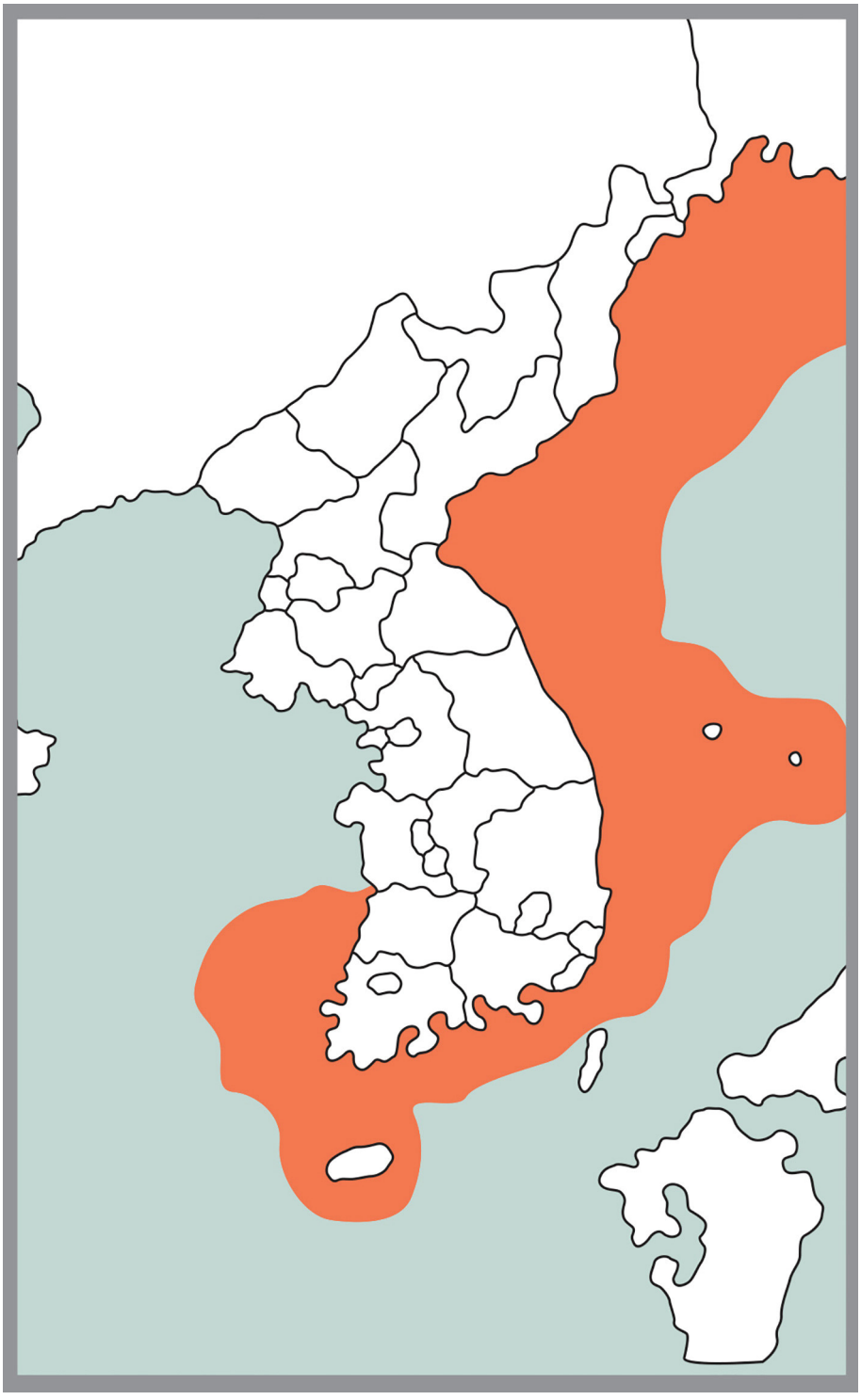

FIGURE 61. Range map of *Eumetopias jubatus* in Korea.

FIGURE 62. Range map of *Zalophus japonicus* in Korea.

Conservation status: The Ministry of Environment of South Korea designated *Z. japonicus* as an Endangered Species in 1997, but the ministry delisted this species in 2012 and announced its extinction. However, no comprehensive survey throughout the range of the species has occurred to determine the status of *Z. japonicus*. The Ministry of Land, Transports and Maritime Affairs designated *Z. japonicus* as a Protected Marine Species in 2007 and retained this listing despite evidence of extinction.

Family PHOCIDAE Gray, 1821

Three genera and four species of earless seals represent the Family Phocidae in Korea (Kim 2004). Because all records of *Phoca vitulina* were made under the name *P. v. largha* or were erroneous records (Kim 2004), we delisted *P. vitulina* from the Korean Phocidae.

Key to genera of Phocidae in Korea

1 Fur not spotted; fore flippers, hind flippers and face dark . . . . . .Histriophoca
- Fur spotted. 2
2 Pelage has small spots; zygomatic arches invisible from behind . . . . . Phoca
- Adult has ring-shaped spots; zygomatic arches projected (visible from behind) . . . . . Pusa

Genus *Histriophoca* Gill, 1873

Histriophoca has been frequently included in the Genus *Phoca,* but both genetic and morphology separated *Histriophoca* from *Phoca* (Berta & Churchill 2012). *Histriophoca* has a distribution in the northern Pacific Ocean.

Histriophoca fasciata (Zimmerman, 1783)—Ribbon Seal

Phoca fasciata Zimmerman, 1783 p.277; Type locality- Kurile Islands; Won, 1958 p.436; Won, 1967 p.92.
Histriophoca fasciata: Won, 1968 p.341; Kim, 2004 p.197.

Range: The species occupies the coastal areas of Korea and is considered rare (Kim 2004; Fig. 63). A record exists for the Daedong River estuary of North Korea (Won 1968).

Remarks: Fedoseev (1984) did not find morphological differences between populations in eastern and western North Pacific Ocean, supporting the monotypic status of this species.

Conservation status: The Ministry of Environment of South Korea listed this species as Endangered in 1997, but subsequently delisted it because of occasional discoveries in coastal areas of Korea. However, the Ministry of Land, Transports and Maritime Affairs safeguarded *H. fasciata* as a Protected Marine Species.

Genus *Phoca* Linnaeus, 1758

In Korea, two species, *P. largha* and *P. vitulina* have been listed in the North Pacific Ocean. Since *P. largha* was initially classified as a subspecies of *P. vitulina*, the name *P. vitulina* has been frequently used for *P. largha*. Also, the Korean common names for the two species (both called 'spotted' seals) led to further confusion, with *P. vitulina* erroneously recorded for *P. largha*. The South Korean government designated *P. vitulina* an Endangered Species in 1997 and a Protected Marine Species in 2007 but delisted *P. vitulina* from both lists in 2012 due to absence of records in the waters of Korea.

Phoca largha Pallas, 1811—Spotted Seal, largha seal

Phoca largha Pallas, 1811 p.113; Type locality- eastern coast of Kamchatka; Won & Smith, 1999 p.29; Kim, 2004 p.194.
P. vitulina: Ellerman & Morrison-Scott, 1951 p.328; Won, 1968 p.336.
P. vitulina largha: Ellerman & Morrison-Scott, 1951 p.328; Won, 1958 p.436; Won, 1968 p.338.

Range: A large colony of several hundred *P. largha* migrates annually through the Yellow Sea, East Sea, and Korea Strait and moves onto Baengnyeong Island in the Yellow Sea (Won & Yoo 2004; Fig. 64). Also, several individuals reside along the coast in small rocky islets near Gyeongpo beach, Gangneung City in the East Sea and Garorim Bay in the Yellow Sea (NIBR 2015).

Remarks: Based on external appearances, harbor and spotted seals are not readily distinguishable from each other. The two species are very similar in appearance, but the spots of the harbor seal tend to appear more faded and sparser on the underside of the body. The spotted seal is slightly smaller than the harbor seal and has a darker face and muzzle, and there are behavioral differences between the two species (Shirihai & Jarrett 2006). MtDNA studies confirmed the respective uniqueness of harbor and spotted seals at the species level (O'Corry-Crowe & Westlake 1997).

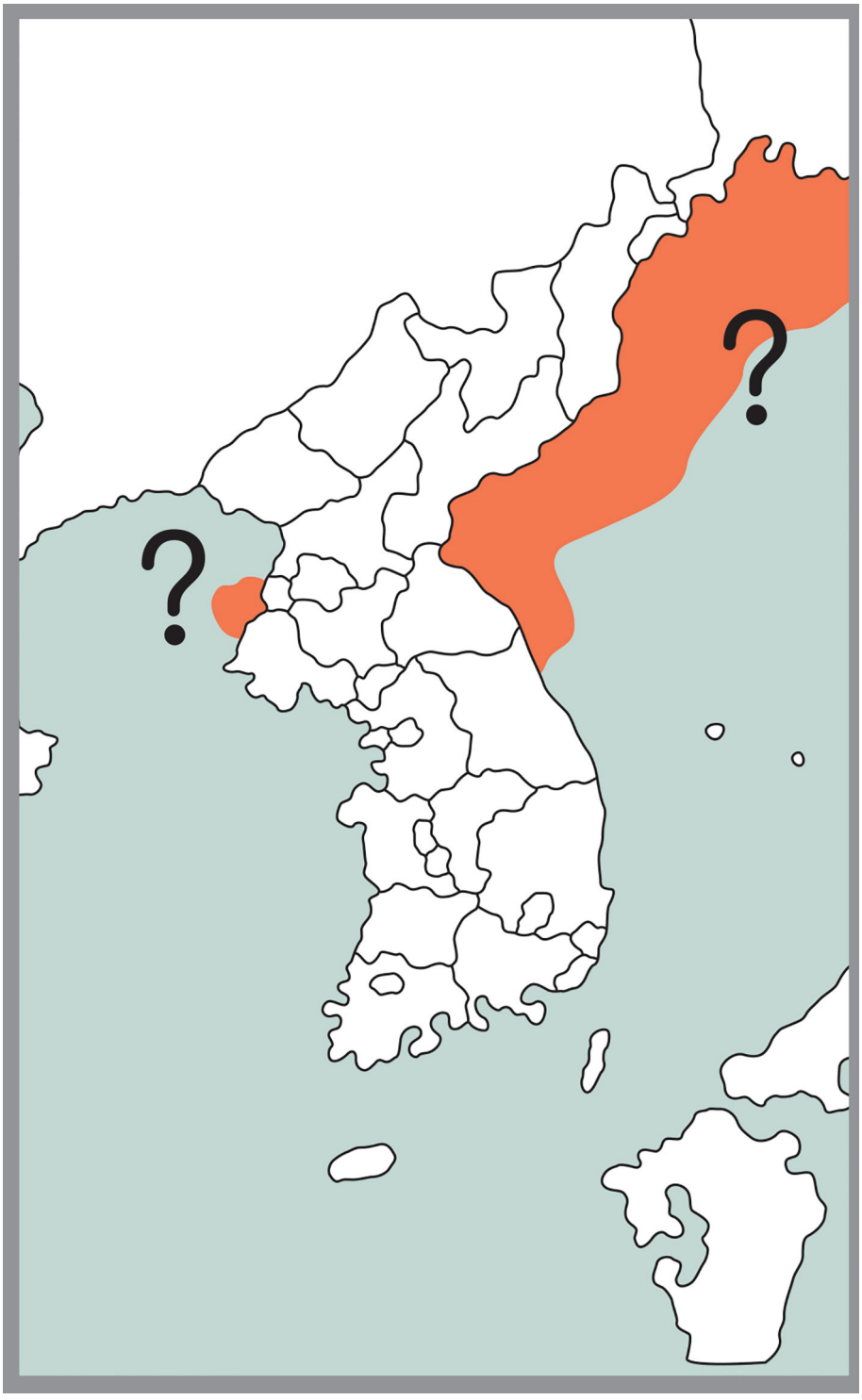

FIGURE 63. Range map of *Histriophoca fasciata* in Korea.

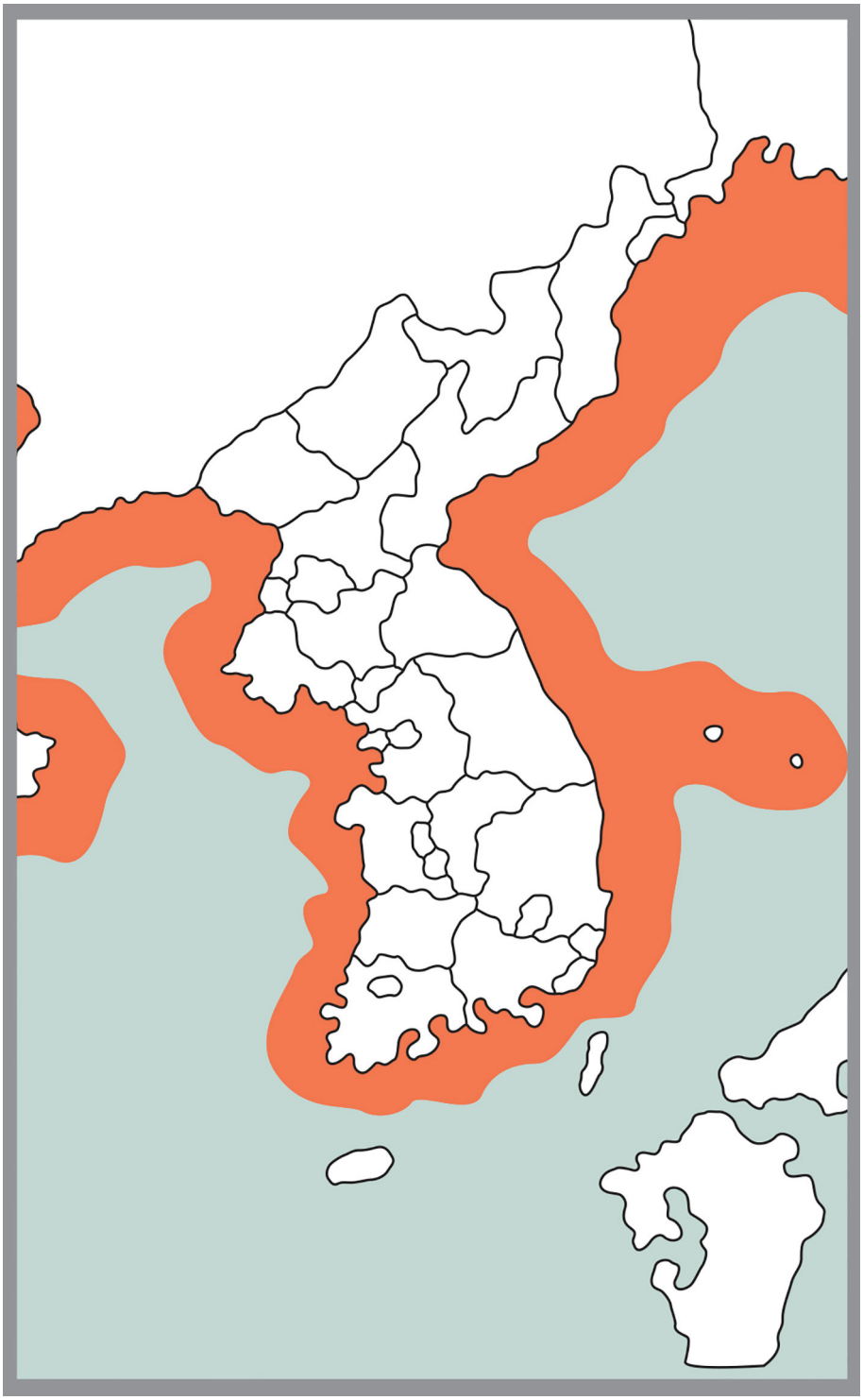

FIGURE 64. Range map of *Phoca largha* in Korea.

Conservation status: The Cultural and Heritage Administration in South Korea designated *P. largha* as a Natural Monument in 1982, followed by a declaration as an Endangered Species in 1997 by the Ministry of Environment and a Protected Marine Species in 2007 by the Ministry of Land, Transports and Maritime Affairs. Korean populations are regarded as 'Endangered' in both the North and South Korean Red Data Books (MAB National Committee of DPR Korea 2002; NIBR 2012). Populations declined from 8,000 individuals in 1940s to 2,300 in 1980s and 600–800 in 2010 (NIBR 2012).

Genus *Pusa* Scopoli, 1771

Pusa was previously included in the Genus *Phoca.* It includes two species, *P. caspica* in the Caspian Sea and *P. hispida* in the Arctic Ocean and northern Pacific and Atlantic oceans.

FIGURE 65. Range map of *Pusa hispida* in Korea.

Pusa hispida (Schreber, 1775)—Ringed Seal

Phoca hispida Schreber, 1775 p.l86 (1776 p312); Type locality- Coast of Greenland and Labrador.
Phoca hispida ochotensis: Won, 1967 p.92.
Pusa hispida: Won, 1968 p.339; Kim, 2004 p.195.
Pusa hispida ochotensis: Kim, 2004 p.196.

Range: Ringed seals rarely occur in the Yellow Sea along the Korean coast and is thus considered a vagrant species (Fig. 65).

Remarks: Although recent comprehensive morphological examinations did not support division of the Arctic population into multiple subspecies (Amano *et al*. 2002), Berta and Churchill (2012) recommended continued recognition of Okhotsk ringed seals around Okhotsk Sea, *P. h. ochotensis* (Pallas, 1811). The Society for Marine Mammalogy has used '(Nordquist, 1889)' as the original author and year citation for the ringed seal; however, the correct author and name for the subspecies, *O. h. ochotensis* is '(Pallas, 1811)'.

Conservation status: The Ministry of Environment designated *P. hispida* an Endangered Species in 1997 but delisted it because of infrequent occurrences in Korea. In 2007, the Ministry of Land, Transports, and Maritime Affairs listed ringed seals as Protected Marine Species.

ORDER ARTIODACTYLA Owen, 1848

Artiodactyla and Cetacea are often considered a single Order Cetartiodactyla (O'Leary & Gatesy 2008; O'Leary 2009). Spaulding *et al.* (2009) supported the name 'Artiodactyla', but they included Cetacea in the Order Artiodactyla. However, most morphologists and paleontologists support a partition between the two orders (Vaughan *et al.* 2013), as Wilson & Reeder (2005) that we followed here.

The Artiodactyla of Korea contains seven species distributed into in six genera and four families.

Key to families of Artiodactyla in Korea

1	No antlers or horns	2
-	Antlers or horns present	4
2	Long muzzle; upper incisors present; teeth bunodont.	Suidae
-	Short muzzle; upper incisors absent; teeth selenodont	3
3	Facial and pedal glands absence; musk glands present in abdomen	Moschidae
-	Facial and pedal glands present; no musk glands in abdomen	*Hydropotes* (Cervidae)
4	Only males have antlers; antlers are deciduous	Cervidae
-	Horns found in both sexes; Horns are not deciduous	Bovidae

Family SUIDAE Gray, 1821

One species, *Sus scrofa,* occurs in Korea.

Genus *Sus* Linnaeus, 1758

Single species *S. scrofa*.

Sus scrofa Linnaeus, 1758—Wild Boar

Sus scrofa Linnaeus, 1758 p.49; Type locality- Germany; Won, 1968 p.345; Han, 1994 p.46; Won & Smith, 1999 p.21; Oh, 2004b p.257; Jo *et al.*, 2012 p.252.
S. ussuricus Heude, 1888 p.54; Type locality- Ussuri, Siberia.

S. gigas Heude, 1896 p.189; Type locality- Vladivostok.
S. coreanus Heude, 1896 p.191; Type locality- Busan, Korea; Kishida & Mori, 1931 p.380.
S. leucomystax var. *continentalis* Nehring, 1889 p.141; Type locality- Vladivostok.
S. continentalis: Kishida & Mori, 1931 p.380.
S. leucomystax continentalis: Kuroda, 1938 p.2.
S. leucomystax coreanus: Kuroda, 1938 p.2; Tate, 1947 p.313.
S. scrofa coreanus: Ellerman & Morrison-Scott, 1951 p.347; Won, 1958 p.430; Won, 1967 p.34; Won, 1968 p.350; Yoon, 1992 p.122.
S. scrofa ussuricus: Won, 1958 p.430; Won, 1967 p.32; Yoon, 1992 p.121.
S. scrofa continentalis: Won, 1968 p.346.

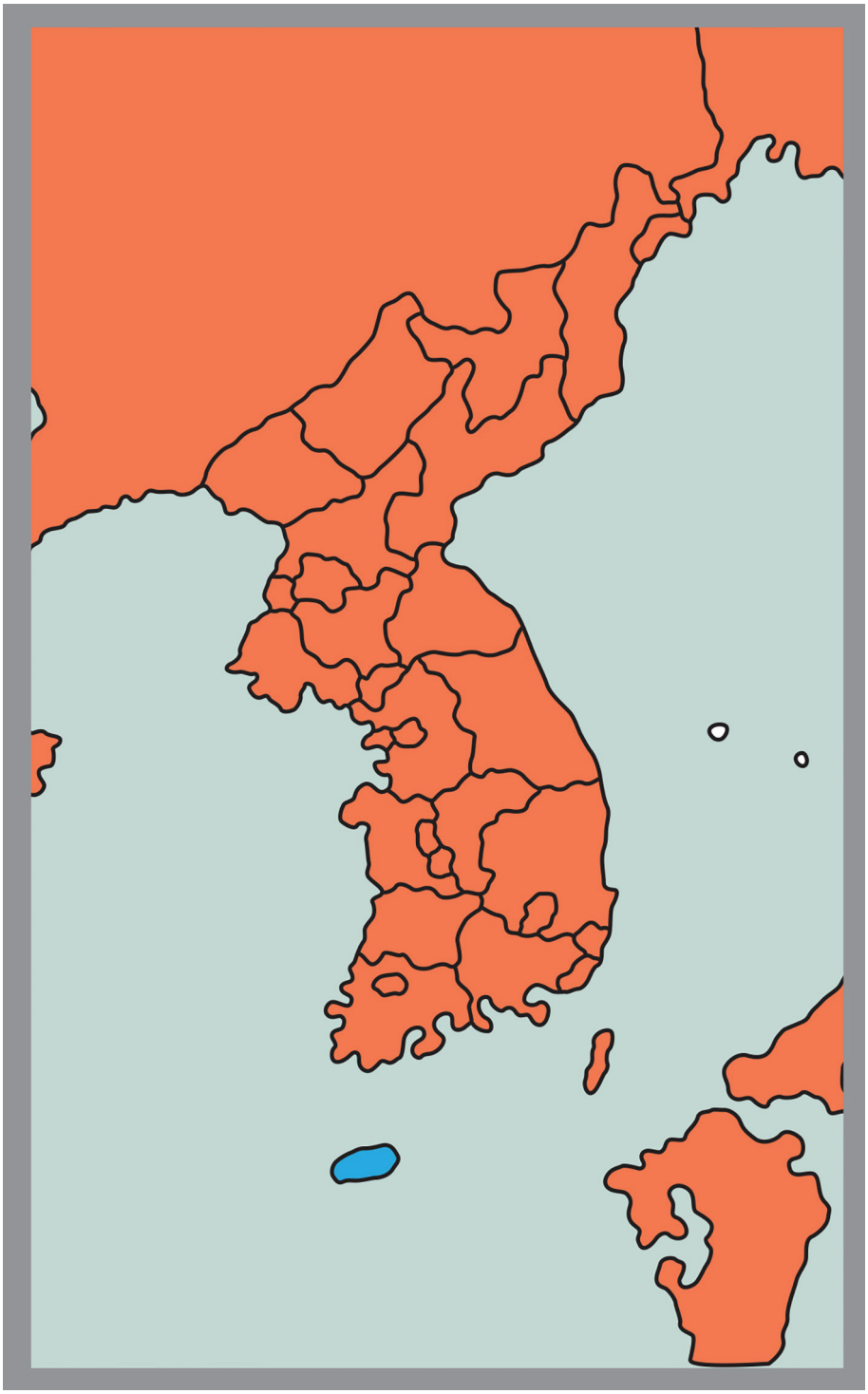

FIGURE 66. Range map of *Sus scrofa* in Korea.

Range: *Sus scrofa* ranges throughout the Korean Peninsula and islands near the mainland (3rd National Nature-Environmental Survey 2006–2013 unpublished electronic data; Fig. 66). The species dispersed into Jeju Island in 2003 as an invasive species (Jo *et al.* 2012).

Remarks: Previously, two subspecies recorded, *S. s. ussuricus* (or *S. s. continentalis*) in northern high mountains around Mt. Baekdu and *S. s. coreanus* in the rest of the country. Sometimes *S. s. coreanus* placed as a synonym of *S. s. ussuricus* due to minor morphological differences. Recent DNA analysis showed that *S. s. coreanus* was more closely related to southeastern Asian and Japanese populations (Cho *et al.* 2009). A hypothesis suggests that *S. s. coreanus* crossed from southeastern Asia or Japan to the Korean Peninsula during the last glacial period with sea level decline (Cho *et al.* 2009).

Family MOSCHIDAE Gray, 1821

Traditionally, musk deer were classified in the Cervidae, but the presence of a series of diagnostic characters (smaller size than Cervidae; large upper canines and absence of antlers; entocarotid branches absent; tensor tympani chamber shallowed and pocketed in lateral wall; stapedial muscle chamber large and transversely elongated) supported the separate Family Moschidae (Webb & Taylor 1980). Korea houses a single species of Moschidae.

Genus *Moschus* Linnaeus, 1758

Moschus was previously regarded as a monospecific genus, but seven species have been recently recognized in this genus (Grubb 2005). Only one species, *M. moschiferus,* occurs in Korea.

Moschus moschiferus Linnaeus, 1758—Siberian Musk Deer

Moschus moschiferus Linnaeus, 1758 p.66; Type locality- Chinese Tatary; Ellerman & Morrison-Scott, 1951 p.353; Won, 1968 p.354; Corbet, 1978 p.198; Han, 1994 p.46; Won & Smith, 1999 p.21; Oh, 2004b p.260.
M. parvipes Hollister, 1911 p.1; Type locality- Mokpo, Korea.
M. moschiferus parvipes: Kishida & Mori, 1931 p.380; Kuroda, 1938 p.4; Tate, 1947 p.330; Ellerman & Morrison-Scott, 1951 p.354; Won, 1958 p.430; Won, 1967 p.37; Won, 1968 p.355.
M. moschiferus moschiferus: Corbet, 1978 p.198; Yoon, 1992 p.124.

Range: *M. moschiferus* occupied the high mountain ranges throughout the Korean Peninsula from the southern tip to northern areas, except Jeju Island (Won 1967). However, a few individuals were recently observed in several high mountains in the Baekdudaegan Mountain Range that form the spine of the Korean Peninsula from Mt. Baekdu in the extreme north to Mt. Jiri at the southern tip (NIBR 2015; Fig. 67).

Remarks: Revision by Sokolov and Prikhod'ko (1997, 1998) delineated five subspecies, including *M. m. parvipes* in Korea.

Conservation status: Both South Korea and North Korea designated *M. moschiferus* a Natural Monument. Also, the Ministry of Environment added the Siberian musk deer to the South Korean Endangered Species list in 1997. The South Korean Red Data Book considered *M. moschiferus* as 'Critically Endangered' (NIBR 2012) and the North Korean Red Data Book classified this species as 'Vulnerable' (MAB National Committee of DPR Korea 2002). The North Korean population was common at least in some areas of Mt. Myohyang until the 1970s, but the populations declined and became almost extinct through illegal snaring (Dr. William Duckworth, IUCN; pers. comm.).

Family CERVIDAE Goldfuss, 1820

Cervids listed in Korea include three genera and four species. Two species of *Cervus* are extinct in South Korea and

their status in North Korea remains uncertain. Each genus belongs to a different Subfamily: *Capreolus* in Capreolinae, *Cervus* in Cervinae, and *Hydropotes* in Hydropotinae.

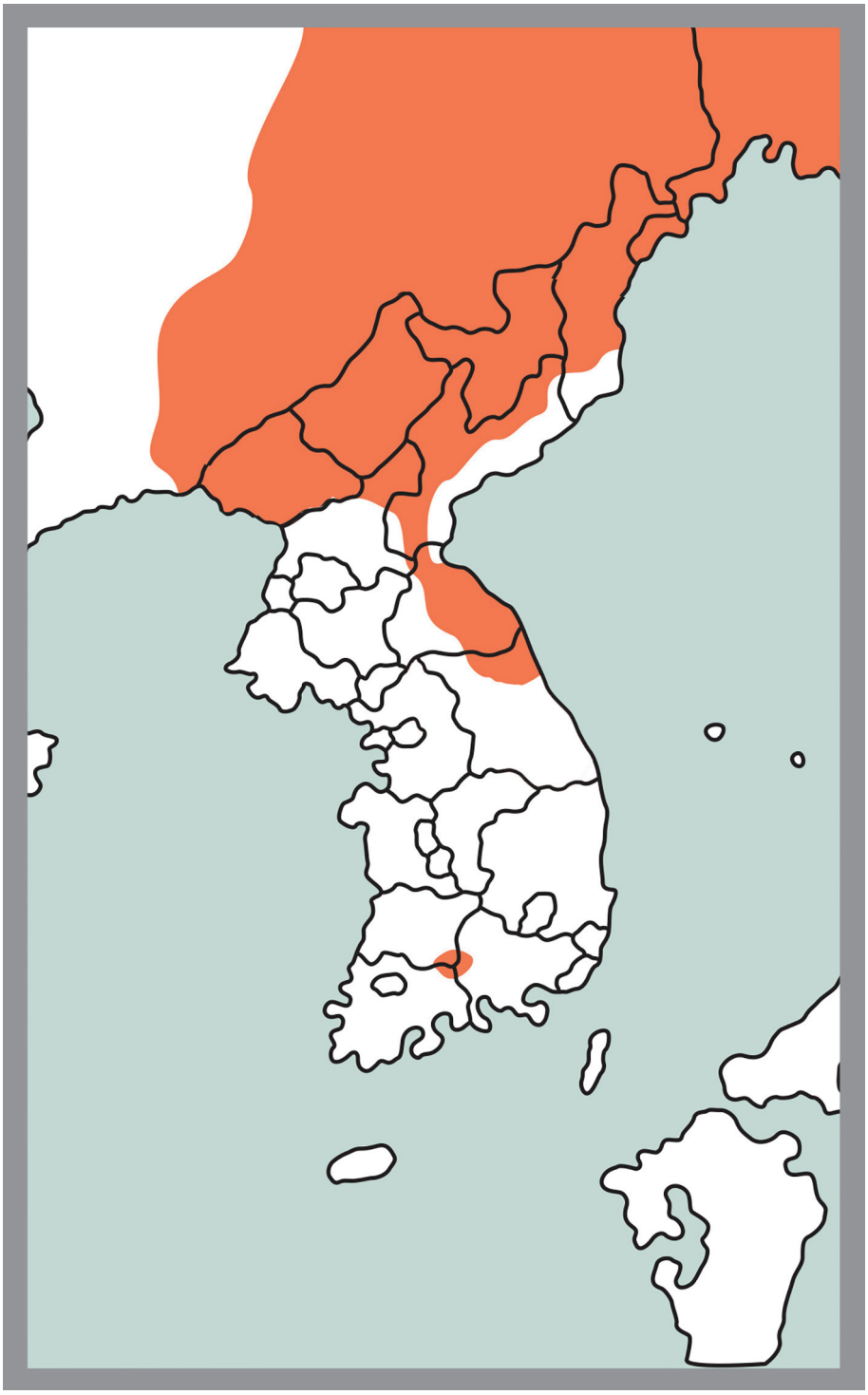

FIGURE 67. Range map of *Moschus moschiferus* in Korea.

Key to genera of Cervidae in Korea

1	Antlers absent in both sex; male with tusk-liked canines	*Hydropotes*
-	Antlers present in males, absent in females	2
2	Antlers very rugose; tail not visible	*Capreolus*
-	Antlers not rugose; tail visible	*Cervus*

Genus *Hydropotes* Swinhoe, 1870

Both male and female *Hydropotes* have a different antlerless morphology from other cervids. Gentry and Hooker (1988) proposed consigning this genus to a separate family. Randi *et al*. (1998) identified *Capreolus* by mtDNA analysis as the closest taxa to *Hydropotes* and advocated placing *Hydropotes* in the Subfamily Capreolinae. We follow Grubb (2005) and classified the genus in Hydropotinae.

Hydropotes inermis Swinhoe, 1870—Chinese Water Deer

Hydropotes inermis Swinhoe, 1870 p.264; Type locality- Yangtze River, China; Ellerman & Morrison-Scott, 1951 p.354; Won, 1968 p.379; Corbet, 1978 p.203; Han, 1994 p.46; Won & Smith, 1999 p.23; Oh, 2004b p.267.
H. argyropus Heude, 1884 p.1017; Type locality- Korea (*Nomen nudum* by Trouessart); Kishida & Mori, 1931 p.380.
H. kreyenbergi Hilzheimer, 1906 p.171; Type locality- Korea.
H. inermis argyropus: Kuroda, 1938 p.8; Tate, 1947 p.331; Ellerman & Morrison-Scott, 1951 p.354; Won, 1958 p.432; Won, 1967 p.55; Won, 1968 p.379; Corbet, 1978 p.203; Yoon, 1992 p.132.

Range: The distribution of the Chinese water deer included central and southern Korea, except Jeju Island and remote islands (Won 1968; Fig. 68). This deer had a limited range in the northeastern part of the Korean Peninsula (Kim *et al*. 2015). Due to its economic value as meat and fur, the North Korean government wanted to increase its range and therefore translocated three times (late 1950s–1960s) the species. Currently, *H. inermis* in North Korea expanded the distribution beyond the northeastern peninsula (Kim 1999).

Remarks: Two distinct subspecies inhabit Far East Asia: one resides in China (*H. i. inermis*), and the other occurs in Korea (*H. i. argyropus*). Although recent DNA analysis showed two phylogroups in *H. i. argyropus* (Koh *et al.* 2012a), Chinese water deer in Korea have limited geographic variation and morphological differences; therefore, only one subspecies, *H. i. argyropus* Heude, 1884 has so far been recognized in Korea (Hu *et al*. 2006, Kim *et al*. 2011a).

Conservation status: Populations of *H. inermis* have expanded in recent years, and the species has become a major agricultural pest in South Korea (NIBR 2017). The North Korean government made a habitat for the species at Mt. Guwol, Hwanghaenam Province a Natural Monument. Despite several releases of Chinese water deer by North Korean government, populations remain small due to illegal snaring for bush meat (Dr. William Duckworth, IUCN, Pers. Comm.). The Gwangju Metropolitan government designated this species a Provincially Protected Species in South Korea. The IUCN Red List records the Chinese water deer as 'Vulnerable'.

Genus *Capreolus* Gray, 1821

The genus, previously viewed as monospecific, currently is described with two species (Grubb 2005), including *C. capreolus* in western Eurasia and *C. pygargus* in eastern Eurasia.

Capreolus pygargus (Pallas, 1771)—Siberian Roe Deer

Cervus pygargus Pallas, 1771 p.453; Type locality- Bugulma uplands, source of River Sok, Russia.
Cervus pygargus var. *mantschurucus* Noack, 1889 p.15.
Capreolus bedfordi Thomas, 1908 p.645; Type locality- 100 mile NW of Taiyuen Fu (Taiyuan), Shanxi Province, China.
Capreolus bedfordi bedfordi: Kuroda, 1917 p.363; (Gwangneung near Seoul): Kishida & Mori, 1931 p.380.
Capreolus pygargus manchuricus: Kishida & Mori, 1931 p.380
Capreolus capreolus ochracea Barclay, 1935 p.626; Type locality- Korea; Kuroda, 1938 p.7.
Capreolus pygargus pygargus: Kuroda, 1938 p.7.
Capreolus capreolus bedfordi: Tate, 1947 p.337; Ellerman & Morrison-Scott, 1951 p.373; Won, 1958 p.432; Won, 1967 p.52; Won, 1968 p.367; Corbet, 1978 p.204; Yoon, 1992 p.133.
Capreolus capreolus pygargus: Won, 1958 p.431; Won, 1968 p.362; Yoon, 1992 p.133.
Capreolus capreolus: Won, 1968 p.360.
Capreolus pygargus: Han, 1994 p.46; Won & Smith, 1999 p.23; Oh, 2004b p.269.
Capreolus pygargus tianschanicus: Oh, 2004b p.270; Jo *et al*., 2012 p.252.

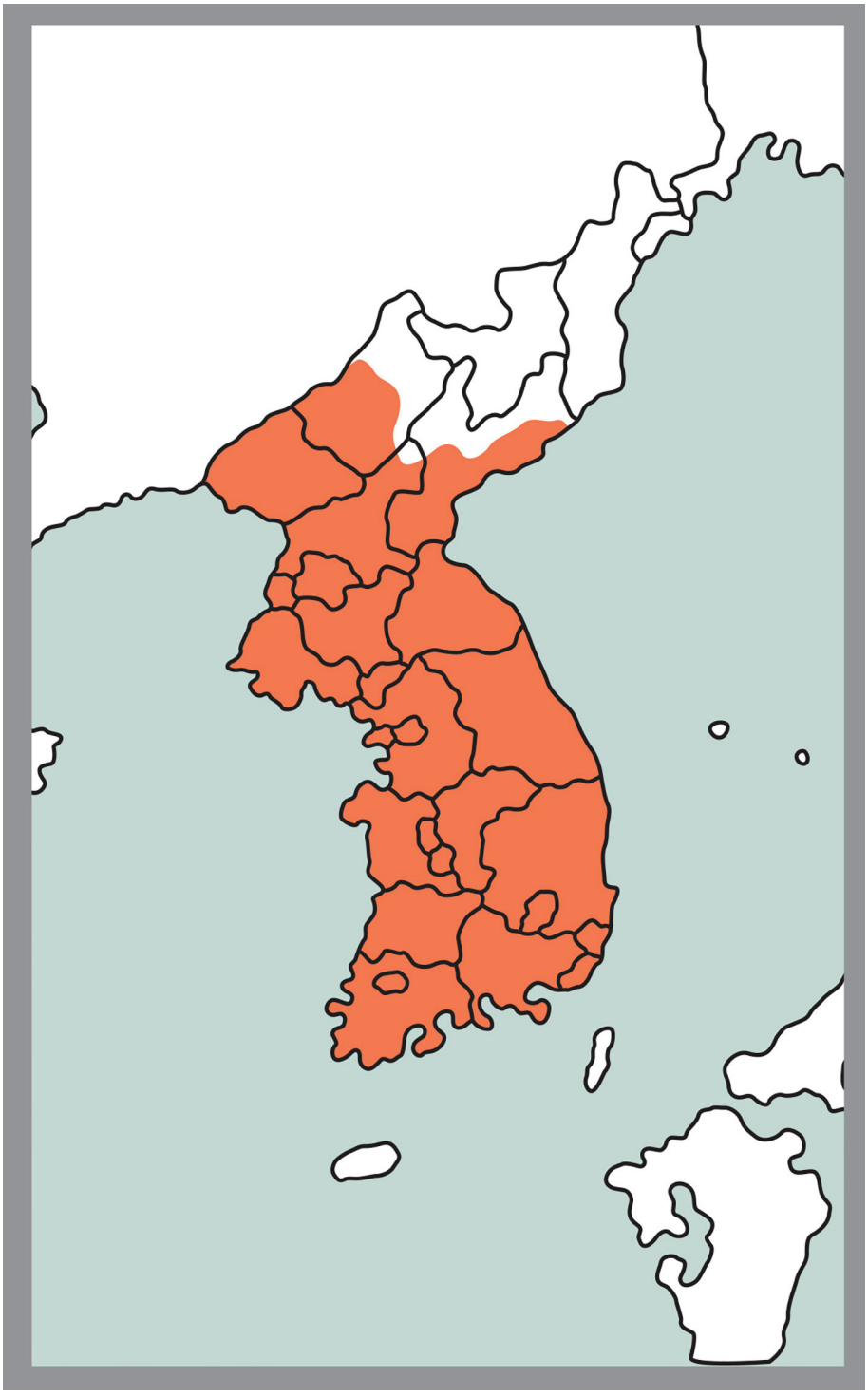

FIGURE 68. Range map of *Hydropotes inermis* in Korea.

Range: The range of *C. pygargus* covers all of the Korean Peninsula and Jeju Island, the latter having the most abundant population (Fig. 69).

Remarks: A single subspecies is supposed to occur in Korea (Oh 2004b). However, while DNA analysis indicated a small genetic difference between the peninsular and continental populations, the Jeju Island population had substantial genetic differences compared to the peninsular and continental populations (Koh & Yang 2000; Koh *et al.* 2012a). Therefore, Koh et al. (2012a) suggested the population on Jeju Island should be recognized as a distinct subspecies. Xiao *et al.* (2007) showed that the average mtDNA distance between northeastern China and European roe deer (5.8%) was more than twice that between northeastern China and Korean roe deer (2.7%). The

authors concluded that roe deer of northeastern China, Korea and Siberia were a single species (*Capreolus pygargus*), distinct from the European roe deer (*Capreolus capreolus*).

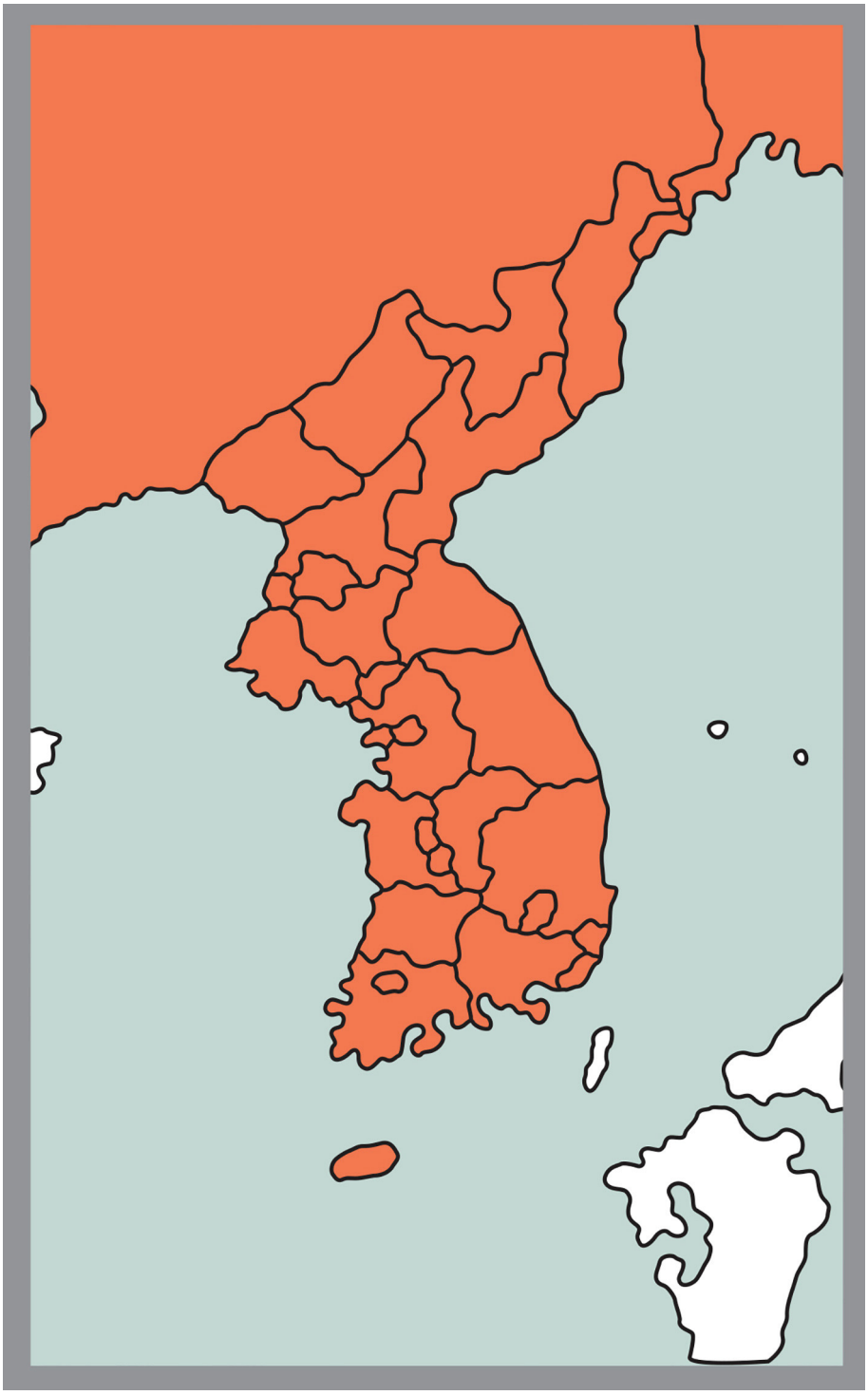

FIGURE 69. Range map of *Capreolus pygargus* in Korea.

Conservation status: The continuous use in folk medicine of antlers of roe deer caused a decline in populations in Korea. Due to active conservation efforts, the density of roe deer on Jeju Island in 2007 increased to 5.33 individuals per km^2 (Kim *et al.* 2007). On the other hand, the density of mainland populations in South Korea declined to 1.86 individuals per km^2 (unpublished data from Wildlife Survey by the NIBR). Siberian roe deer on Jeju Island are now considered an 'agricultural pest' because of their damage to crops (Oh 2011). Seoul, Ulsan, Gwangju Metropolitan governments and Jeollanam Province Provincial government designated this species as a

Provincially Protected Species. Like mainland populations of Siberian roe deer, populations of most wildlife game species declined or even became extirpated in North Korea by illegal poachers using snares (William Duckworth, IUCN, Pers. Comm.).

Genus *Cervus* Linnaeus, 1758

Two species, *C. elaphus* and *C. nippon,* previously inhabited Korea. Both species became extirpated in South Korea and their status in North Korea remains uncertain. A small population of *C. nippon* from Taiwan became established in Mt. Songni National Park as an invasive species (Koh *et al.* 2010a).

Key to species of Genus *Cervus* in Korea

- Dorsal pelage unspotted; no gap between first and second tine of antler (Fig. 70) . . . . . *C. elaphus*
- Pelage spotted; large gap between first and second tine of antler. . . . . *C. nippon*

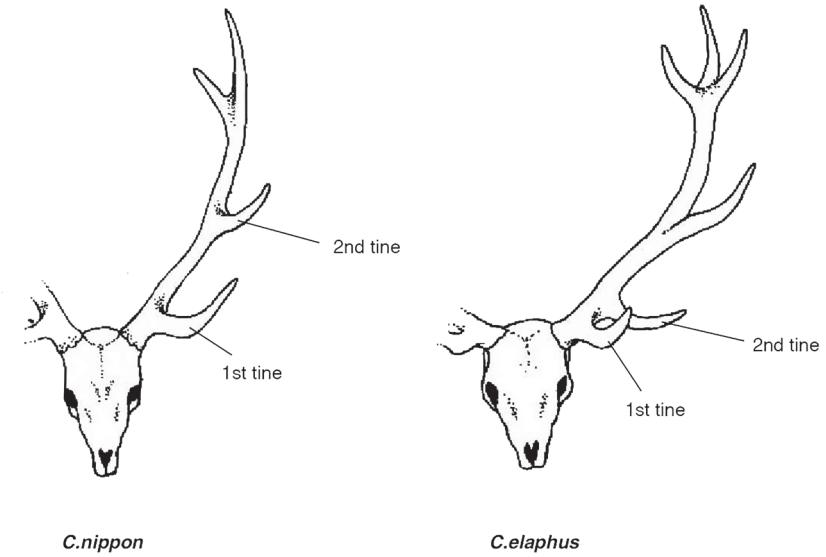

FIGURE 70. Antlers of *C. nippon* and *C. elaphus.*

Cervus elaphus Linnaeus, 1758—Red deer

Cervus elaphus Linnaeus, 1758 p.67; Type locality- Sweden; Won, 1968 p.368; Han, 1994 p.46; Won & Smith, 1999 p.22; Oh, 2004b p.265.
C. xanthopygus Milne-Edwards, 1867 p.376; Type locality- northern Manchuria; Kishida & Mori, 1931.
C. luhdorfi Bolau 1880 p.33; Type locality- 280 mile east of Vladivostok, northern Manchuria.
C. isubra Noack, 1889 p.9; Type locality- Suchan River, North and East Manchuria.
C. bedfordianus Lydekker, 1896 p.932; Type locality- Manchuria.
C. xanthopygus var. *typicus* de Pousargues, 1898 p.209.
C. canadaensis xanthopygus: Kuroda, 1938 p.7.
C. elaphus xanthopygus: Tate, 1947 p.346; Won, 1958 p.431; Won, 1967 p.49; Won, 1968 p.371; Yoon, 1992 p.129.

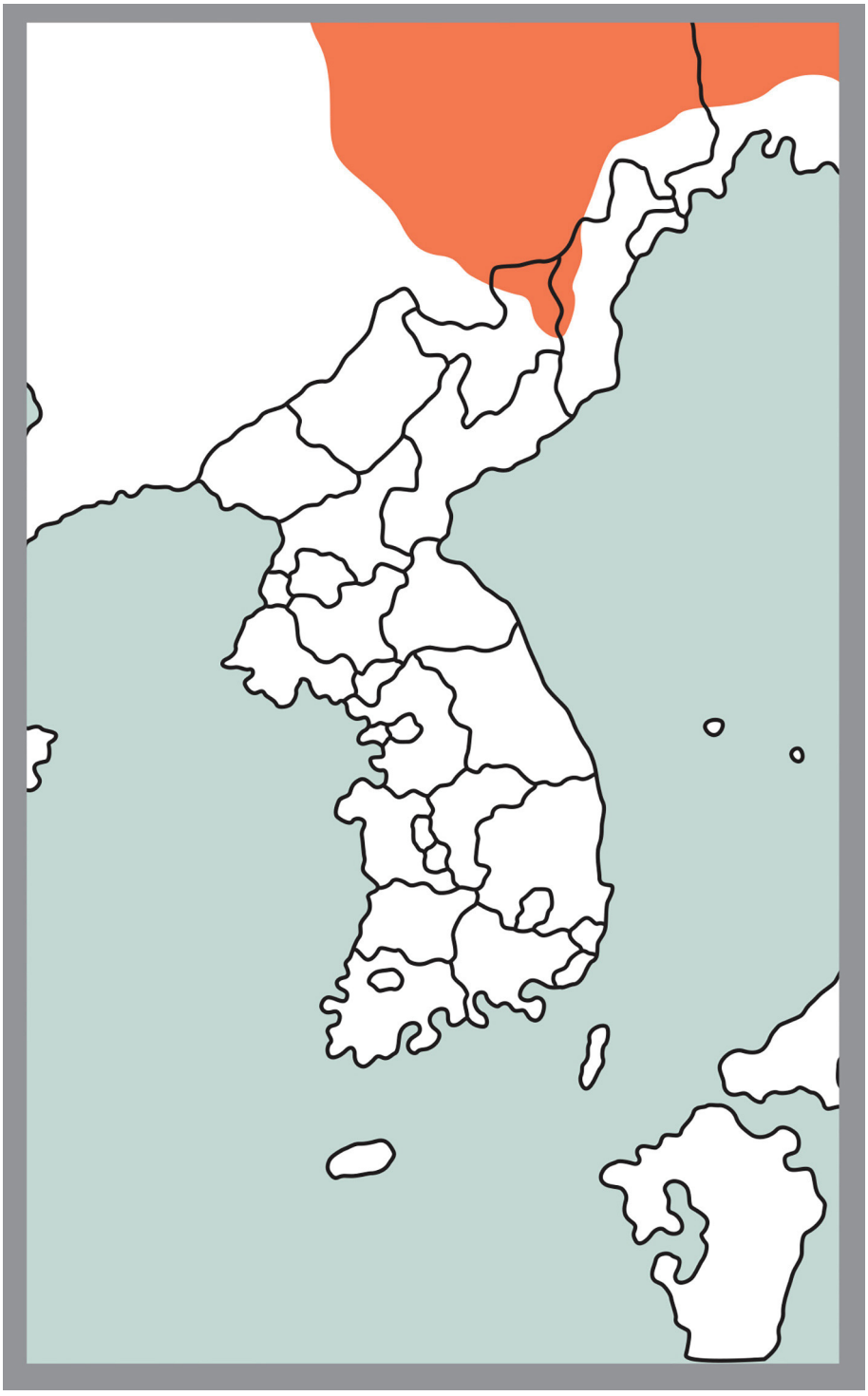

FIGURE 71. Range map of *Cervus elaphus* in Korea.

Range: Red deer were abundant in extreme northeastern Korea in the early 1900s (Lee 1965) but became rare by the 1960s (Won 1968). Populations may persist in North Korea at Mt. Baekdu and adjacent areas (Woo 1990; Won & Smith 1999), although this remains uncertain (Fig. 71).

Remarks: Genetic investigations using mtDNA indicated that an eastern lineage including populations from North America had a closer relation to the populations in Mongolia and northeastern China than populations in Europe (Mahmut *et al*. 2002). Ancestral populations of *C*. *elaphus* emigrated from northeastern Eurasia to North America via Beringia during the last glacial period in the Pleistocene (Geist 1998). The genetic distances (2.0%) between North American and Mongolian populations provided an estimated divergence time between 52,000 and

80,000 years (Polziehn & Strobeck 1998). The recognized subspecies of red deer in Far East Asia including Korea is *C. e. xanthopygus* (Won & Smith 1999).

Conservation status: The North Korean government designated habitat in Samjiyeon at Mt. Baekdu a Natural Monument (Kim *et al.* 2015). The Red Data Book for North Korea lists *C. elaphus* as a 'Rare' species (MAB National Committee of DPR Korea 2002). The South Korean government has not addressed the conservation status of the red deer.

Cervus nippon Temminck, 1838—Sika Deer

Cervus nippon Temminck *in* Siebold, 1837 [1838] p.22; Type locality- Nagasaki, Japan; Won, 1968 p.374; Corbet, 1978 p.200; Han, 1994 p.46; Won & Smith, 1999 p.22; Oh, 2004b p.262; Jo *et al*., 2012 p.252.
C. hortulorum Swinhoe, 1864 p.169; Type locality- Beijing, China; Kishida & Mori, 1931 p.380.
C. mandarinus Milne-Edwards, 1871 p.174; Type locality-Beijing, China.
C. dybowskii Taczanowski, 1876 p.123; Type locality- Ussuri, Manchuria.
C. mantchuricus Swinhoe, 1864 p.169; Type locality- Newchwang (Yingkou), Manchuria; Kishida & Mori, 1931 p.380.
C. hortulorum hortulorum: Kuroda, 1938 p.6.
C. nippon hortulorum: Tate, 1947 p.341; Ellerman & Morrison-Scott, 1951 p.365; Won, 1958 p.431; Won, 1967 p.43; Won, 1968 p.375; Corbet, 1978 p.200; Yoon, 1992 p.128.
C. nippon nippon: Ellerman & Morrison-Scott, 1951 p.365.
C. nippon mantchuricus: Won, 1958 p.430; Won, 1967 p.41; Yoon, 1992 p.126.

Range: Historically, *C. nippon* inhabited the Korean Peninsula, Jeju Island, and southern coastal islands (Lee 1965). Recently, the distribution became limited to the Chinese and Russian border areas in Hamgyeongbuk Province and Ryanggang Province, North Korea (Jin & Ouh 1990; Won & Smith 1999; Fig. 72). Although the South Korea populations were extirpated in the 1990s, translocated sika deer from Taiwan released for religious ceremonies became invasive at Mt. Songni National Park (Koh *et al.* 2010a). The National Park Service attempted to remove the Taiwanese Sika deer but about 100 feral deer remain (Songni National Park office, Pers. Comm.).

Remarks: Won (1967) listed two subspecies, *C. n. mantchuricus* in Jeju Island and *C. n. hortulorum* in the Korean Peninsula. Only one subspecies, *C. n. hortulorum,* formed populations in Korea after the extirpation of the species on Jeju Island (Won 1968). Corbet (1978) relegated *C. n. mantchuricus* as a synonym of *C. n. hortulorum*. Various populations of *C. nippon* have an uncertain origin or mixed ancestry. The genetic status of *C. n. hortulorum* remains particularly uncertain (Harris 2008).

Conservation status: The North Korean government established habitats for *C. nippon* in Samjiyeon County and Beakam County as Natural Monuments in 1980. Also, the South Korean government designated *C. nippon* as an Endangered Species in 2005. However, the species became extinct in South Korea, with no plans for reintroduction. Although the IUCN listed this species as a species of 'Least Concern', the Red Data Book for South Korea registered *C. nippon* as 'Regionally Extinct' (NIBR 2012). The Red Data Book for North Korea lists the species as 'Endangered' (MAB National Committee of DPR Korea 2002).

Family BOVIDAE Gray, 1821

Only a single (wild) species occurs in Korea.

Genus *Naemorhedus* C. H. Smith, 1827

This genus represents the Subfamily Caprinae. The different spellings in the literature for this genus include '*Naemorhedus', 'Naemorh**ae**dus', 'N**e**morh**ae**dus', 'N**e**morhedus'* and *'N**e**mo**rr**h**ae**dus',* but the original spelling was '*Naemorhedus'* (Grubb 2005). *Naemorhedus* was previously regarded as a monospecific genus but currently four species are recognized (Grubb 2005). Only one species, *N. caudatus,* occurred in Korea.

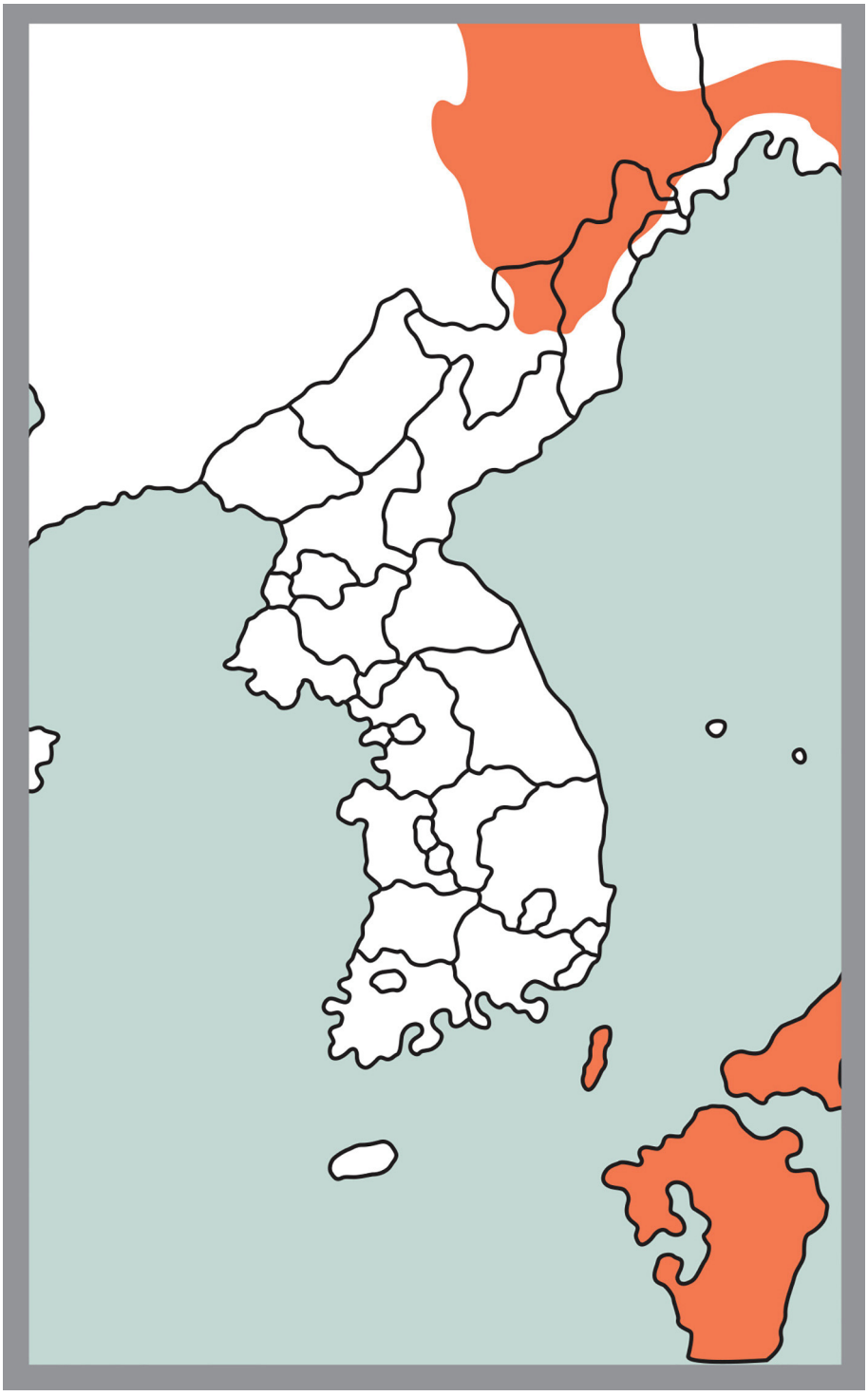

FIGURE 72. Range map of *Cervus nippon* in Korea.

Naemorhedus caudatus (Milne-Edwards, 1867)—Long-tailed Goral

Antilope caudata Milne-Edwards, 1867 p.377; Type locality- Amurland, Siberia, Russia.
A. (*Caprina*) *crispa* Radde, 1862 p.262; Type locality- Amur River.
Kemas raddeanus Heude, 1894 p.240; Type locality- Ussuri, Manchuria.
Nemorheadus raddeanus: Lydekker, 1913 p.209 (Amurland); Kishida & Mori, 1931 p.380; Kuroda, 1938 p.9.
Naemorhedus goral: Ellerman & Morrison-Scott, 1951 p.401.
Naemorhedus goral raddeanus: Ellerman & Morrison-Scott, 1951 p.402; Won, 1958 p.432; Won, 1967 p.59

Nemorhaedus goral: Won, 1968 p.380; Corbet, 1978 p.212; Oh, 2004b p.272.
Nemorhaedus goral raddeanus: Won, 1968 p.380.
Nemorhaedus goral caudatus: Corbet, 1978 p.212; Yoon, 1992 p.137.
Nemorhaedus caudatus: Han, 1994 p.46; Won & Smith, 1999 p.23.

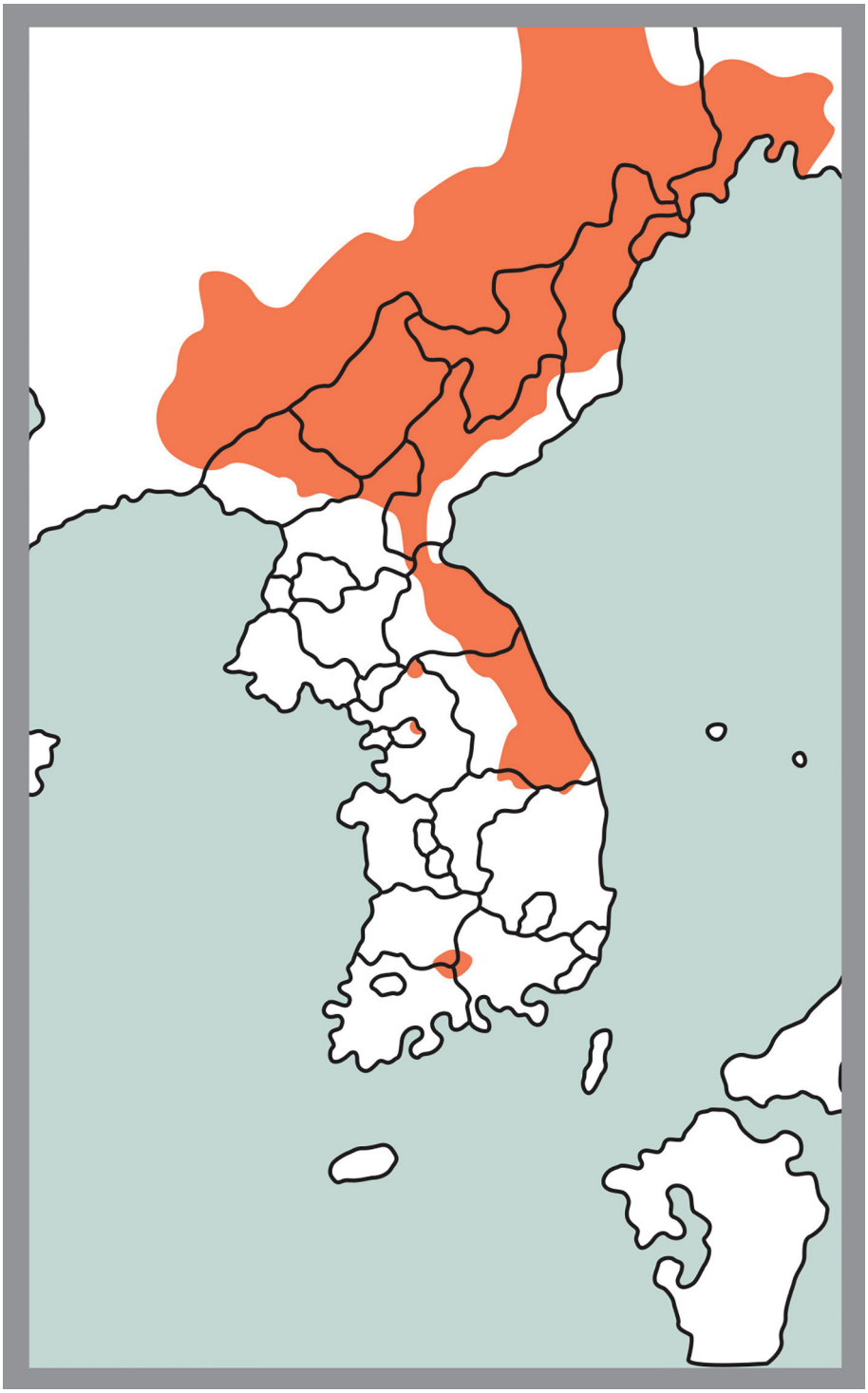

FIGURE 73. Range map of *Naemorhedus caudatus* in Korea.

Range: The species occurred in most high mountains of Korea until the early 20th century (Won 1967). Only a small number of long-tailed gorals are now dispersed along the Baekdudaegan Mountain Range (Choi & Choi 2007). In South Korea, *N. caudatus* inhabits high mountains of Gangwon Province and northern Gyeongsangbuk Province (NIBR 2015; Fig. 73). Currently, goral is expanding its range and therefore, in 2018, one goral was poached by a snare in Pocheon (40 km northwest from Seoul) and two gorals occurred at an urban park in Seoul

(Observation by the author, YSJ). In North Korea, the status of goral is ambiguous. Mt. Myohyang has a relatively healthy population and perhaps other populations, too (Dr. William Duckworth, IUCN, Pers. Comm.), whereas Kim *et al*. (2015) were concerned about drastic declines of gorals in North Korea.

Remarks: The long-tailed goral has been regarded as a monotypic species, but recent DNA analysis indicated differences between populations in China and Korea and suggested the name *N. c. raddeanus* to designate the subspecies in Korea (Min *et al*. 2004).

Conservation status: The South Korean government designated *N. caudatus* a Natural Monument in 1968 and an Endangered Species in 1997. In North Korea, *N. caudatus* with its habitats at Dancheon City, Hamgyeongnam Province, and Daehongdan County, Ryanggang Province were designated as Natural Monuments in 1980. CITES lists the long-tailed goral in Appendix I. Also, this species is classified as 'Vulnerable' in both North and South Korean Red Books (MAB National Committee of DPR Korea 2002; NIBR 2012).

ORDER CETACEA Brisson, 1762

Eight families, 26 genera and 37 species of cetaceans that occur in Korea are classified in two Suborders, Mysticeti and Odontoceti, occur in Korea.

We followed the List of Marine Mammal Species and Subspecies (Committee on Taxonomy 2014) for the common and scientific names of Korean cetaceans.

Except for species listed in Appendix I (see below), all species of the order Cetacea are in CITES Appendix II.

Key to suborders of Cetacea in Korea

-	Teeth absent; skull symmetrical	Mysticeti
-	Teeth present; skull asymmetrical	Odontoceti

SUBORDER MYSTICETI Flower, 1864

Three families (Balaenidae, Balaenopteridae, and Eschrichtiidae) represent Mysticeti in Korea.

Key to families of Mysticeti in Korea

1	Dorsal fin absent; rostrum strongly arched in side; rostrum base slightly wider than tip	Balaenidae
-	Dorsal fin (or dorsal humps) present; rostrum flat or slightly arched	2
2	Rostrum flat; nasals reduced; frontals slightly or not visible on vertex	Balaenopteridae
-	Rostrum slightly arched; nasals large; frontals exposed on vertex	Eschrichtiidae

Family BALAENIDAE Gray, 1821

Eubalaena japonica is the only species of the Family Balaenidae that occurs in the waters of Korea.

Genus *Eubalaena* Gray, 1864

Three species are identified in the Genus, *E. australis* in the Southern Hemisphere, *E. glacialis* in the North Atlantic Ocean, and *E. japonica* in North Pacific Ocean. All species in this genus are listed on CITES Appendix I.

Eubalaena japonica (Lacépède, 1818)—North Pacific Right Whale

Balaena japonica Lacépède, 1818 p.469; Type locality- Japan; True, 1884 p.591.
B. antarcitca antarcitca: Temminck & Schlegel *in* Siebold, 1844 p.18.
B. sieboldii Gray, 1864 p.349; Type locality- coast of Japan and northwest coast of North America.
B. australis: Aoki, 1913 p.333.
B. glacialis sieboldii: Kuroda, 1938 p.9.
Eubalaena glacialis: Kim *et al*., 2000 p.64; Kim, 2004 p.215.

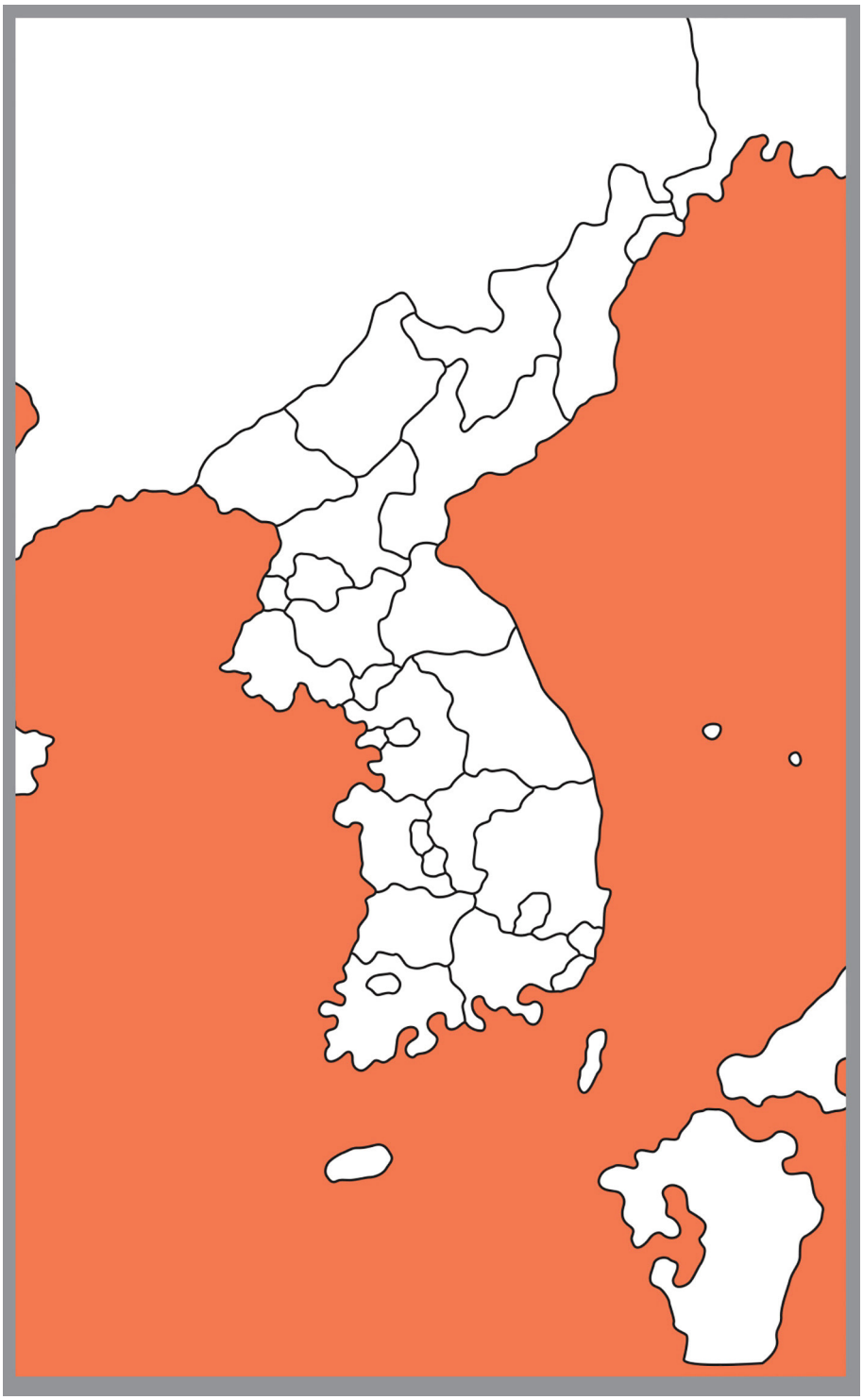

FIGURE 74. Range map of *Eubalaena japonica* in Korea.

Range: In the North Pacific, right whales occur during the summer in the Sea of Okhotsk, the southeastern Bering Sea, the Aleutian Islands, and the northern Gulf of Alaska (Shirihai & Jarrett 2006). During the winter, they occur (at least, historically) southward to the East Sea (Brownell *et al.* 2001). In 1911 and the 1960s, fishermen caught two individuals in the waters of Korea (Park 1987). No record existed after 1974 (Park 1987), until February 2015, when one whale became tangled in a net of a mussel farm in Namhae, on the southern coast. This migratory whale usually occurs in the East Sea between April and May (Fig. 74).

Remarks: North Pacific and North Atlantic right whales were initially considered a single species, *E. glacialis* (Müller 1776), whereas, the southern right whale, *E. australis* was subsumed as a separate species (National Marine Fisheries Service 2013). Whale biologists divided the Northern and Southern Hemisphere forms based on skeletal and genetic data (Schaeff *et al*. 1997; Churchill *et al*. 2012). Rosenbaum *et al*. (2000) compiled a database of mtDNA samples from right whales in the North Atlantic Ocean, North Pacific Ocean, and Southern Hemisphere and concluded that three right whale species had genetic validity. Gaines *et al*. (2005) and Kaliszewska *et al*. (2005) subsequently confirmed the three species of right whales by analyses of nuclear DNA and the genetics of whale lice, respectively. In 2008, the National Marine Fisheries Service listed the North Pacific right whale as a separate species under the Endangered Species Act (ESA) based on these genetic studies.

Conservation status: The South Korean government made *E. glacialis* (currently, *E. japonica*) a Protected Marine Species in 2007. CITES lists the species on Appendix I. It is listed on the IUCN Red List as 'Endangered'. Based on our information, North Korea is not involved in the conservation of this whale.

Family BALAENOPTERIDAE Gray, 1864

The Family Balaenopteridae in the waters of Korea is represented by six species and two genera in the waters of Korea.

Key to genera of Balaenopteridae in Korea

- Flippers less than 1/5 of body; absence of tubercles on flippers. . . . . *Balaenoptera*
- Long flippers (1/4 to 1/3 of body length); flippers with tubercles on leading edge . . . . . *Megaptera*

Genus *Balenoptera* Lacépède, 1804

Among the six species of *Balenoptera,* five occur in the waters of Korea (Mead & Brownell 2005).

Key to species of Genus *Balenoptera* in Korea

1 Ventral pleats end before navel 2
- Ventral pleats extend to or beyond navel 3
2 Ventral pleats 22–70; 200–300 baleen plates each side . . . . . *B. acutorostrata*
- Ventral pleats 32–65; 219–402 black baleen plates each side. . . . . *B. borealis*
3 Three conspicuous ridges on rostrum; 40–70 ventral pleats. . . . . *B. edeni*
- One ridge on rostrum; 55–100 ventral pleats 4
4 Head u-shaped from above; dorsal fin 1% body length; maximum body length 33 m. . . . . *B. musculus*
- Head v-shaped from above; dorsal fin 2.5% body length; maximum body length 27 m . . . . . *B. physalus*

Balaenoptera acutorostrata Lacépède, 1804—Common Minke Whale

Balaenoptera acuto-rostrata Lacépède, 1804 p.134; Type locality- France; Kuroda, 1938 p.11.
B. acutorostrata: Won, 1958 p.433; Won, 1967 p.78; Won, 1968 p.240; Kim *et al*., 2000 p.60; Kim, 2004 p.222.

Range: *Balaenoptera acutorostrata* consistently inhabits the East Sea and Yellow Sea (Fig. 75). Observations peak

in spring followed by autumn, during migration. This species swims primarily in the mid-Yellow Sea and continental shelf of the East Sea but rarely comes into the coastal waters of Korea.

Remarks: The subspecies *B. a. scammoni* Deméré, 1986 was assigned to the population living in the North Pacific Ocean. However, the population of *B. acutorostrata* in the East Sea between Korea and Japan might represent a new subspecies (Archer *et al*. 2013).

Conservation status: All populations of this species are included in CITES Appendix I (except the population in the waters of West Greenland is included in Appendix II).

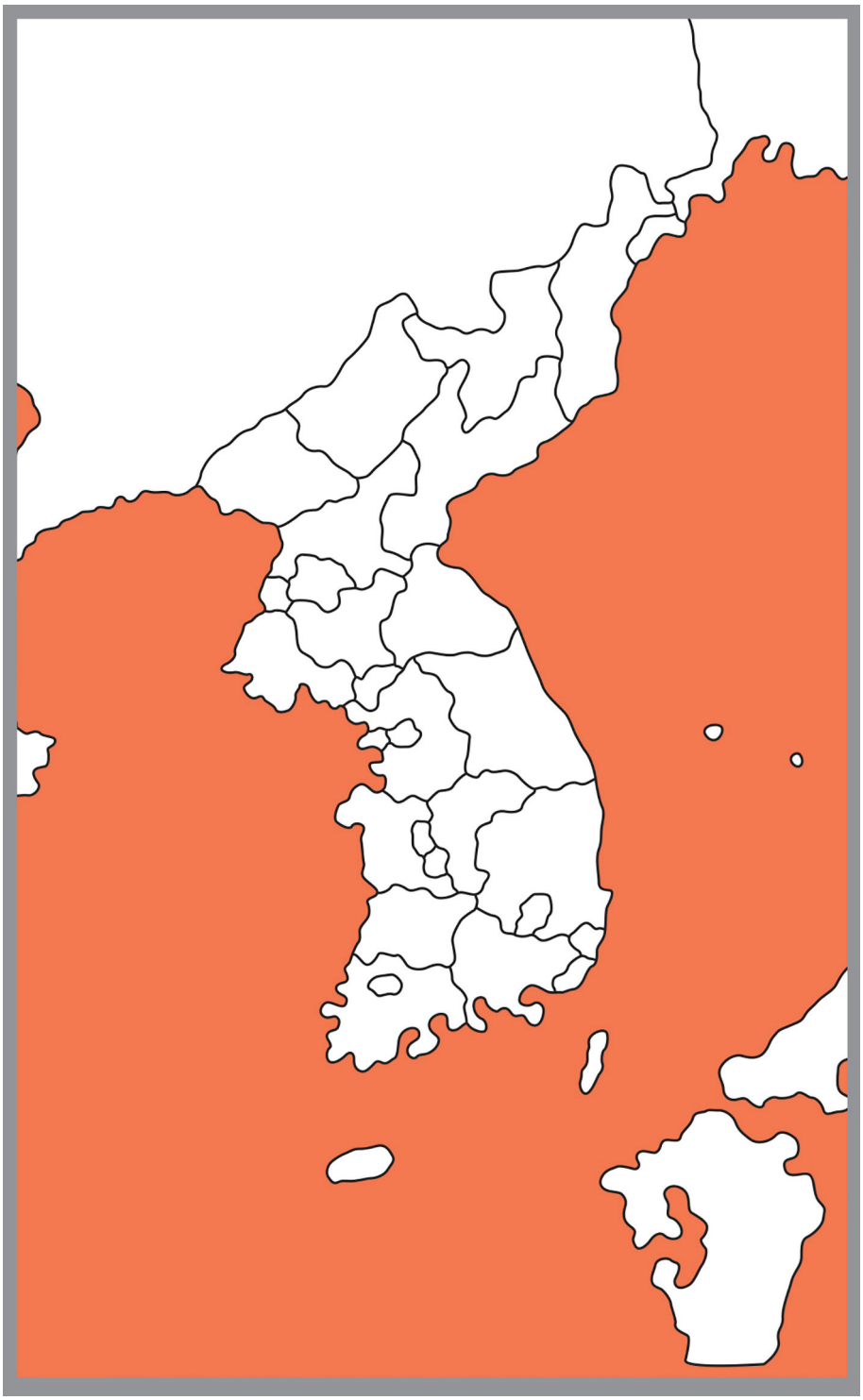

FIGURE 75. Range map of *Balaenoptera acutorostrata* in Korea.

Balaenoptera borealis Lesson, 1828—Sei Whale

Balaenoptera borealis Lesson, 1828 p.342; Type locality- Germany; Kuroda, 1938 p.10; Ellerman & Morrison-Scott, 1951 p.715; Kim *et al*., 2000 p.56; Kim, 2004 p.220.

Range: Despite the species being a cosmopolitan species with wide distribution, only few observations of *B. borealis* have recorded in the waters of Korea (Fig. 76). Since 1911, fishermen caught only seven Sei whales (three in 1968) in the waters near Korea (Park 1987).

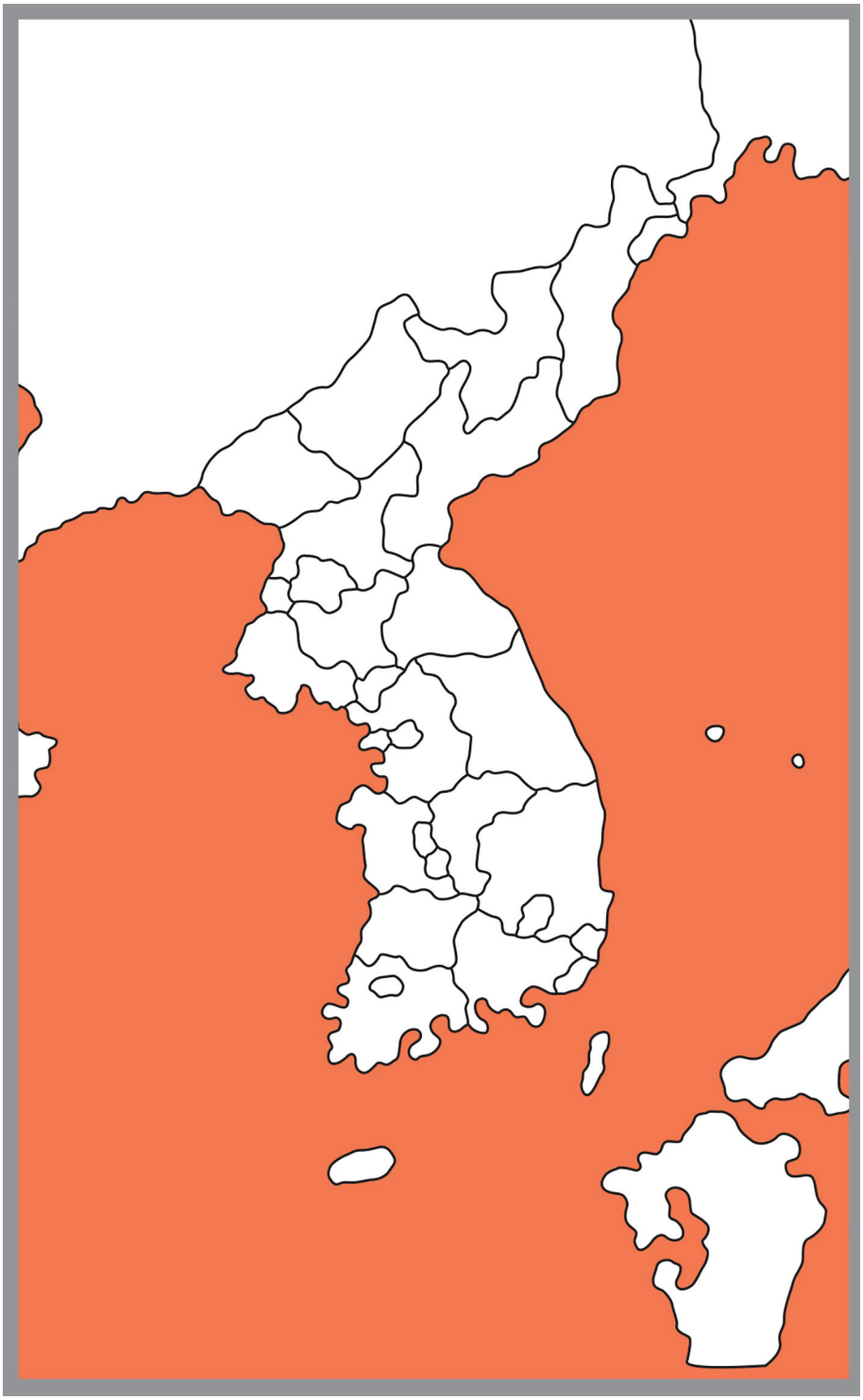

FIGURE 76. Range map of *Balaenoptera borealis* in Korea.

Remarks: Although marine biologists placed the Northern Hemisphere stock in the subspecies *B. b. borealis*, this stock might represent two or three different lineages (eastern and western or eastern, central and western stocks; Reeves & Kenney 2003).

Conservation status: The South Korean government made the Sei whale a Protected Marine Species in 2007. This species also occurs on CITES Appendix I and in the IUCN Red List as 'Endangered'. Based on our information, North Korea is not involved in the conservation of this whale.

Balaenoptera edeni Anderson, 1879—Bryde's Whale

Balaenoptera edeni Anderson, 1879 p.551; Type locality- Burma; Kim *et al*., 2000 p.58; Kim, 2004 p.221.

Range: Since the first observation of Bryde's whale in the East Sea in 1994 (Kim 2004), four individuals were observed in Korean waters: one at Incheon in 2005, another from Ulsan in 2010 and the other two on Jeju Island in 2004 and 2009, respectively. The species also occurs in the southern and western seas near Korea (Fig. 77). Also, forensic research showed that Bryde's whales were illegally traded at Korean markets in Busan (Moon & Ku 2000).

Remarks: The taxonomic status of the species remains debated whether 1 species, 2 species (*B. edeni* & *brdei* complex and *B. omurai*), or 3 species complex (*B. edeni, B. brydei,* and *B. omurai*) (Mead & Brownell 2005). However, based on the distribution of the species in Korean waters, we consider *B. edeni* is the appropriate classification because the debate is based on size dimorphism (Mead & Brownell 2005).

Conservation status: The South Korean government designated the species a Protected Marine Species in 2007. CITES lists *B. edeni* (and *B. omurai*) under Appendix I. Based on our information, North Korea is not involved in the conservation of this whale.

Balaenoptera musculus (Linnaeus, 1758)—Blue Whale

Balaena musculus Linnaeus, 1758 p.76; Type locality- Fifth of Forth, Scotland.
Physalus sibbaldii Gray, 1847 p.92; Type locality- Coast of Yorkshire, England.
Sibbalius sulfureus Cope, 1869 p.20; Type locality- North Atlantic, US; True, 1884 p.591.
Balaenoptera musculus: Kuroda, 1938 p.11; Won, 1958 p.433; Won, 1967 p.79; Won, 1968 p.236; Kim *et al*., 2000 p.52; Kim, 2004 p.217.

Range: *Balaenoptera musculus* has rarely been encountered in the East Sea (Fig. 78). Whalers harvested a total of 20 blue whales in the waters of Korea during 1911 to 1944 (Park 1987). There has been no record of this whale in Korean waters since 1944.

Remarks: The Northern Hemisphere stock (except the Indian Ocean stock) is identified under *B. m. musculus* (Reilly *et al.* 2008).

Conservation status: The South Korean government designated this species a Protected Marine Species in 2007. The North Korean Red Data Book listed this species as 'Rare.' CITES has protected *B. musculus* as an Appendix I species, and the IUCN designated this whale as 'Endangered'.

Balaenoptera physalus (Linnaeus, 1758)—Fin Whale

Balaena physalus Linnaeus, 1758 p.75; Type locality- Norway.
Sibbalius veliferus: True, 1884 p.591.
Balaenoptera velifera copei Elliot, 1901 p.13; Type locality- Shumagin Island, Alaska.
Balaenoptera physalus: Kuroda, 1938 p.10; Ellerman & Morrison-Scott, 1951 p.715; Won, 1958 p.433; Won, 1967 p.77; Won, 1968 p.238; Kim *et al*., 2000 p.54; Kim, 2004 p.219.
Balaenoptera swinhoii: Kuroda, 1938 p.11.

Range: Fishermen have caught *B. physalus* along all the coasts of Korea, but observations of this whale came

primarily from the East Sea (Fig. 79). The harvest of 921 fin whales from 1958 to 1982 possibly led to their rarefaction (Park 1987). In 1996, the stranded body of a fin whale was found at Incheon. Observations of this species in spring and autumn on the northeastern coast follow the October to May migrations in the Yellow Sea (Kim 2004). During August and November, these whales appear congregate around the southern coast.

Remarks: Although the polyphyletic fin whales are clustered into three genetic clades, the taxonomic status of fin whales in the North Pacific Ocean remains unresolved (National Marine Fisheries Service 2013).

Conservation status: The South Korean government designated *B. physalus* as a Protected Marine Species in 2007. The Red Data Book of North Korea listed it as a 'Rare' species (MAB National Committee of DPR Korea 2002). This species is listed on Appendix I of CITES.

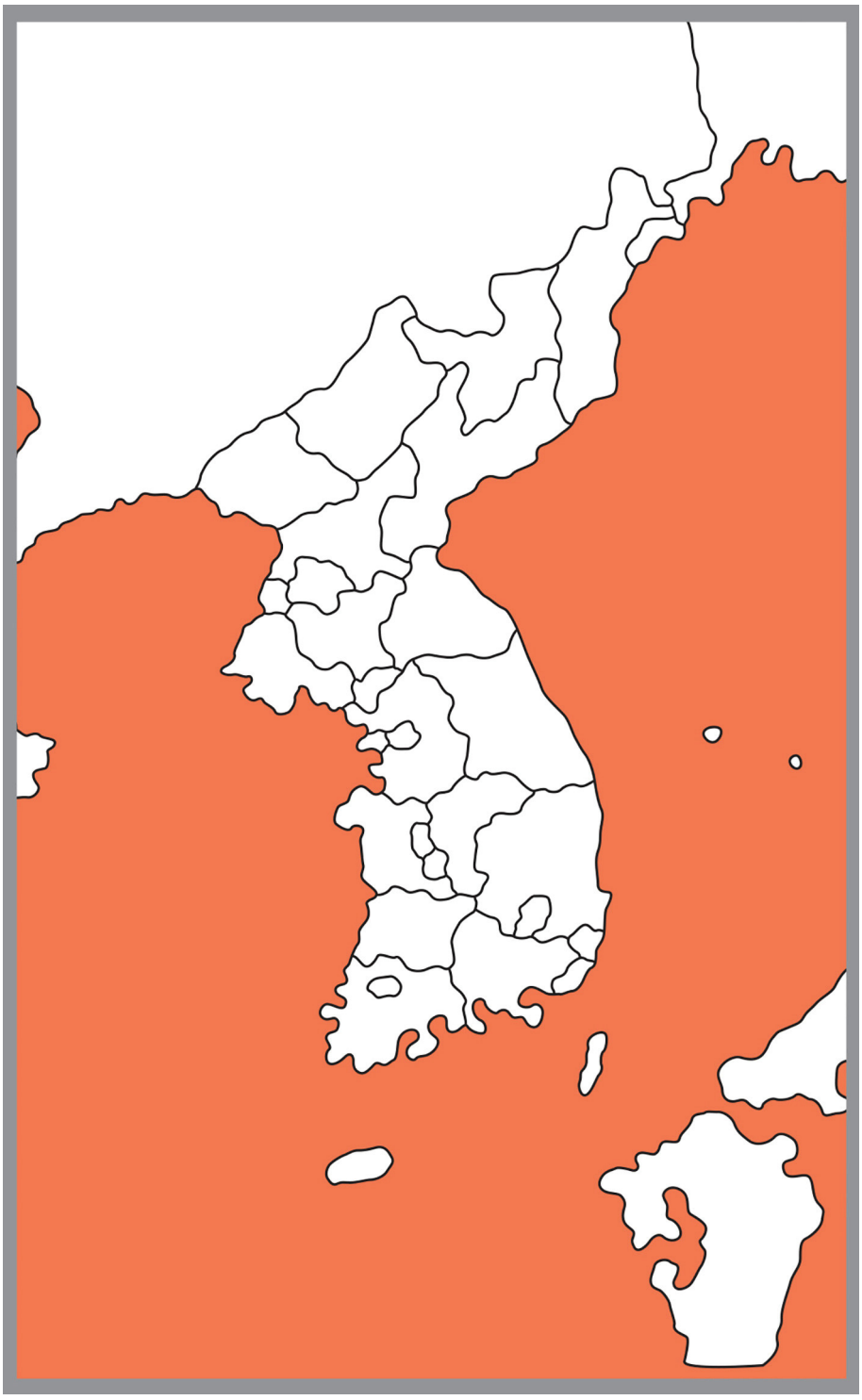

FIGURE 77. Range map of *Balaenoptera edeni* in Korea.

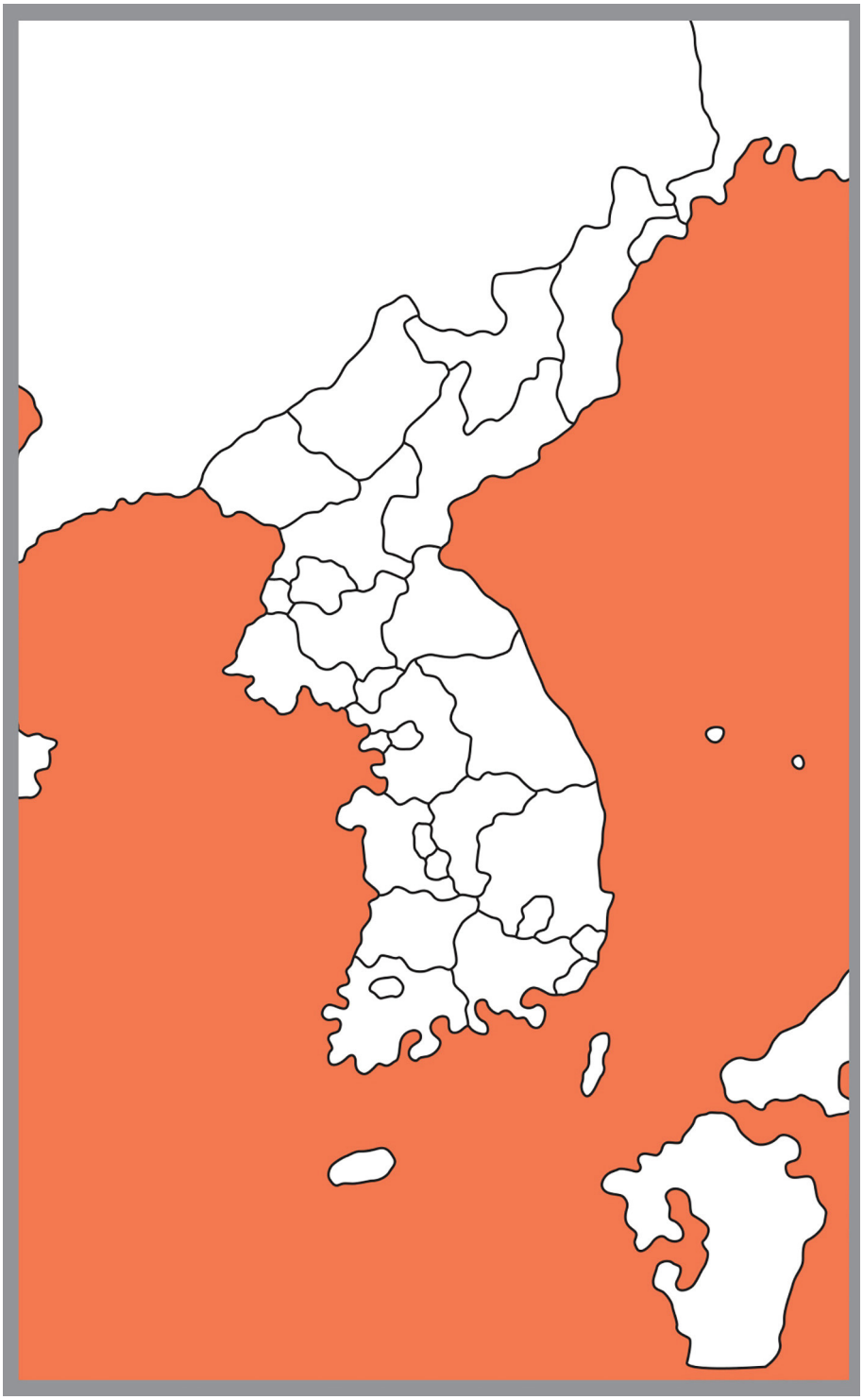

FIGURE 78. Range map of *Balaenoptera musculus* in Korea.

Genus *Megaptera* Gray, 1846

Megaptera is a monospecific genus that has a global distribution, from cold regions through temperate oceans and tropical waters.

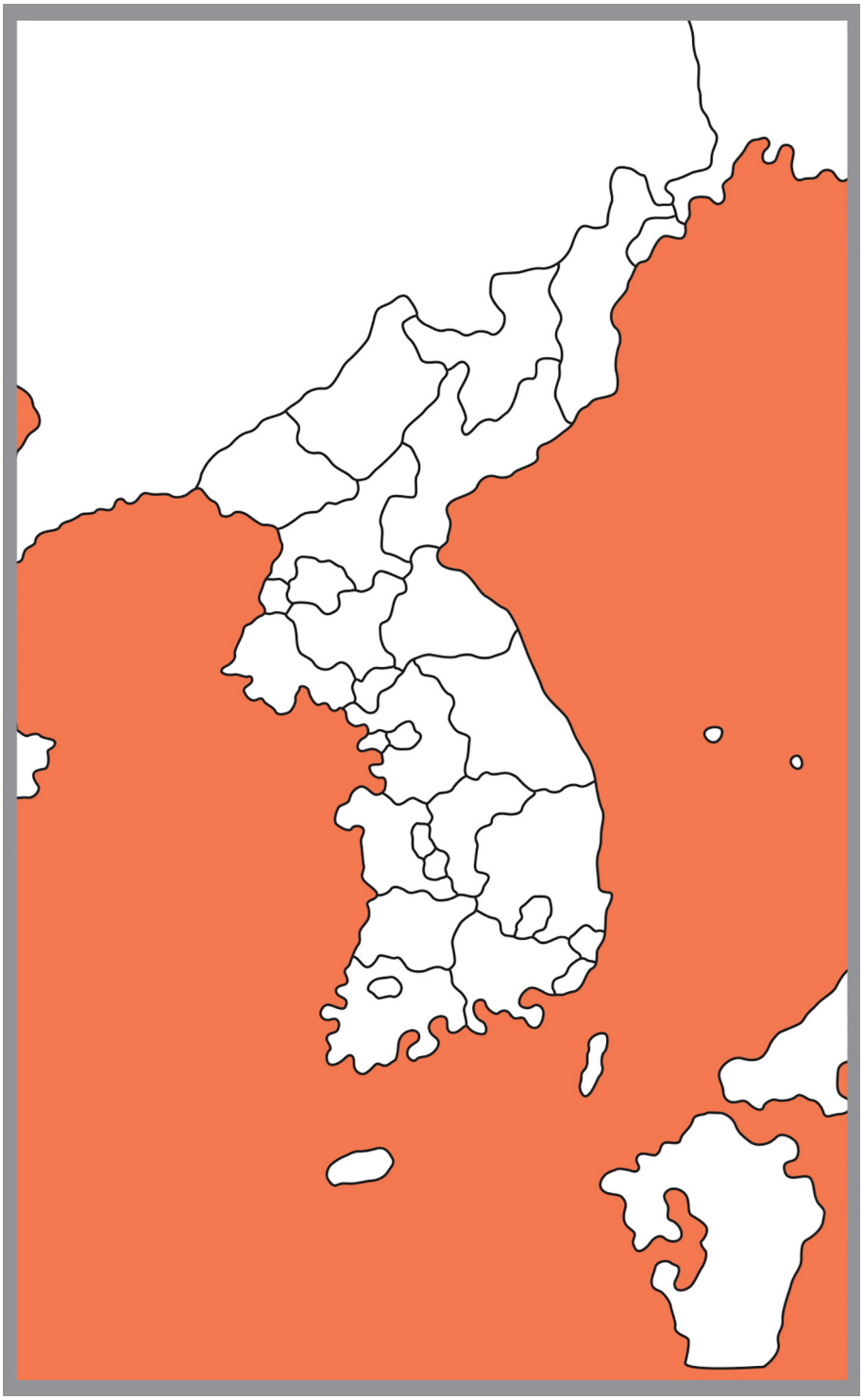

FIGURE 79. Range map of *Balaenoptera physalus* in Korea.

Megaptera novaeangliae (Borowski, 1781)—Humpback Whale

Balaena novae angliae Borowski, 1781 p.21; Type locality- New England Coast, US.
Balaena nodosa Bonnaterre, 1789 p.5; Type locality- New England Coast, US.
Megaptera kuzira Gray, 1850 p.30; Type locality- Japan.
Megaptera versabilis Cope, 1869 p.15; Type locality- North Pacific.
Megaptera nodosa: Kuroda, 1938 p.12; Won, 1968 p.243.
Megaptera novaeangliae: Won, 1958 p.434; Won, 1967 p.80; Kim *et al*, 2000 p.62; Kim, 2004 p.223.

Megaptera nodosa nodosa: Won, 1968 p.244.
Megaptera novaeangliae kuzira: Jackson *et al*., 2014 p.8 (North Pacific).

Range: Humpback whales inhabit coastal waters. The first record of *M. novaeangliae* in Korea occurred in 1911 in the waters off Ulsan (Andrews 1916). During the Japanese invasion (1910–1945), fishermen caught 128 humpback whales in the Korean waters; since 1958, only 13 were captured (Park 1987). More recently, observations of humpback whales have regularly been made in waters southeast of Korea (Kim 2004; Fig. 80).

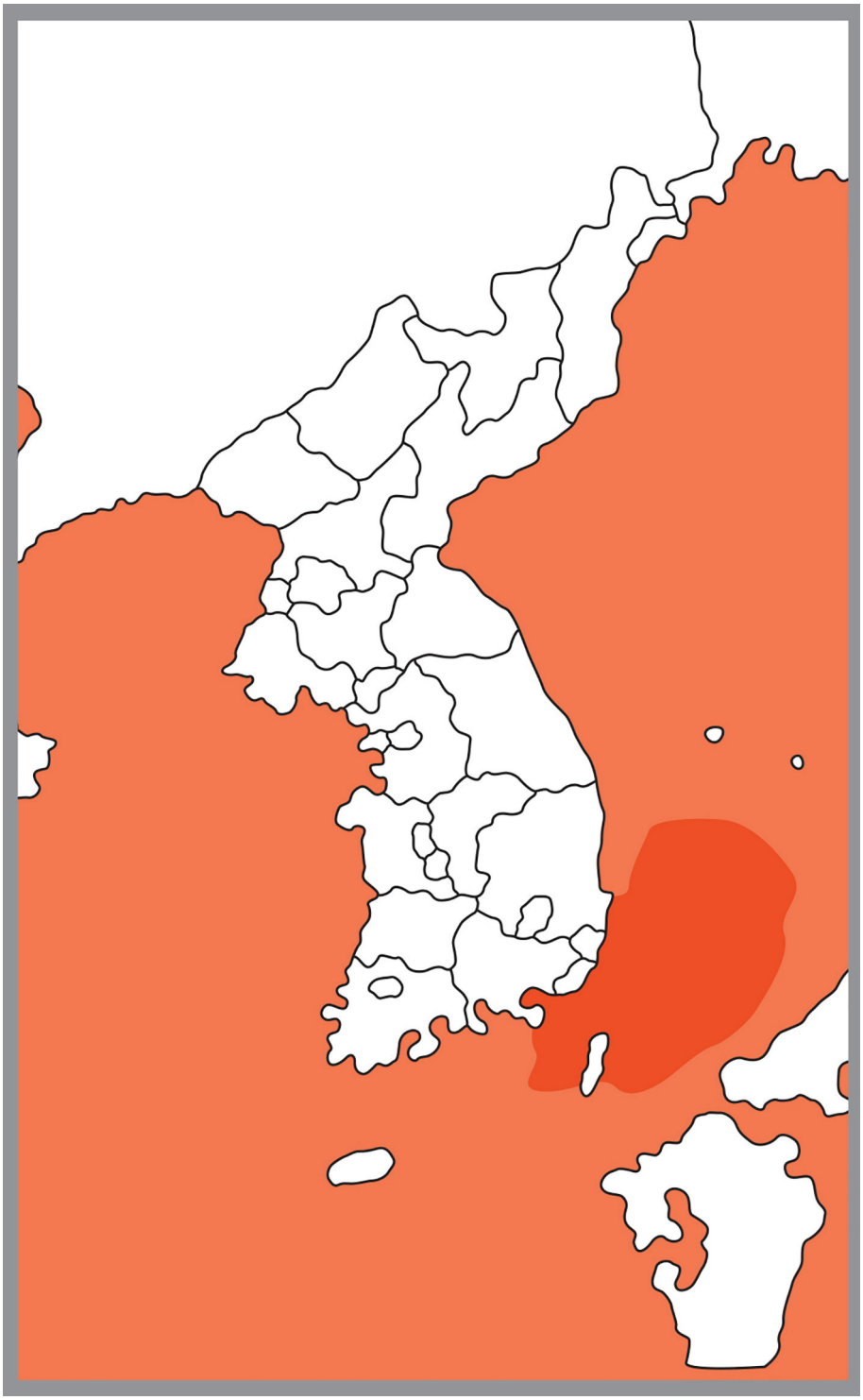

FIGURE 80. Range map of *Megaptera novaeangliae* in Korea.

Remarks: Previously, North Korea and South Korea had different scientific names for this species, *M. nodosa* and *M. novaeangliae*, respectively (Won 1967, 1968). A recent study based on nuclear and mitochondrial DNA resulted in the recognition of the single species *M. novaeangliae* and three subspecies: *M. n. kuzira* (Gray, 1850) for the North Pacific Ocean (including Korea), *M. n. novaeangliae* (Borowski, 1781) for the North Atlantic Ocean and *M. n. australis* (Lesson, 1828) for the Southern Hemisphere (Jackson *et al*. 2014). Divergence time estimates indicated that the North Pacific Ocean subspecies was the earliest offshoot, rising ~ 175,000 years ago (Jackson *et al*. 2014).

Conservation status: *Megaptera novaeangliae* has been a Protected Marine Species in South Korea since 2007. The Red Data Book of North Korea classified this species as 'Vulnerable' (MAB National Committee of DPR Korea 2002). CITES lists this species on Appendix I.

Family ESCHRICHTIIDAE Ellerman and Morrison-Scott, 1951

Only a single species, *E. robustus,* represents this family in the waters of Korea.

Genus *Eschrichtius* Gray, 1864

Eschrichtius robustus (Lilljeborg, 1861)—Gray Whale

Balaenoptera robusta Lilljeborg, 1861 p.602; Type locality- Graso Island, Uppland, Sweden.
Agaphelus glaucus Cope, 1868 p.225; Type locality- Monterey Bay, California.
Rhachianectes glaucus: Andrews, 1914 p.232; Kishida, 1924 p.320; Kuroda, 1938 p.12.
Eschrichtius gibbosus: Ellerman & Morrison-Scott, 1951 p.713; Won, 1958 p.434; Won, 1967 p.81; Won, 1968 p.233.
E. robustus: Kim *et al*., 2000 p.66; Kim, 2004 p.225.

Range: The Korean stock almost became extirpated with the harvest of five gray whales in 1964 (Park 1987). The possible extinction of the Korean stock in the 1970s was debated (Bowen 1975; Brownell & Chun 1977). However, the re-discovery of gray whales in the 1990s ensured the survival of the Korean stock, with no more than 200 individuals surviving in the West Pacific Ocean (Reeves & Kenney 2003). Historically *E. robustus* migrated through Ulsan twice a year, from late November to the end of January and from mid-March to mid-May (Fig. 81). This whale is commonly observed in the East Sea, but no recent observations have been reported in the waters of Korea.

Remarks: Pre-whaling genetic bottleneck in gray whales has been suggested (Alter *et al*. 2007). Gray whales feed in Arctic and subarctic benthic environments, and marine biologists assume gray whales have a sensitivity to changes in climate, and climatic events such as the Medieval Warm Period (ca. 900–1200 AD) or Little Ice Age (ca. 1300–1850 AD) could have caused population declines. The poorly understood relationship between populations of the gray whale and climate-driven ecosystem features such as sea ice, freshwater input to near-shore benthic ecosystems, and prey preference could have caused the distinction of this species from other taxa (Perryman *et al*. 2002, Moore *et al*. 2003). A recent genetic study supported the hypothesis that gray whales experienced a recent, major population decline (Alter *et al.* 2007). The small F_{ST} value (0.1125) between eastern and western individuals supports the monotypic status of the species (Alter *et al*. 2012). Because of differences in haplotype frequencies between eastern and western lineages (among 36 haplotypes, three were unique to the western population, 26 to the eastern, and seven were shared), the Korean stock could be a distinct subspecies due to its isolation and lack of gene flow (LeDuc *et al*. 2012).

Conservation status: Ever since R. C. Andrews (1914) reported a 'Korean stock' of gray whales, Koreans have favored the gray whale like national whale because of the word 'Korean' stock. The South Korean government designated this species with a migration route in the East Sea a Natural Monument in 1962 and a Protected Marine Species in 2007. CITES listed the gray whale on Appendix I. The North Korean government classified this species as 'Rare' (MAB National Committee of DPR Korea 2002).

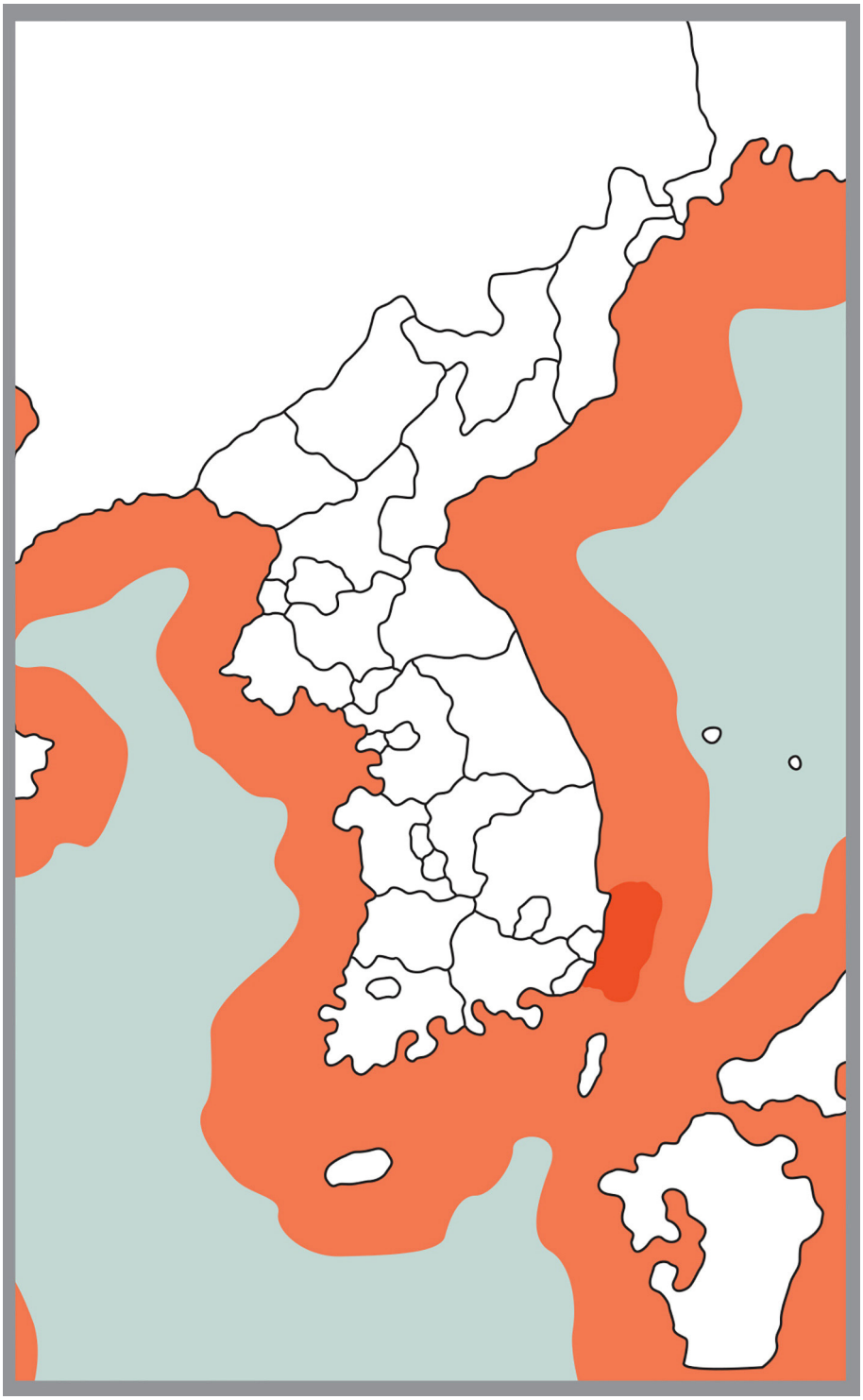

FIGURE 81. Range map of *Eschrichtius robustus* in Korea.

SUBORDER ODONTOCETI Flower, 1867

Families in the Korean Odontoceti include Delphinidae, Monodontidae, Phocoenidae, Physeteridae, and Ziphiidae.

Key to families of Odontoceti in Korea

1	Nares of similar size 2
-	Skull extremely asymmetrical; left nare much larger than right . . . . . Physeteridae
2	Heterodont teeth; large teeth restricted lower jaw; no teeth on upper jar . . . . . Ziphiidae
-	Homodont teeth; mandibular symphysis short: <1/3 of mandible length 3
3	Teeth <12, concentrated from frontal tip to 2/3 of jaw and absent on 2/3 to rear end of both upper and lower jaws . . . . . Monodontidae
-	Teeth >12, evenly distributed on both jaws (except *Grampus*: only lower teeth). 4
4	Teeth pointed; no bony boss on nares . . . . . Delphinidae
-	Teeth blunt; bony boss on nares . . . . . Phocoenidae

Family PHYSETERIDAE Gray, 1821

The Genus *Kogia* has often been treated as belonging to a distinct family, the Kogiidae (Geisler *et al*. 2011). Here, we followed Mead and Brownell (2005) and classified *Kogia* in the Family Physeteridae, with three species and two genera listed in the waters of Korea.

Key to genera of Physeteridae in Korea

-	Body length <4 m; head <15% of body length; prominent dorsal fin with no knuckles . . . . . *Kogia*
-	Head squarish and large (1/4–1/3 of body length); low rounded dorsal hump; spinal ridge with knuckles. . . . . *Physeter*

Genus *Kogia* Gray, 1846

Kogia is often treated as a distinct Family, Kogiidae Gill, 1871, but is retained in the same phylogenetic group as the sperm whale (Genus *Physeter*) based on cytochrome *b* analysis (May-Collado & Agnarsson 2006). We followed the taxonomy by Mead and Brownell (2005). Two species are recognized, and both have a worldwide distribution.

Key to species of Genus *Kogia* in Korea

-	Short dorsal fin (<5% body length); distance snout tip to blowhole >10% of total length. . . . . *K. breviceps*
-	Long dorsal fin (>5% of body length); distance snout tip to blowhole <10% of total length. . . . . *K. sima*

Kogia breviceps (Blainville, 1838)—Pygmy Sperm Whale

Physeter breviceps Blainville, 1838 p.337; Type locality- Cape of Good Hope, South Africa.
Kogia floweri Gill, 1871 p.738; Type locality- Mazatlan, Sinaloa, Mexico.
K. breviceps: Kuroda, 1938 p.13; Kim *et al*., 2000 p.72; Kim, 2004 p.229.

Range: This species has a limited range in the East Sea (Fig. 82). The South Korean Coast Guard chronicled the only record of this species as a by-catch at Pohang (central east coast) in 2003 (Pohang Coast Guard, unpublished data).

Remarks: *Kogia breviceps* is considered monotypic, but geographic variation within the species has not been assessed (Chivers *et al*. 2005).

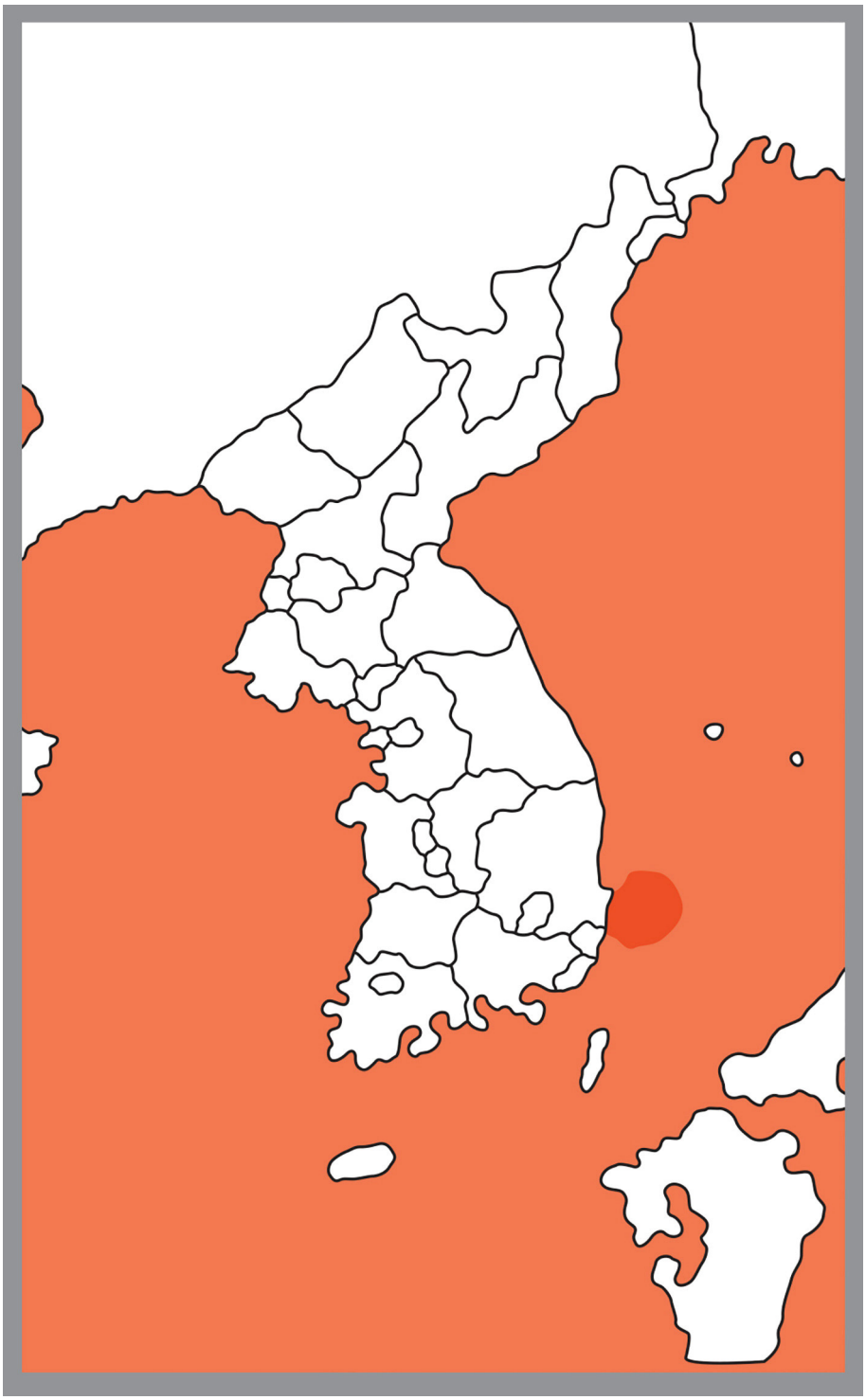

FIGURE 82. Range map of *Kogia breviceps* in Korea.

Kogia sima (Owen, 1866)—Dwarf Sperm Whale

Physeter (*Euphyseter*) *simus* Owen, 1866 p.30; Type locality- Andhra Pradesh, India.
Kogia simus: Kuroda, 1938 p.13; Kim *et al*., 2000 p.73.
K. sima: Kim, 2004 p.230.

Range: Although no record exists in Korea, stranded dwarf sperm whales have been reported along the west coast of Japan near Korea (200 km from Busan; National Museum of Nature and Science 2009). The species is expected to inhabit waters of the East Sea along the coast of Korea (Kim 2004; Fig. 83).

Remarks: The dwarf sperm whale has sometimes been designated erroneously under '*Kogia simus*'. The scientific name is here corrected to *K. sima* for agreement with Latin gender (Rice 1998). Although *K. sima* is considered monotypic, mtDNA analysis suggested two reproductively isolated clades between the Indo-Pacific and Atlantic oceans (Chivers *et al*. 2005).

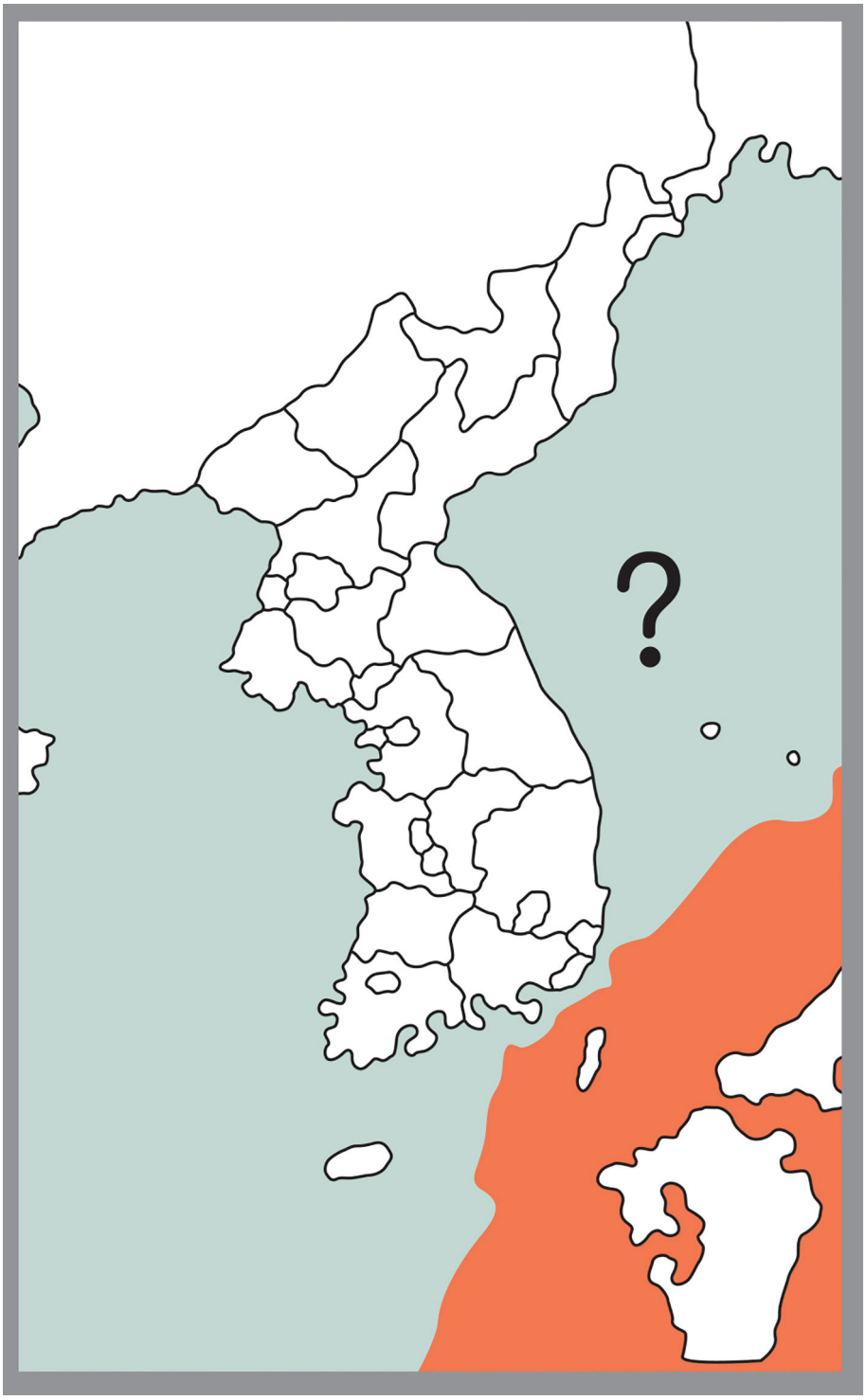

FIGURE 83. Range map of *Kogia sima* in Korea.

Genus *Physeter* Linnaeus, 1758

Physeter, a monospecific genus with a world-wide distribution.

Physeter catodon Linnaeus, 1758—Sperm Whale, cachalot

Physeter catodon Linnaeus, 1758 p.76; Type locality- Middenpiat, Netherland; Kuroda, 1938 p.13; Ellerman & Morrison-Scott, 1951 p.721; Won, 1968 p.230.
P. macrocephalus Linnaeus, 1758 p.76; Type locality- North Atlantic (European Seas); Kim *et al*., 2000 p.70; Kim, 2004 p.227.

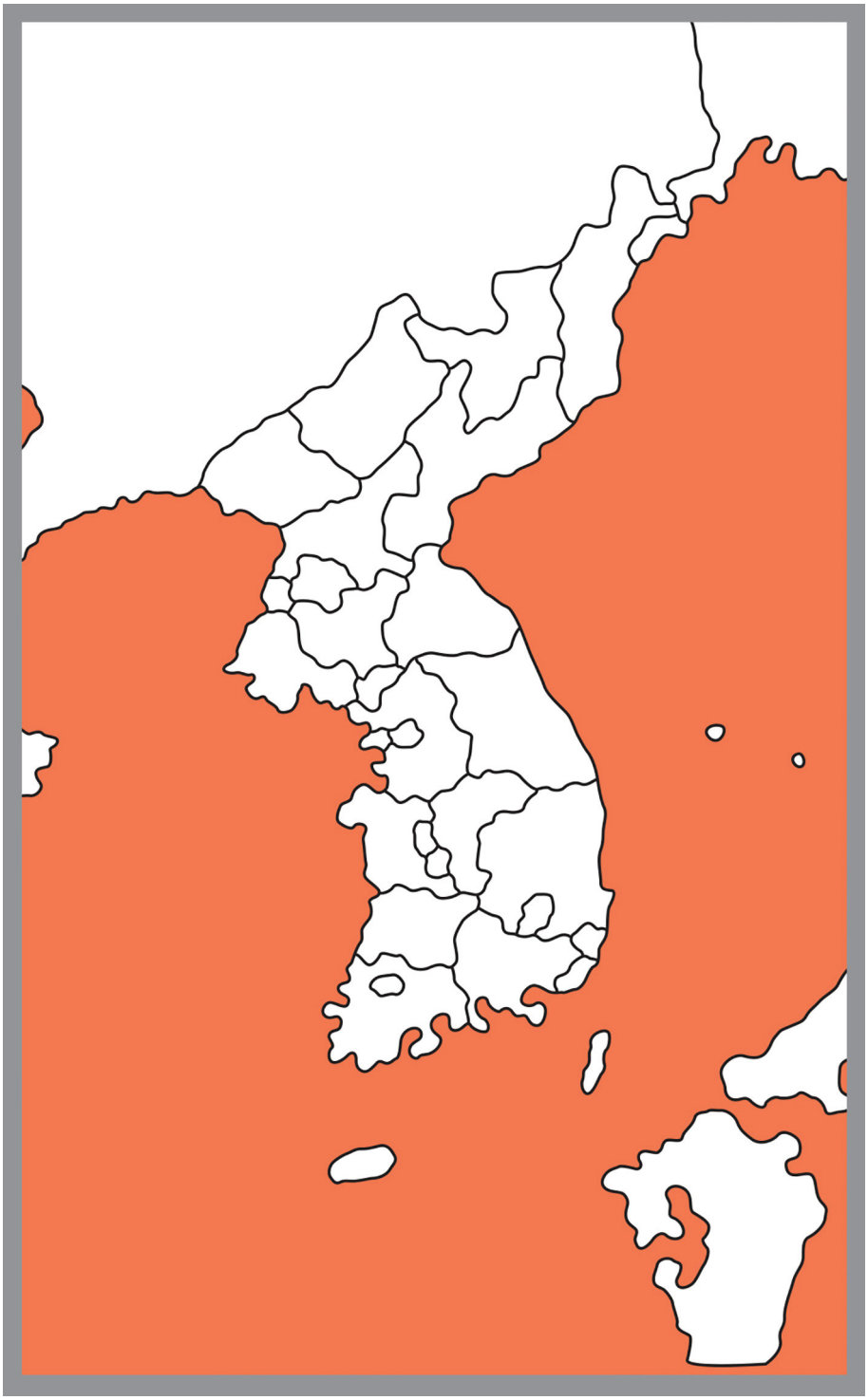

FIGURE 84. Range map of *Physeter catodon* in Korea.

Range: The sperm whale has a sporadically occurrence in the seas surrounding Korea (Kim 2004; Fig. 84). A group of eight sperm whales occurred in the East Sea, 15 km from Pohang in 2004 (Dr. H. S. Sohn, Korean Cetacean Research Institute, Pers. Comm.). One dead individual beached on Ui-do (island) in the southern Yellow Sea in 2005 (Mokpo Coast Guard, unpublished data).

Remarks: Linnaeus used both *P. catodon* and *P. macrocephalus* to designate the sperm whale. *Physeter catodon* has line priority, whereas Linnaeus used *P. macrocephalus* for the type specimen. Here, we followed the taxonomy of Wilson and Reeder (2005).

Conservation status: The South Korean government designated the sperm whale a Protected Marine Species in 2007. CITES currently lists the species on Appendix I under *P. microcephalus*. Based on our information, North Korea is not involved in the conservation of this whale.

Family ZIPHIIDAE Gray, 1865

Despite priority on the first name, Hyperoodontidae Gray, 1846, the name Ziphiidae has been used for more than a century (Mead & Brownell 2005). Based on Article 23.12 of the International Code of Zoological Nomenclature (1999), we followed Mead and Brownell (2005). There are three genera and five species of the family Ziphiidae in the waters of Korea.

Key to the genera of Ziphiidae in Korea

1 Beak indistinct; head with light color . . . . . *Ziphius*
- Long beak prominent 2
2 Two pairs of teeth (lower jaw) . . . . . *Berardius*
- One pair of teeth (lower jaw) . . . . . *Mesoplodon*

Genus *Ziphius* G. Cuvier, 1823

Ziphius is a monotypic genus with a worldwide distribution.

Ziphius cavirostris G. Cuvier, 1823—Cuvier's Beaked Whale, goose-beaked whale

Ziphius cavirostris G. Cuvier, 1823 p.350; Type locality- France; Kim *et al.*, 2000 p.78; Kim, 2004 p.234.
Z. grebnitzkii Stejneger, 1883 p.77; Type locality- Commander Islands, Bering Sea, Russia.

Range: No official records verified strandings or by-catch of Cuvier's beaked whales from the waters of Korea. However, molecular investigations confirmed that the meat of *Z. cavirostris* was sold at markets in Korea (Dalebout *et al*. 2005). Since a federal law in South Korea prohibits the import of whale meat from other countries or deep-sea fisheries, there is high probability that the meet of *Z. cavirostris* in markets was poached from Korean waters (Fig. 85).

Remarks: Despite regional variation in morphology (Dalebout *et al.* 2005), *Z. cavirostris* is considered a monotypic species.

Genus *Berardius* Duvernoy, 1851

Two species have been recognized based on genetic analyses, *B. arnuxii* in the Southern Hemisphere and *B. bairdii* in the North Pacific Ocean (Dalebout 2002, Dalebout *et al*. 2004). Mead and Brownell (2005) suggested that *Berardius* could be monotypic. A third and as yet unnamed species (informally known as 'Karasu') was described in 2016 in the North Pacific (Morin *et al.* 2017).

FIGURE 85. Range map of *Ziphius cavirostris* in Korea.

Berardius bairdii Stejneger, 1883—Baird's Beaked Whale

Berardius bairdii Stejneger, 1883 p.75; Type locality- Commander Islands, Bering Sea, Russia; Kuroda, 1938 p.14; Won, 1968 p.218; Kim *et al*., p.76; Kim, 2004 p.233.

Range: The species mostly occurs in the cold temperate waters of the North Pacific and ranges into Korean waters during March to October, with peaks of occurrence between May and August. Along the east coast of Korea, *B.*

bairdii migrates from the North as far South as Jumunjin Pier (central east coast) and returns to the North in October (Fig. 86). Several strandings and by-catch in the East Sea are recorded every year (Kim 2004).

Remarks: None.

Conservation status: The species is listed by CITES on Appendix I. This species is not protected by either South Korea or North Korea.

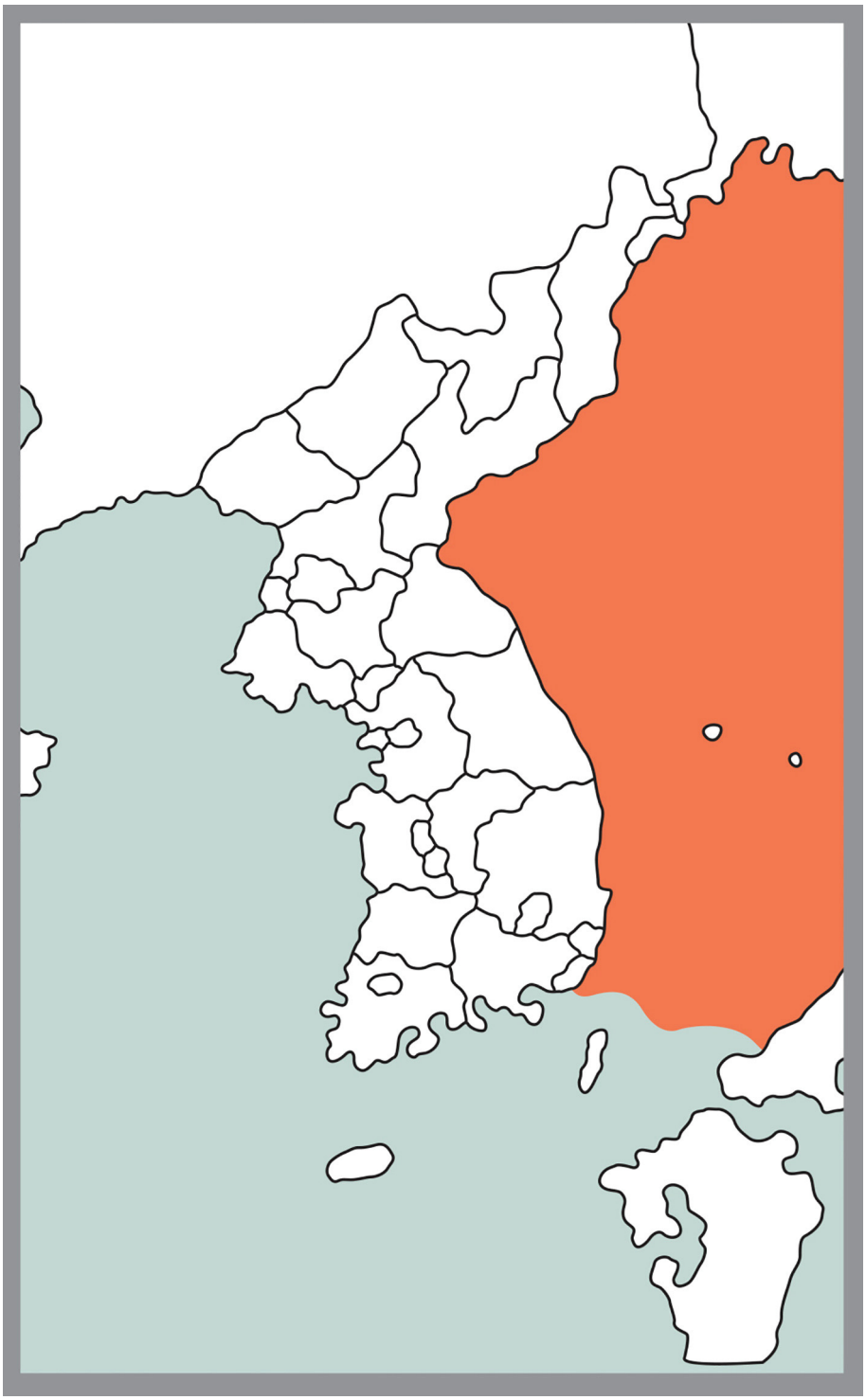

FIGURE 86. Range map of *Berardius bairdii* in Korea.

Genus *Mesoplodon* Gervais, 1850

Three of the 14 recognized species of *Mesoplodon* occur or are likely to occur in the waters of Korea.

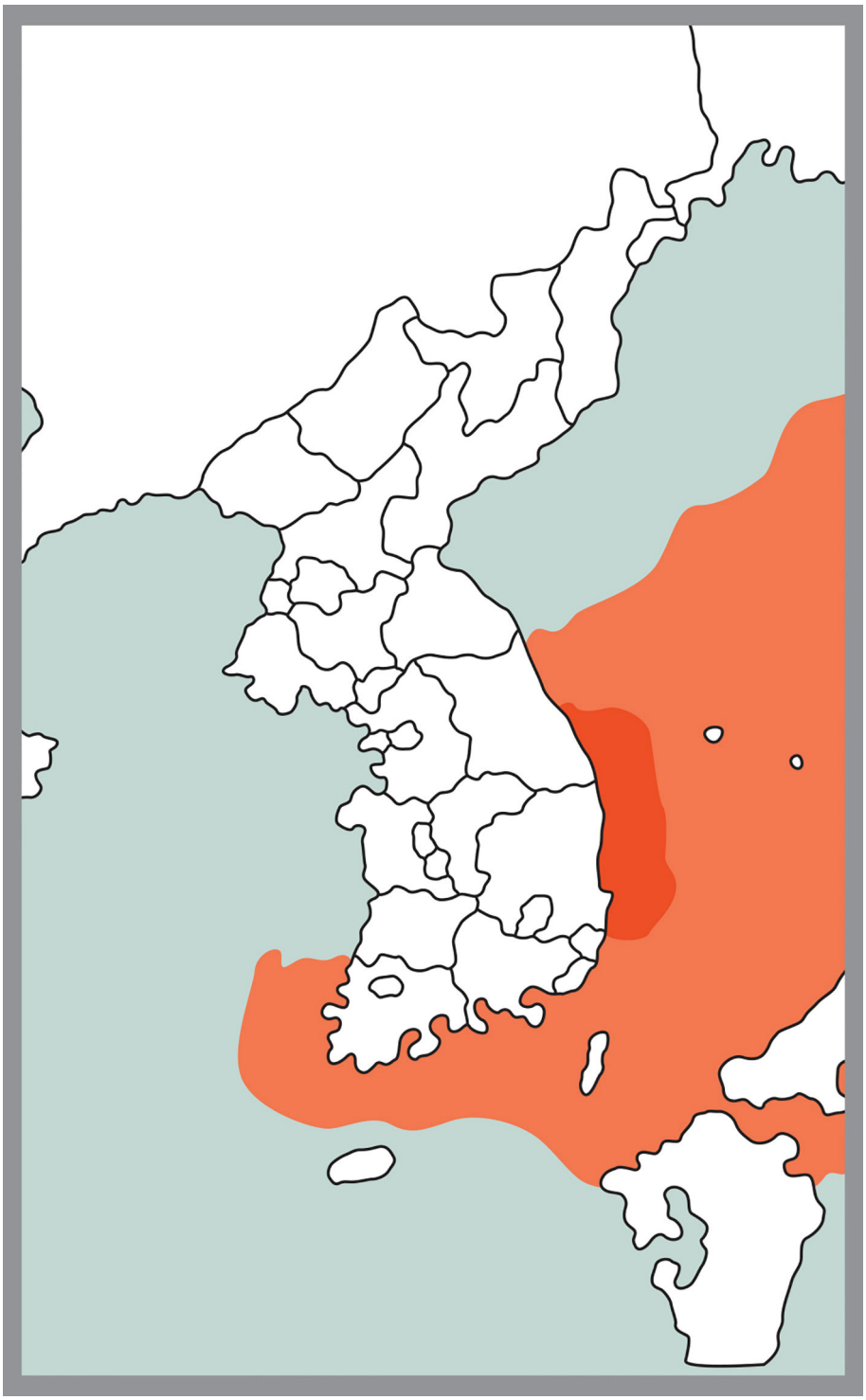

FIGURE 87. Range map of *Mesoplodon stejnegeri* in Korea.

Key to species of Genus *Mesoplodon* in Korea

1 White pattern present on throat . . . . . M. stejnegeri
- White pattern absent on throat 2

2 Forehead flattened; male tusk very large; lower jaw massive with strongly arched contour . . . . . M. densirostris
- Long forehead with small rounded melon; male has small flattened tusks that barely protrude from gum line of the middle of lower jaw (female tusk absence); jawline strongly arched . . . . . M. ginkgodens

Mesoplodon stejnegeri True, 1885—Stejneger's Beaked Whale

Mesoplodon stejnegeri True, 1884 [1885] p.584; Type locality- Commander Islands, Bering Sea, Russia; Kim *et al.*, 2000 p.80; Kim, 2004 p.235.

Range: Stranding and by-catch of Stejneger's beaked whales have mostly occurred along the east coast of southern Gangwon Province and Gyeongsangbuk Province (Fig. 87). The population in the East Sea has likely become isolated from the Pacific Ocean (Loughlin & Perez 1985). Few observations of the species have occurred during marine surveys in Korea (Cetacean Research Institute 2007).

Remarks: Although isolated populations reside in the East Sea, the taxonomic status of the population remains uncertain.

Mesoplodon densirostris (Blainville, 1817)—Blainville's Beaked Whale

Delphinus densirostris Blainville, 1817 p.178; Type locality- Unknown.
Mesoplodon densirostris: Kuroda, 1938 p.14; Kim *et al.*, 2000 p.82; Kim, 2004 p.235.

Range: The species has a cosmopolitan distribution but is rarely observed in the waters of Korea (Kim 2004; Fig. 88). In February 1998, one adult (4.7 m in length) became stranded at Incheon (west coast; Incheon Coast Guard, unpublished data).

Remarks: The species represents the Subgenus *Dioplodon* (Nowak 2003).

Mesoplodon ginkgodens Nishiwaki and Kamiya, 1958—Ginkgo-toothed Beaked Whale

Mesoplodon ginkgodens Nishiwaki and Kamiya, 1958 p.53; Type locality- Oiso Beach, Sagami Bay (near Tokyo), Japan; Kim *et al*., p.79; Kim, 2004 p.236.

Range: The overall range of the species covers temperate and tropical waters in the North Pacific and Indian Oceans. Most of the records have originated from the seas around Japan (Taylor *et al*. 2008). Despite the regular stranding of ginkgo-toothed beaked whales in Japan (Yamada 2009), no stranding or by-catch has been reported in the waters of Korea (Fig. 89).

Remarks: Despite the absence of records in Korea, the species has been listed as present since the National Fisheries Research Institute published *Whales of Korea* in 2000. Dalebout *et al*. (2012) presented genetic and morphological data supporting the resurrection of *M. hotaula* as either a separate species or a subspecies of *M. ginkgodens*. Three *Mesoplodon* stocks were identified in the Pacific Ocean. However, at this point, no subspecific classification has been proposed.

Family MONODONTIDAE Gray, 1821

Only a single species, *Delphinapterus leucas* is encountered in the waters of Korea.

Genus *Delphinapterus* Lacépède, 1804

Delphinapterus is a monospecific genus that inhabits the Arctic Oceans and cold waters and has seldom been observed in the waters of Korea.

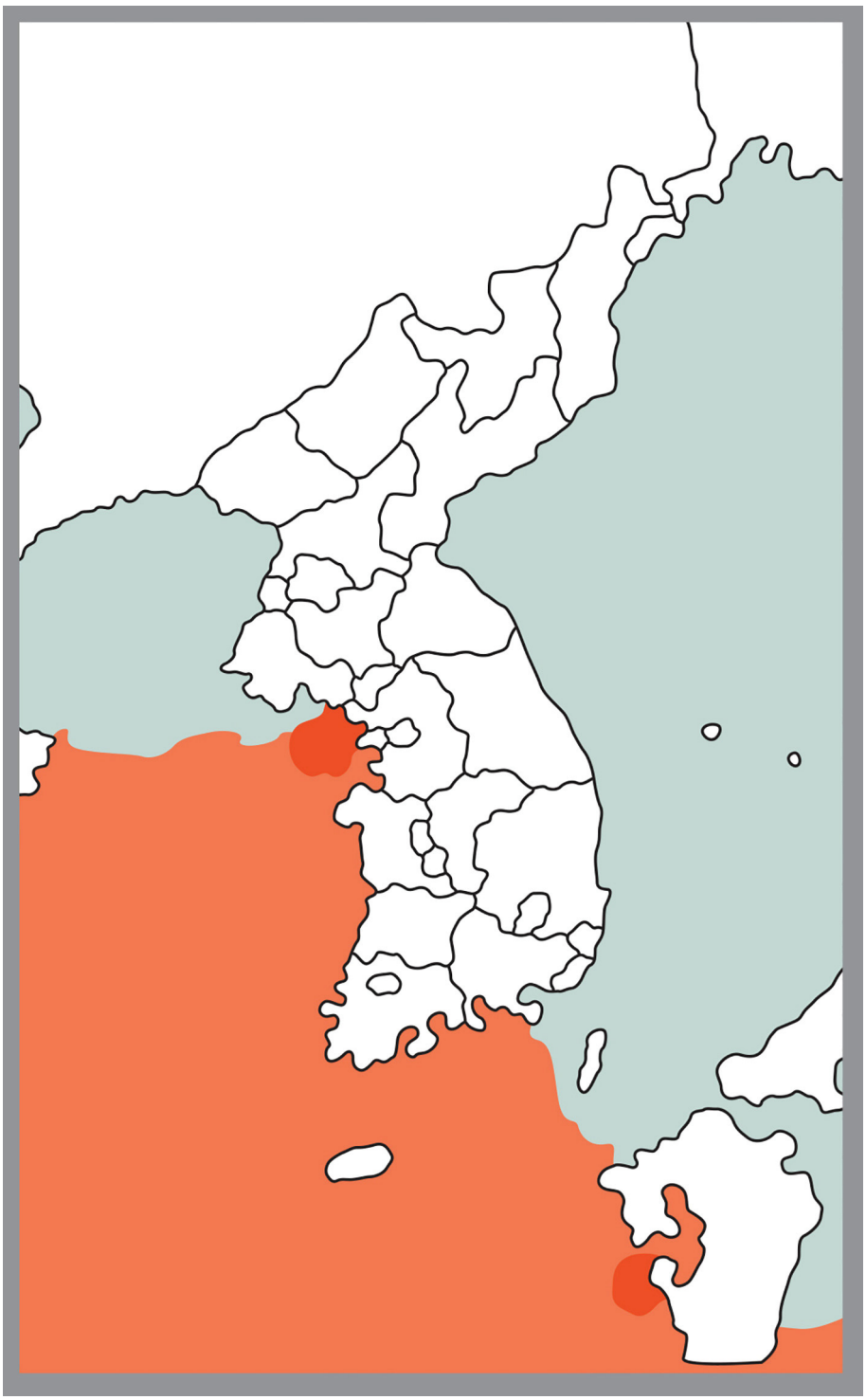

FIGURE 88. Range map of *Mesoplodon densirostris* in Korea.

Delphinapterus leucas (Pallas, 1776)—Beluga, white whale

Delphinus leucas Pallas, 1776 p.85; Type locality- Mouth of Ob River, Northeast Siberia.
Delphinapterus catodon: True, 1884 p.590.
Delphinapterus leucas: Kuroda, 1938 p.14; Kim *et al*., 2000 p.74; Kim, 2004 p.231.

Range: The beluga is common in the Sea of Okhotsk but very rare in the waters of Korea. Since it was observed migrating along the southeastern coast near Busan (southeastern tip of the Korean Peninsula) in August of 1997, the range is expected to reach the southern waters of the East Sea (Kim 2004; Fig. 90).

Remarks: The genetic structure of the mtDNA control region of the beluga whale in the Russian Far East down into the East Sea indicated a high degree of philopatry (Meschersky *et al*. 2013). Some populations became genetically isolated from those of the Sea of Okhotsk; whereas, they share a common gene pool (Meschersky *et al*. 2013). Allelic frequencies at nine microsatellite loci had a mean genetic diversity of 0.69 that increased from north to south with the highest value in the south (Meschersky *et al*. 2013). The high level of haplotypic and nucleotide diversity and the presence of a set of unique haplotypes in beluga whales suggests that their ancestors lived and bred in the southern Sea of Okhotsk or in the East Sea of Korea during a time span that includes the pre-Holocene epoch. This area probably served as the refugium from which animals dispersed northward (Meschersky *et al*. 2013). Despite geographic variation in size and DNA, *D. leucas* is considered a monotypic species.

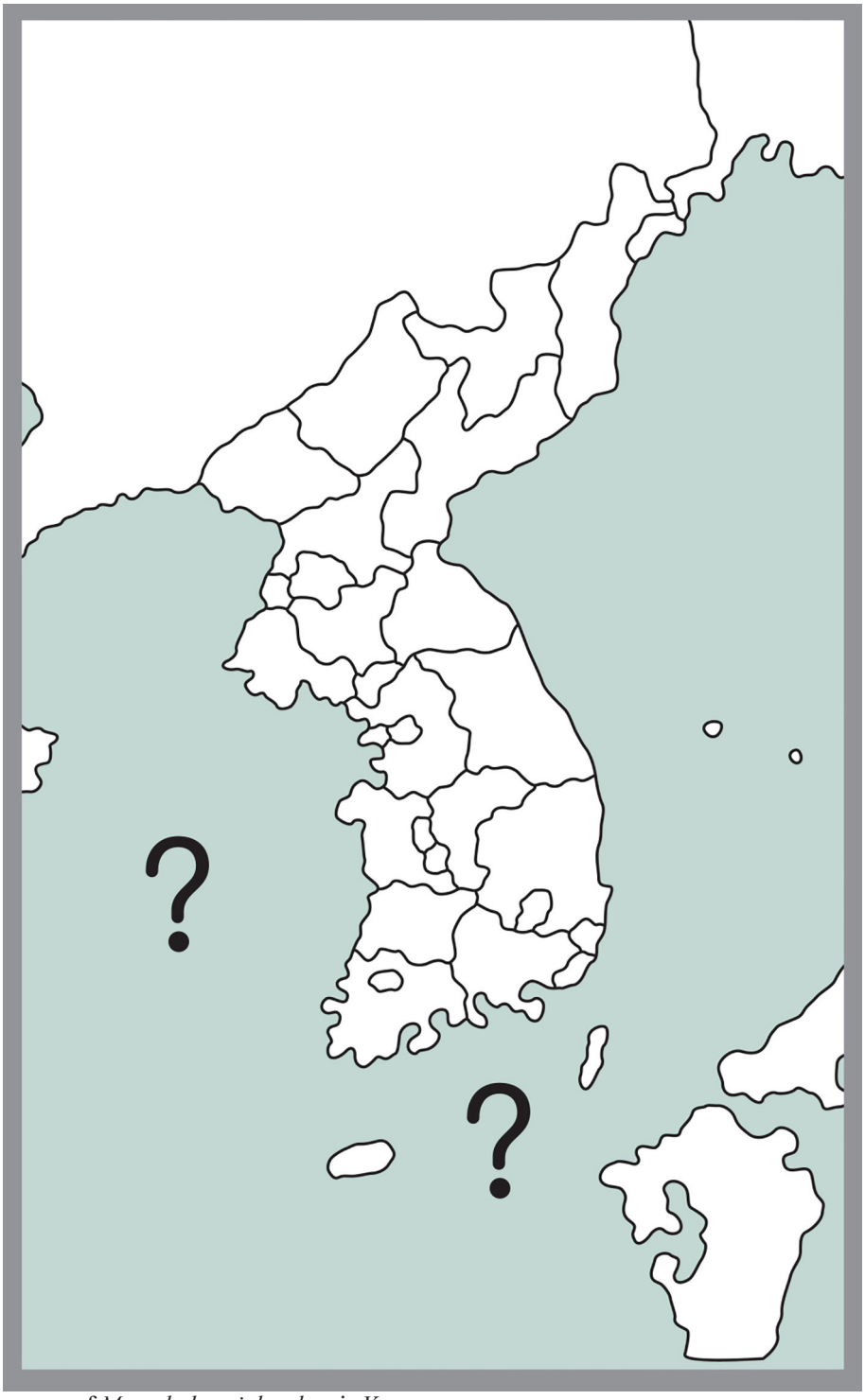

FIGURE 89. Range map of *Mesoplodon ginkgodens* in Korea.

FIGURE 90. Range map of *Delphinapterus leucas* in Korea.

Family DELPHINIDAE Gray, 1821

A total of 17 species distributed in 13 genera represent the Family Delphinidae in the waters of Korea.

Key to the genera of Delphinidae in Korea

1	Dorsal fin absent	*Lissodelphis*
-	Dorsal fin present	2
2	Blunt head, no prominent beak	3
-	Long head, beak present	8
3	Upper teeth absent; 3–7 lower teeth on each side of jaws (maybe absent or extensively worn); forehead with deep vertical crease	*Grampus*
-	Upper and lower teeth present	4
4	Flipper broad, paddle-shaped, rounded tip; dorsal fin pointed, tall, erected; female 0.9 m in length, male 1.8 m in length; striking black and white coloration	*Orcinus*
-	Dorsal fin pointed, <0.8 m	5
5	Dorsal fin with broad base, located on anterior 1/3 body; dorsal fin low and falcate; bulbous head; long sickle-shaped flippers	*Globicephala*
-	Dorsal fin located on central body	6
6	Elbow-shaped flipper; prominent hump; lips black	*Pseudorca*
-	Flipper slightly rounded; no hump; lips white	7
7	Teeth <15 each side (8–10 upper jaw, 10–13 lower jaw)	*Feresa*
-	Teeth >15 each side (20–26 upper jaw, 22–25 lower jaw)	*Peponocephala*
8	Beak smoothly joins forehead	*Steno*
-	Beak with sharp crease where joins forehead	9
9	Dark lateral striped from face to anus	*Lagenodelphis*
-	Lateral striped absent or not continued from face to anus	10
10	Discrete, short beak <3% body length; large pale gray bifurcated patches from forehead to tail	*Lagenorhynchus*
-	Distinct beak >3% body length	11
11	Teeth >39 each tooth row	12
-	Teeth 18–29 on each tooth row; sharp crease where beak joins forehead	*Tursiops*
12	Hourglass pattern present on each side	*Delphinus*
-	Hourglass pattern on each side absent	*Stenella*

Genus *Lissodelphis* Gloger, 1841

Two species, *L. borealis* in North Pacific Ocean and *L. peronei* in the Southern Hemisphere have been usually described in this genus (Shirihai & Jarrett 2006). Mead and Brownell (2005), however, suggested the possibility of a monotypic genus.

Lissodelphis borealis (Peale, 1848)—Northern Right-whale Dolphin

Delphinapterus borealis Peale, 1848 p.35; Type locality- Oregon, US (46° 6’ 50” N, 135° 5’ W).
Tursio borealis: Kuroda, 1938 p.16.
Lissodelphis borealis: Kim *et al*., 2000 p.107; Kim, 2000 p.250.

Range: Stranded *L. borealis* rarely occur along the coast of Gyeongsangbuk Province, east-central Korea (Kim 2004; Fig. 91). This dolphin is considered a vagrant in Korean waters.

Remarks: Speculation about the classification of *L. borealis* as a species led to the proposal that *L. borealis* represents a subspecies of *L. peronei* (Honacki *et al*. 1982), but most modern whale biologists accept the current classification as a species. However, the current taxonomic status could change with a larger sample (Jefferson & Newcomer 1993). The current taxonomy has the northern right-whale dolphin as a monotypic species.

Genus *Grampus* Gray, 1828

Grampus is a monospecific genus.

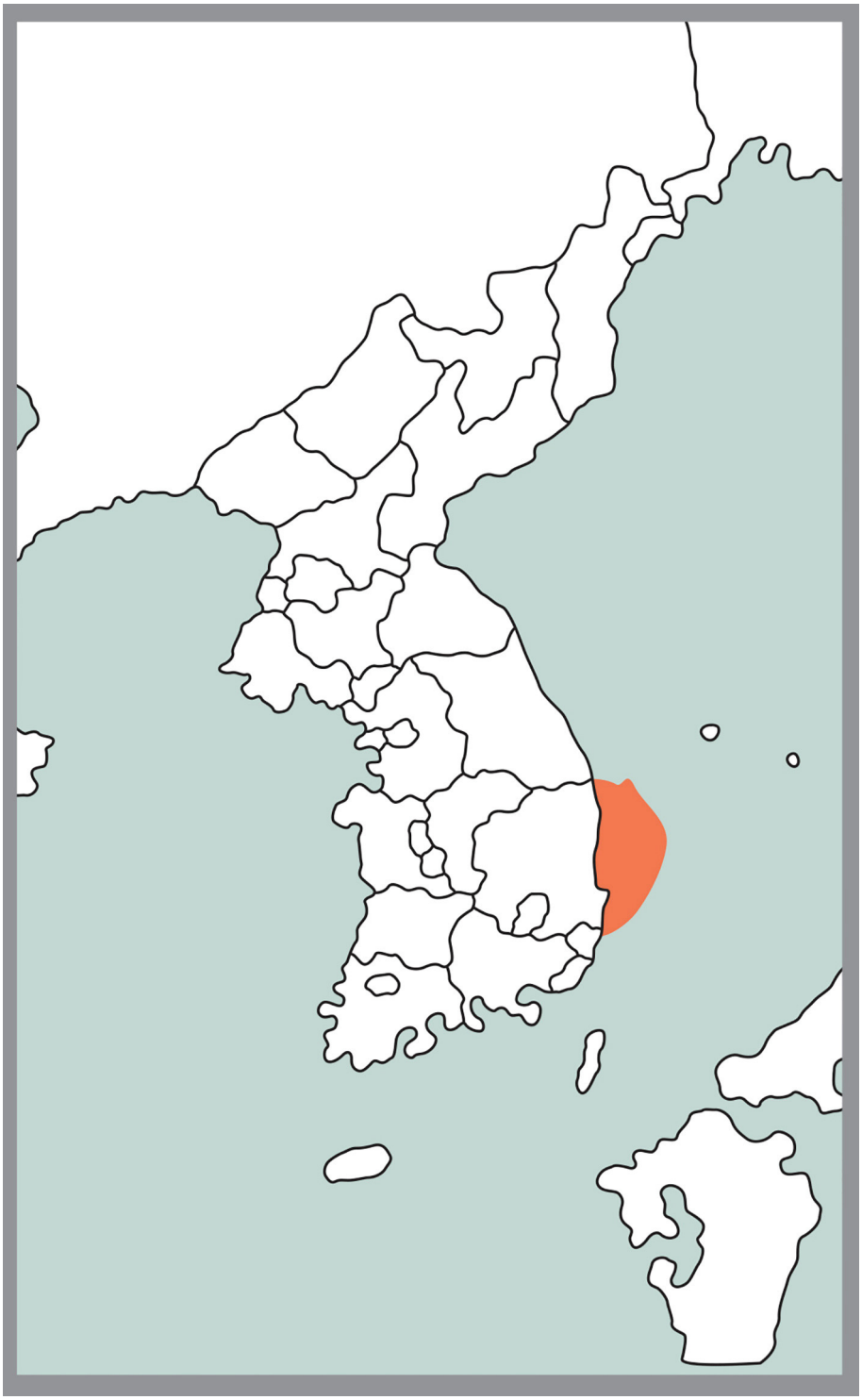

FIGURE 91. Range map of *Lissodelphis borealis* in Korea.

Grampus griseus (G. Cuvier, 1812)—Risso's Dolphin, gray grampus

Delphinus griseus G. Cuvier, 1812 p.14; Type locality- Finistère, France.
Grampus sakamata Gray, 1846 p.31; Type locality- Japan.
G. stearnsii Dall, 1873 p.13; Type locality- coast of California, US.
G. griseous: Kuroda, 1938 p.18; Kim *et al*., 2000 p.92, 2004 p.241.

Range: The distribution of the species encompasses Korea, with most observations recorded in the East Sea, where continental shelves below a depth of 200 m provide breeding sites along the central coast from Gangneung to Sokcho (Cetacean Research Institute 2007; Fig. 92).

Remarks: Risso's dolphin has a worldwide distribution, but little information exists about the genetic structure among local, coastal populations. Genetic data indicate low diversity between inshore and offshore populations with microsatellite DNA markers (F_{ST} = 0.0296) and mtDNA sequences (F_{ST} = 0.260). Gaspari *et al*. (2007) estimated low allelic diversity for nearly all loci among all populations. So far, Risso's dolphin has been considered a monotypic species.

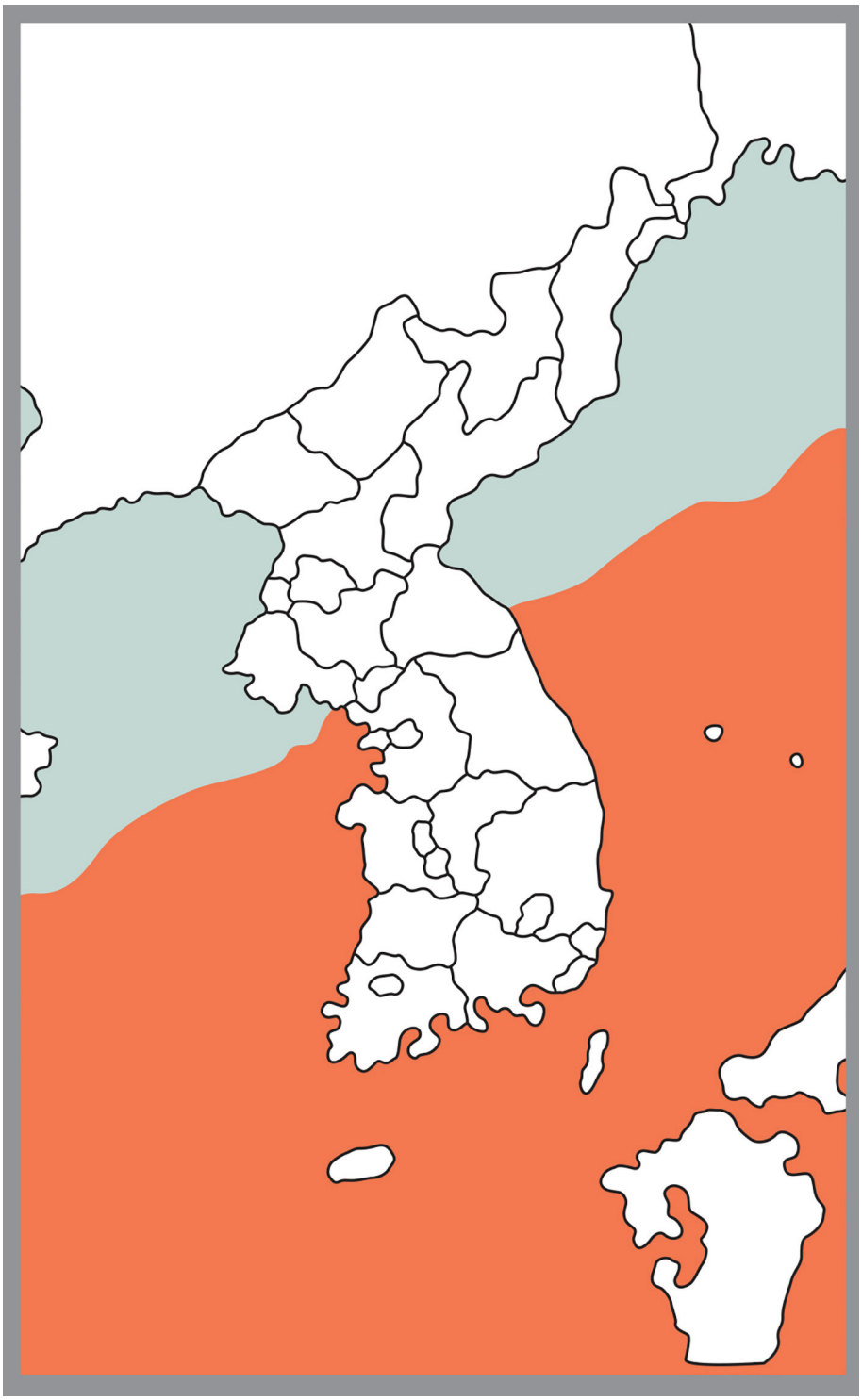

FIGURE 92. Range map of *Grampus griseus* in Korea.

Genus *Orcinus* Fitzinger, 1860

Orcinus has generally been treated as a monospecific genus (Mead & Brownell 2005). Although the differences in the morphology, genetics, ecology, and behavior of the three ecotypes are well known -resident (piscivorous specialist), transient (mammalian carnivore) and offshore (probably piscivorous)- their taxonomic status remains unresolved (Reeves *et al.* 2004). While Hoelzel *et al*. (1998) supported a concept of a single species based on both nDNA and mtDNA, LeDuc *et al*. (2008) suggested multiple species at least for populations in the Antarctic as substantial based on morphology and the mitochondrial control region. Morin *et al.* (2010) suggested promoting the three ecotypes to three species based on complete mitochondrial genome analysis.

Orcinus orca (Linnaeus, 1758)—Killer Whale, orca

Delphinus orca Linnaeus, 1758 p.77; Type locality- eastern North Atlantic (European Seas).
Orca ater Cope, 1869 p.22; Type locality- North Pacific (Oregon to Aleutian Islands).
Orca pacifica Gray, 1870 p.76; Type locality- North Pacific.
Orcinus orca: Kuroda, 1938 p.18; Won, 1958 p.435; Won, 1967 p.85; Won, 1968 p.227; Kim *et al*., 2000 p.84; Kim, 2004 p.237.

Range: Incidental catches of *O. orca* occurred in the East Sea and around Jeju Island (Cetacean Research Institute 2007; Fig. 93).

Remarks: The killer whale, an abundant, highly social species with reduced genetic variation, has no consistent geographical pattern of global diversity and no mtDNA variation within regional populations (Hoelzel *et al*. 2002). Because of range-wide low genetic diversity, the killer whale remains a monotypic species, even though two subspecies (resident killer whale and transient killer whale or Bigg's killer whale) or three ecotypes have been proposed (Reeves & Read 2003; Morin *et al.* 2010). Compared to Antarctic and eastern North Pacific populations, which have three well-described ecotypes (Stevens *et al.* 1989; Pitman & Ensor 2003), populations of *O. orca* in the western North Pacific have been poorly studied. Both specialized piscivorous resident and mammal eating transient ecotypes inhabit the western North Pacific Ocean (Burdin *et al.* 2007; Pilot *et al*. 2010; Morin *et al*. 2010); the ecotype inhabiting seas around Korea remains uncertain.

Genus *Globicephala* Lesson, 1828

Two species, *G. macrorhynchus* with a worldwide distribution and *G. melas* with a limited distribution in the North Atlantic Ocean and southern oceans, compose this genus. Only *G. macrorhynchus* inhabits the waters of Korea.

Globicephala macrorhynchus Gray, 1846—Short-finned Pilot Whale

Globicephalus macrorhynchus Gray, 1846 p.33; Type locality- South Seas.
Globicephalus sieboldii Gray, 1846 p.32; Type locality- Japan.
Globicephalus scammonii Cope, 1869 p.21; Type locality- Coast of lower California and Mexico.
Globicephala sieboldii: Kuroda, 1938 p.19.
Globicephala scammonii: Kuroda, 1938 p.19.
Globicephala macrorhynchus: Kim *et al*., 2000 p.90; Kim, 2004 p.240.

Range: Short-finned pilot whales seldom visit Korean waters (Fig. 94). One group of 12 *G. macrorhynchus* was observed around Dok-Island, East Sea in 2004 (Cetacean Research Institute 2007). Three short-finned pilot whales appeared but one of them (probably a calf) stranded on Jeju Island, and the calf was rescued in August 2008 (Yang 2010). The same three moved to the Yellow Sea and died on a beach and mud flat at Chungcheongnam Province in September 2008 (Yang 2010).

Remarks: Two geographic forms of short-finned pilot whales with different external and cranial morphology reside off northern and southern Japan (Rice 1998). Their exact taxonomic status remains uncertain, despite

differences in size, morphology, DNA and breeding cycles (Shirihai & Jarrett 2006). So far, the short-finned pilot whale is considered a monotypic species (Mead & Brownell 2005).

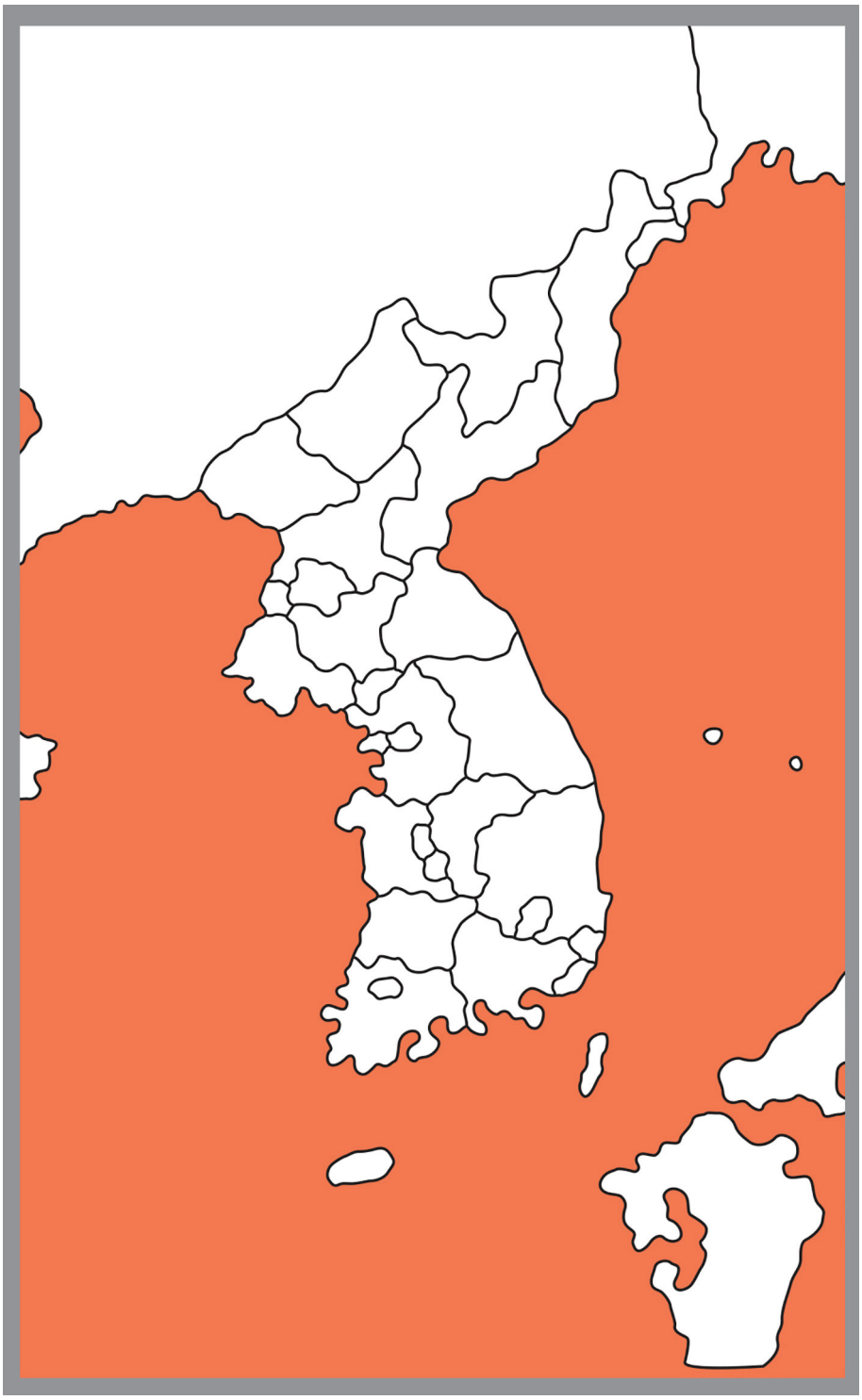

FIGURE 93. Range map of *Orcinus orca* in Korea.

Genus *Pseudorca* Reinhardt, 1862

This genus is monospecific and has a worldwide distribution.

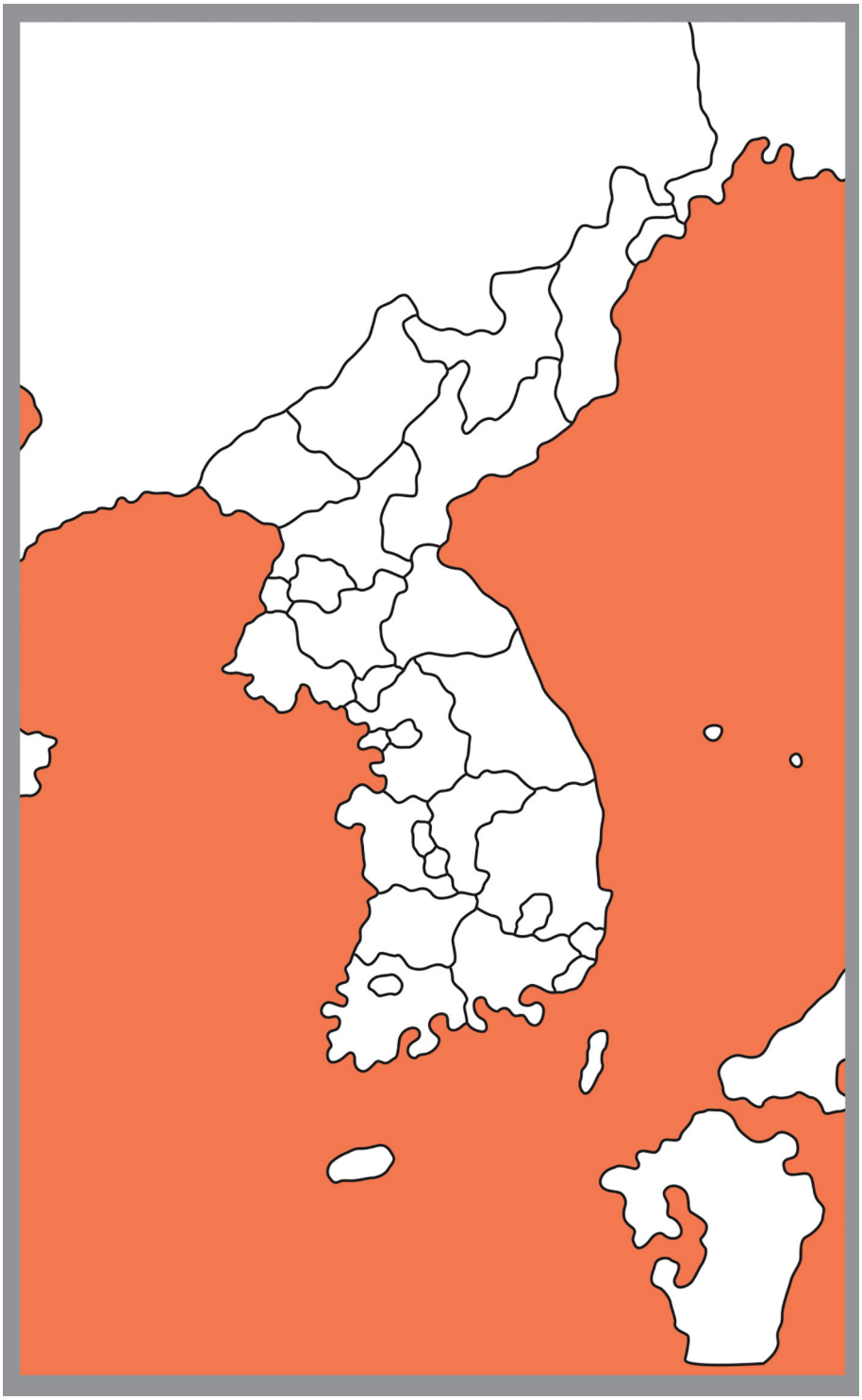

FIGURE 94. Range map of *Globicephala macrorhynchus* in Korea.

Pseudorca crassidens (Owen, 1846)—False Killer Whale

Phocaena crassidens Owen, 1846 p.516; Type locality- England, UK.
Pseudorca crassidens: Kuroda, 1938 p.18; Kim *et al*., 2000 p.86; Kim, 2004 p.238.

Range: Observation of the false killer whale occur during early summer to late autumn in the East Sea, especially near the coast of Gyeongsangbuk Province (Kim 2004; Fig. 95).

Remarks: The false killer whale, long considered a monotypic species, is now recognized by several stocks (Carretta *et al*. 2010). The Central North Pacific and Eastern North Pacific stocks are significantly differentiated from each other based on mtDNA analysis (Chivers *et al*. 2007, 2010).

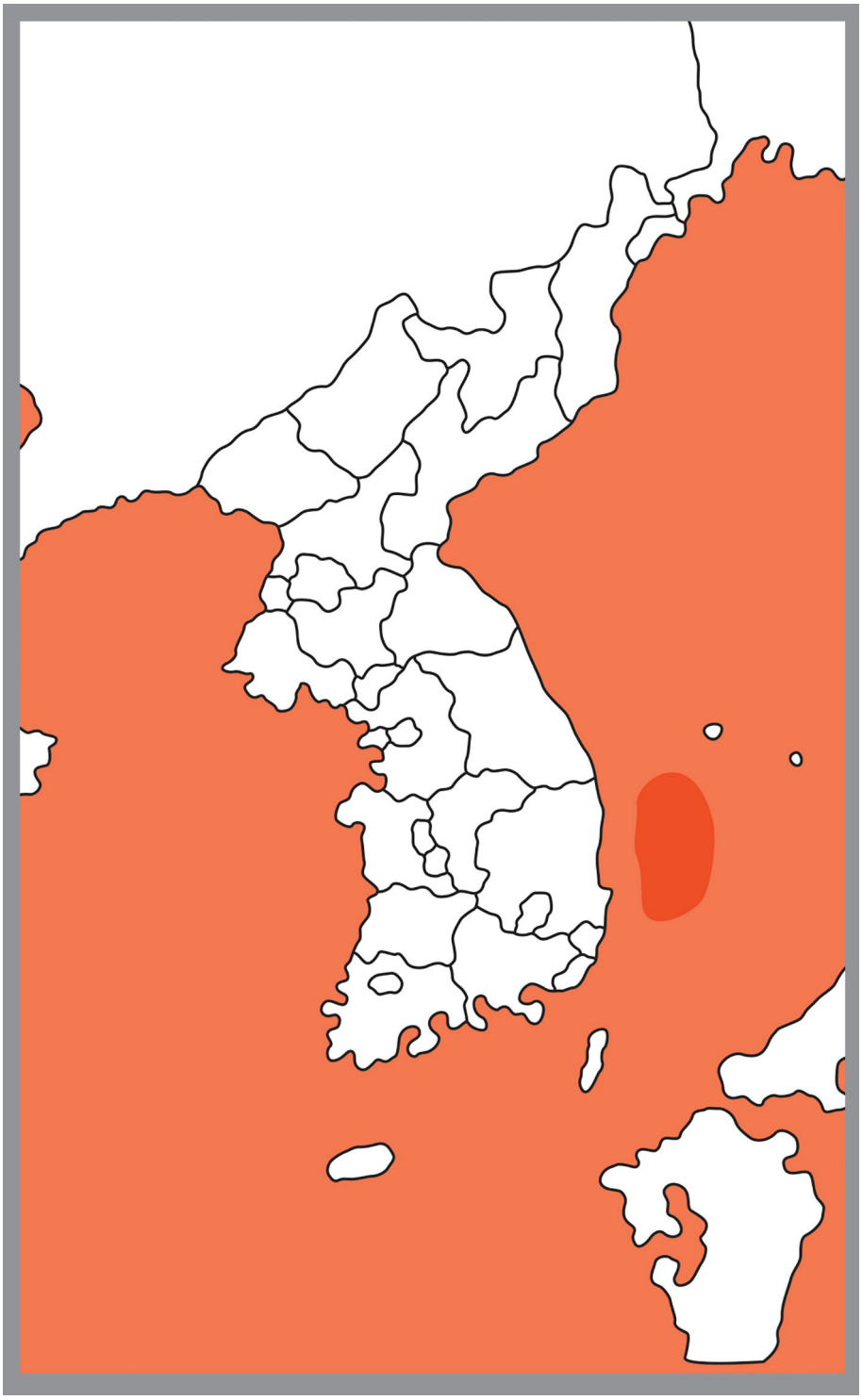

FIGURE 95. Range map of *Pseudorca crassidens* in Korea.

Genus *Feresa* Gray, 1870

Despite a worldwide distribution *Feresa* is a monospecific genus that rarely occurs in the waters of Korea.

Feresa attenuata Gray, 1874—Pygmy Killer Whale

Feresa attenuata Gray, 1874 p.238; Type locality- South Seas; Kim *et al.*, 2000 p.88; Kim, 2004 p.239.

Range: Since *F. attenuata* rarely enters the waters of Korea, vagrant might better fit the distribution status of this species (Fig. 96).

Remarks: The pygmy killer whale is a monotypic species with low genetic diversity across its range (Burbidge *et al*. 2012).

FIGURE 96. Range map of *Feresa attenuata* in Korea.

Genus *Peponocephala* Nishiwaki and Norris, 1966

Monotypic genus formerly included in the Genus *Lagenorhynchus*.

***Peponocephala electra* (Gray, 1846)—Melon-headed Whale, electra dolphin**

Lagenorhynchus electra Gray, 1846 p.35; Type locality is unknown.
Peponocephala electra: Kim *et al*., 2000 p.89; Kim, 2004 p.240.

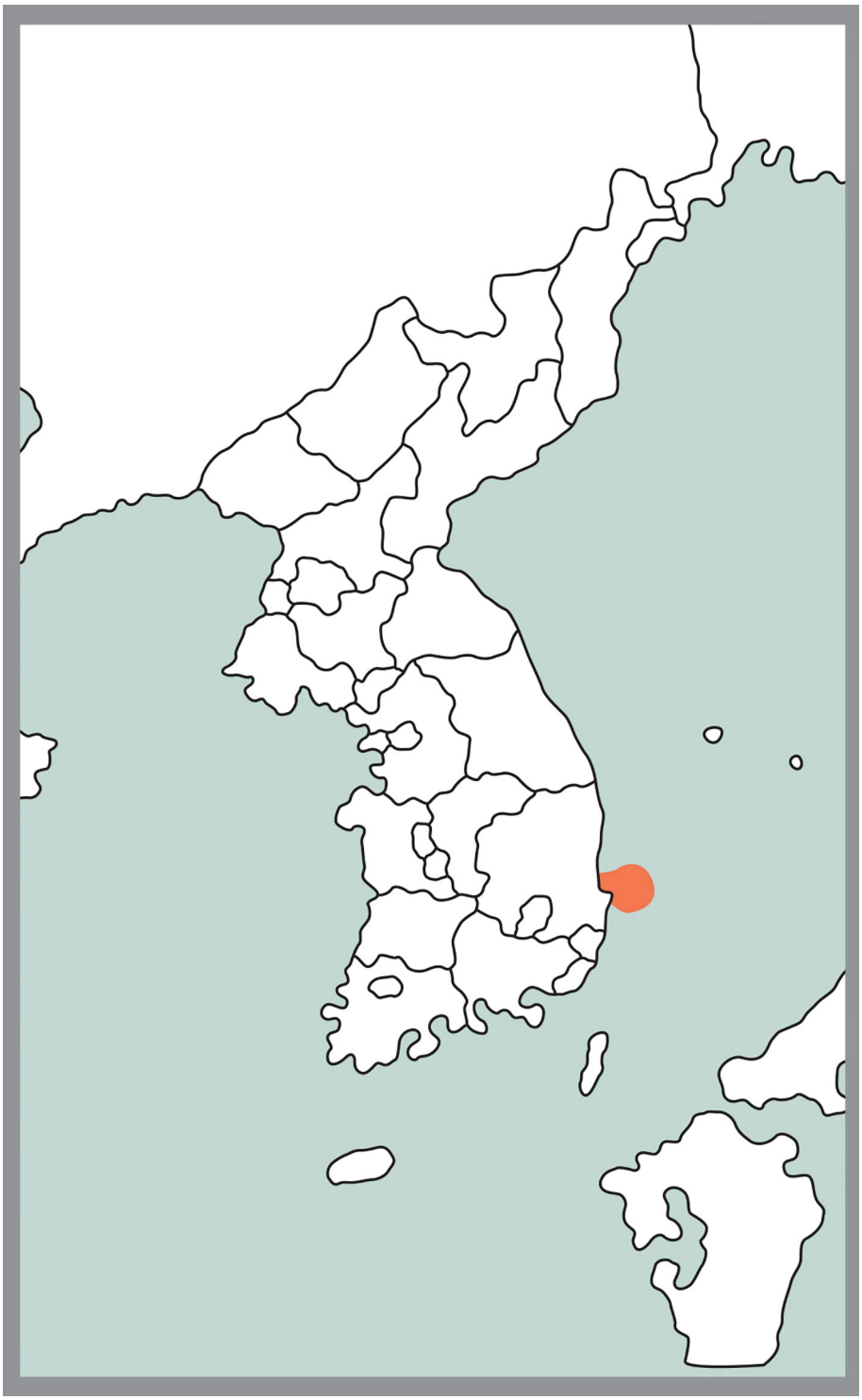

FIGURE 97. Range map of *Peponocephala electra* in Korea.

Range: A stranded *P. electra* on the beach at Pohang, Gyeongsangbuk Province (East Coast) in 2009 represented the first and only record of *P. electra* in Korea (Kim *et al*. 2010; Fig. 97).

Remarks: Originally described as *Lagenorhynchus electra*, the melon-headed whale was recently placed in the monospecific Genus *Peponocephala*. This taxon has no current taxonomic confusion or recognized subspecies (Jefferson & Barros 1997).

Genus *Steno* Gray, 1846

The Genus *Steno* is monospecific.

Steno bredanensis (G. Cuvier *in* Lesson, 1828)—Rough-toothed Dolphin

Delphinus bredanensis G. Cuvier *in* Lesson, 1828 p.206; Type locality- Coast of France.
D. rostratus Desmarest, 1817 p.160 (not valid by Miller, 1924 see p.508).
Steno rostratus Gray, 1846 p.43; Type locality- North Sea; Miller, 1924 p.508; Kuroda, 1938 p.17.
S. bredanensis: Kim *et al.*, 2000 p.106; Kim, 2004 p.249.

Range: The range of *S. bredanensis* reaches the South Sea of Korea (Fig. 98). A few vagrant individuals have stranded on Jeju Island and Busan (Kim 2004).

Remarks: Kuroda (1938) named this species in Korea as *S. rostratus*, but the latter was synonymized into *S. bredanensis* (Watkins *et al.* 1987). A controversy arose over whether *Steno* should be grouped with *Orcaella* or *Sotalia* (Caballero *et al*. 2008, McGowen *et al*. 2009, Steeman *et al*. 2009). Recent DNA investigations failed to confirm all of the revisions suggested by LeDuc *et al*. (1999) and did not produce consistent estimates of phylogenetic relationships within the family (LeDuc *et al*. 1999; Caballero *et al*. 2008). Traditionally, based on morphological similarity, the Genus *Steno* was placed in the Subfamily Stenoninae with the Genera *Sousa,* and *Sotalia* (Perrin 1989, Vilstrup *et al*. 2011). *Steno bredanensis* is currently considered a monotypic taxon.

Genus *Lagenodelphis* Fraser, 1956

The Genus *Lagenodelphis* is monospecific.

Lagenodelphis hosei Fraser, 1956—Fraser's Dolphin

Lagenodelphis hosei Fraser, 1956 p. 496; Type locality- Mouth of Lutong River, Borneo.

Range: Although *L. hosei* has a worldwide distribution in tropical pelagic waters, the first record in Korea was 2006 (Kim *et al*. 2013). One stranded Fraser's dolphin (adult female) was found on the beach in Jeju Island (Kim *et al*. 2013; Fig. 99).

Remarks: Despite its worldwide distribution, *L. hosei* is very rare around Korean waters. Even in Japan, only four records of Fraser's dolphin were confirmed (Amano 2009c).

Genus *Lagenorhynchus* Gray, 1846

Of the six species recognized in the genus, only *L. obliquidens* inhabits the North Pacific Ocean. Based on cytochrome *b* gene analysis, LeDuc *et al.* (1999) regarded *Lagenorhynchus* as polyphyletic and suggested splitting the genus into three genera, *Lagenorhynchus* Gray, 1846; *Leucoplearus* Gray, 1866; and *Sagmatias* Cope, 1866. LeDuc *et al.* (1999) recommended placing *L. obscurus, L. obliquidens, L. cruciger*, and *L. australis* in the Genus *Sagmatias.* However, Mead and Brownell (2005) proposed relegating two of the genera as a subgenera of

Lagenorhynchus. However, *Sagmatias* appeared polyphyletic by analysis of nuclear genes (McGowen *et al*. 2009). *Lagenorhynchus obscurus* and *L. obliquidens* were separated from the *L. cruciger—L. australis* group, which were more closely related to *Cephalorhynchus*. Although some taxonomists recognized *Sagmatias* as a distinct genus (Murakami *et al*. 2014), the IUCN Red List still uses the Mead and Brownell (2005) taxonomy for *Lagenorhynchus* (Hammond *et al*. 2012). Since marine biologists have not reached an agreement on this genus, we have followed the taxonomy of Mead and Brownell (2005).

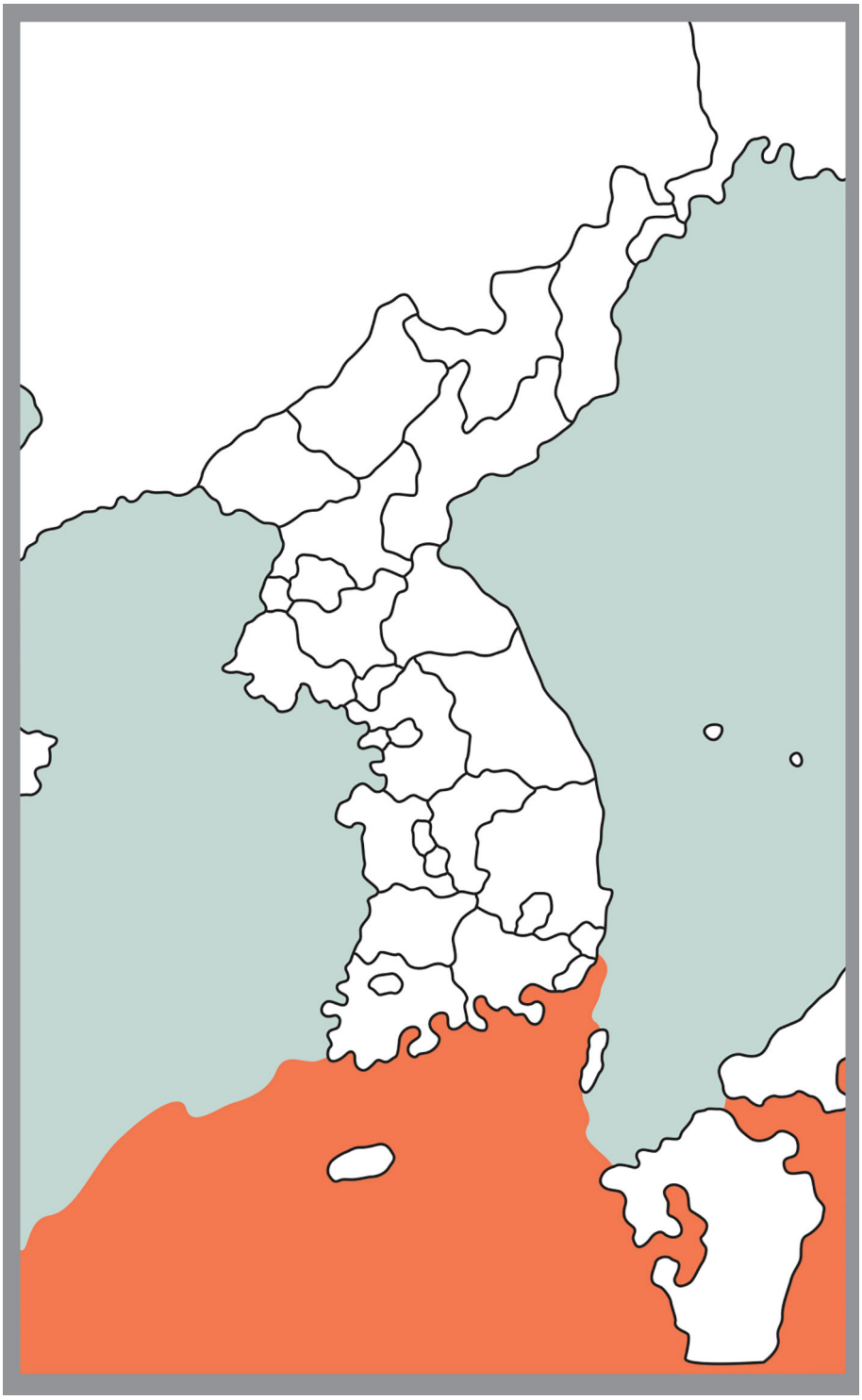

FIGURE 98. Range map of *Steno bredanensis* in Korea.

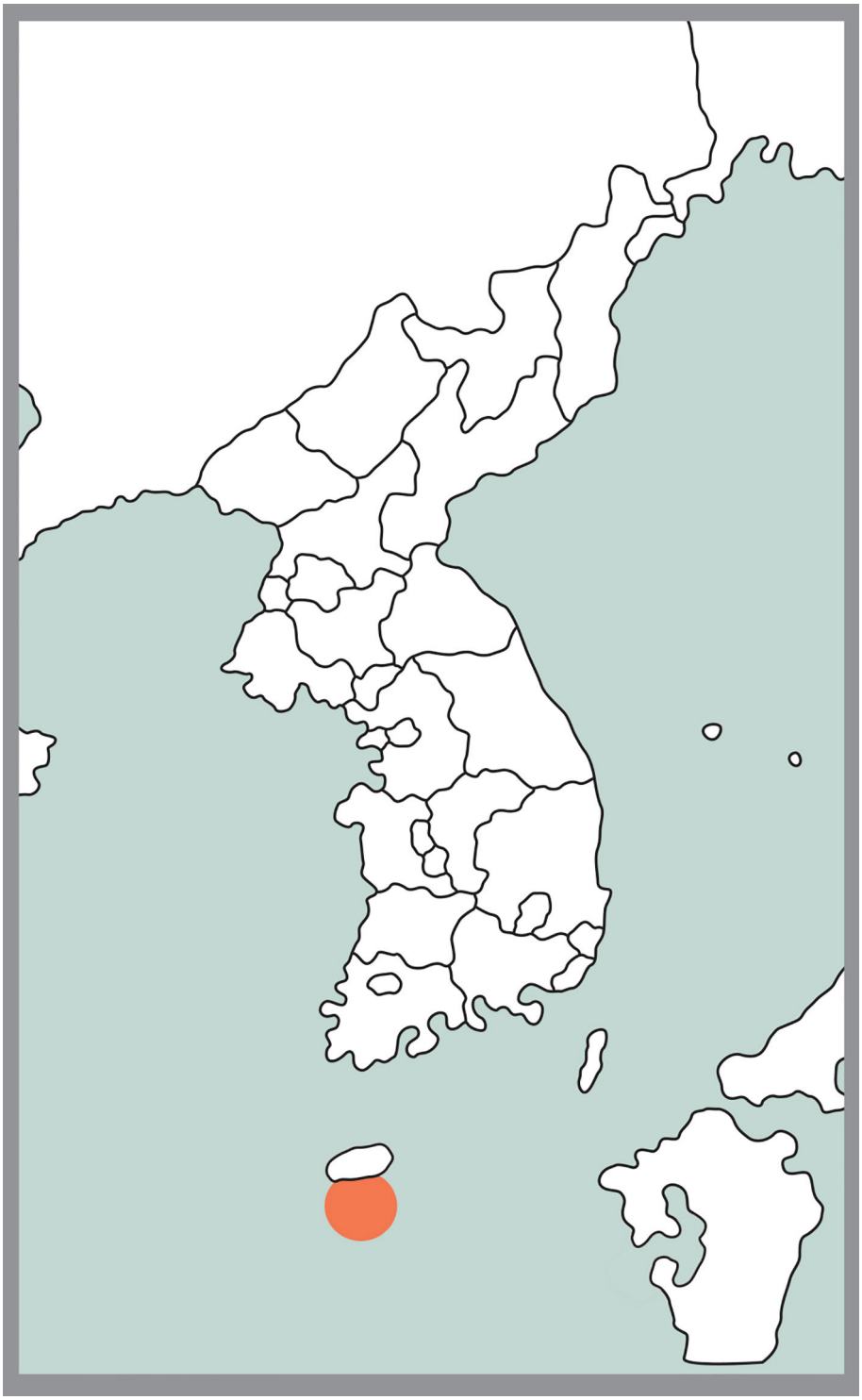

FIGURE 99. Range map of *Lagenodelphis hosei* in Korea.

Lagenorhynchus obliquidens Gill, 1865—Pacific White-sided Dolphin

Lagenorhynchus obliquidens Gill, 1865 p.177; Type locality- San Francisco, US; Kuroda, 1938 p.17; Won, 1968 p.222; Kim *et al*., 2000 p.98; Kim, 2004 p.244.

Range: Most observations of Pacific white-sided dolphins occur during early summer to late autumn over the continental shelf in the East Sea of Korea, especially the central to northern regions (Sohn et al. 2012; Fig. 100).

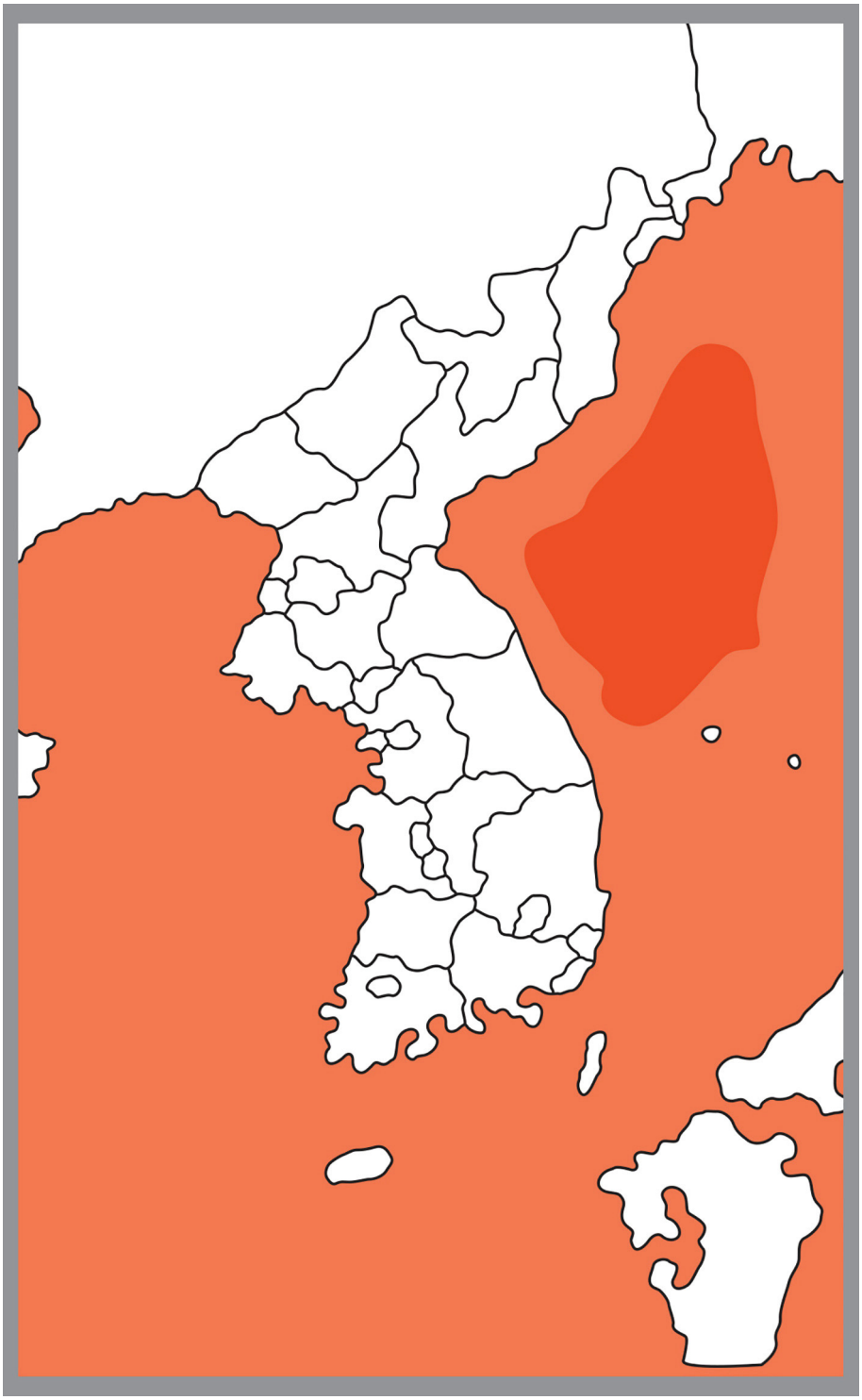

FIGURE 100. Range map of *Lagenorhynchus obliquidens* in Korea.

Remarks: Consistent genetic differences of mtDNA and microsatellite persisted between individuals from the East Sea and offshore North Pacific Ocean. Microsatellite alleles indicated that the Pacific white-sided dolphins in these two areas belong to different populations with severely restricted gene flow. The low genetic diversity and mtDNA genealogy of the populations in the East Sea implied an origin from a small population that colonized the East Sea or experienced population reduction when this sea became isolated from the North Pacific Ocean during a glacial period in the Late Pleistocene (Hayano *et al*. 2004). The Pacific white-sided dolphin appears morphologically similar to the dusky dolphin (*Lagenorhynchus obscurus*) in the southern Pacific Ocean. Genetic analysis indicated that the two species diverged about 2 Mya. Both have been traditionally placed in the Genus

Lagenorhynchus, but molecular studies showed *L. obliquidens* was closer to the Genus *Cephalorhynchus* than *L. obscurus*. Shirihai and Jarrett (2006) proposed the new Genus *Sagmatia*s for these species. However, the Pacific white-sided dolphin remains classified as a monotype species.

Genus *Tursiops* Gervais, 1855

The Genus *Tursiops* was previously viewed as monospecific (Mead & Brownell 2005). The current taxonomy by Mead and Brownell (2005) includes two species, *T. aduncus* in Indian and western North Pacific Ocean and *T. truncatus* with a worldwide distribution. Both species occur in the waters of Korea.

Key to species of Genus *Tursiops* in Korea

- Total number of vertebrae 59–62; 21–29 pairs of teeth on upper & lower jaw . . . . . *T. aduncus*
- Total number of vertebrae 64–67; 19–27 pairs of teeth on upper and lower jaw . . . . . *T. truncatus*

Tursiops aduncus (Ehrenberg, 1833)—Indo-Pacific Bottlenose Dolphin

Delphinus aduncus Ehrenberg, 1833 decasII, folio K, ftn. 1; Type locality- Dahlak Archipelago, Ethiopia (currently, Eritrea).
T. truncatus: Kim *et al*., 2000 p.100; Kim, 2004 p.245.
T. aduncus: Kim, 2011 p.5.

Range: *Tursiops aduncus* only occurs in the waters of Jeju Island (Kim 2004; Fig. 101).

Remarks: Analyses of external morphology and skeletal characters of co-occurring '*aduncus*' and '*truncatus*' forms in Chinese waters confirmed that *T. aduncu*s represents a distinct species from *T. truncatus* (Wang *et al*. 2000a, b). Two independent mitochondrial DNA studies (control region and cytochrome *b* gene) supported this result (LeDuc *et al*. 1999; Wang *et al*. 1999). These genetic data suggest a closer relationship of *T. aduncus* to *Stenella frontalis*, *S. clymene*, *S. coeruleoalba* and *Delphinus* spp. than to *T. truncatus* (LeDuc *et al*. 1999), indicating the necessity of a taxonomic revision within the Subfamily Delphininae. Habitat specialization occurred independently in different ocean basins, perhaps with *T. aduncus* filling the ecological niche of the inshore ecotype in some coastal regions of the Indian and western Pacific Ocean (Tezanos-Pinto *et al*. 2009).

Although the morphological difference in the population of *Tursiops* near Jeju Island has been recognized (Kim *et al*. 2000; Kim 2004), Kim (2010, 2011) raised this population to a distinct species *T. aduncus* from *T. truncatus*. Previously marine mammalogists considered that the distribution of *T. aduncus* was reached in Korean waters. In 2010, Kim (2010) found that the population of Jeju Island was morphologically different from *T. truncatus*. Therefore, before 2010, *T. truncatus* in the water near Jeju Island was referred to as *T. aduncus*.

Conservation status: The Indo-Pacific bottlenose dolphin was designated a Protected Marine Species in 2012 by the South Korean government.

Tursiops truncatus (Montagu, 1821)—Common Bottlenose Dolphin

Delphinus truncatus Montagu, 1821 p.75; Type locality- England, UK.
Tursiops gillii Dall, 1873 p.13; Type locality- Monterey, California, US.
Tursiops nuuanu Andrews, 191b1 p.233; Type locality- Pacific (12°N, 120°W)
T. truncates: Kuroda, 1938 p.17; Kim *et al*., 2000 p.100; Kim, 2004 p.245.

Range: *Tursiops truncatus* inhabits waters near the Korean Peninsula and has no overlap with the range of *T. aduncus* in the waters off Jeju Island (Kim 2004; Fig. 102).

Remarks: The Genus *Tursiops* has a controversial taxonomy. Several previously described species of bottlenose dolphins had wide distributions and variations in morphological characteristics. *Tursiops truncates,* a widespread species, was comprised of both near shore and offshore forms (Hoelzel 1998; Rice 1998). It belongs to

a complex of several species with substantial genetic differences, even among neighboring populations, such as offshore and coastal forms in the North Atlantic Ocean (Hammond *et al.* 2012).

Genus *Delphinus* Linnaeus, 1758

Delphinus was regarded as a monospecific genus with a single species, *D. delphis,* until two species were recognized based on both morphology and mtDNA analysis (Heyning & Perrin 1994; Nowak 2003); both occur in Korean waters.

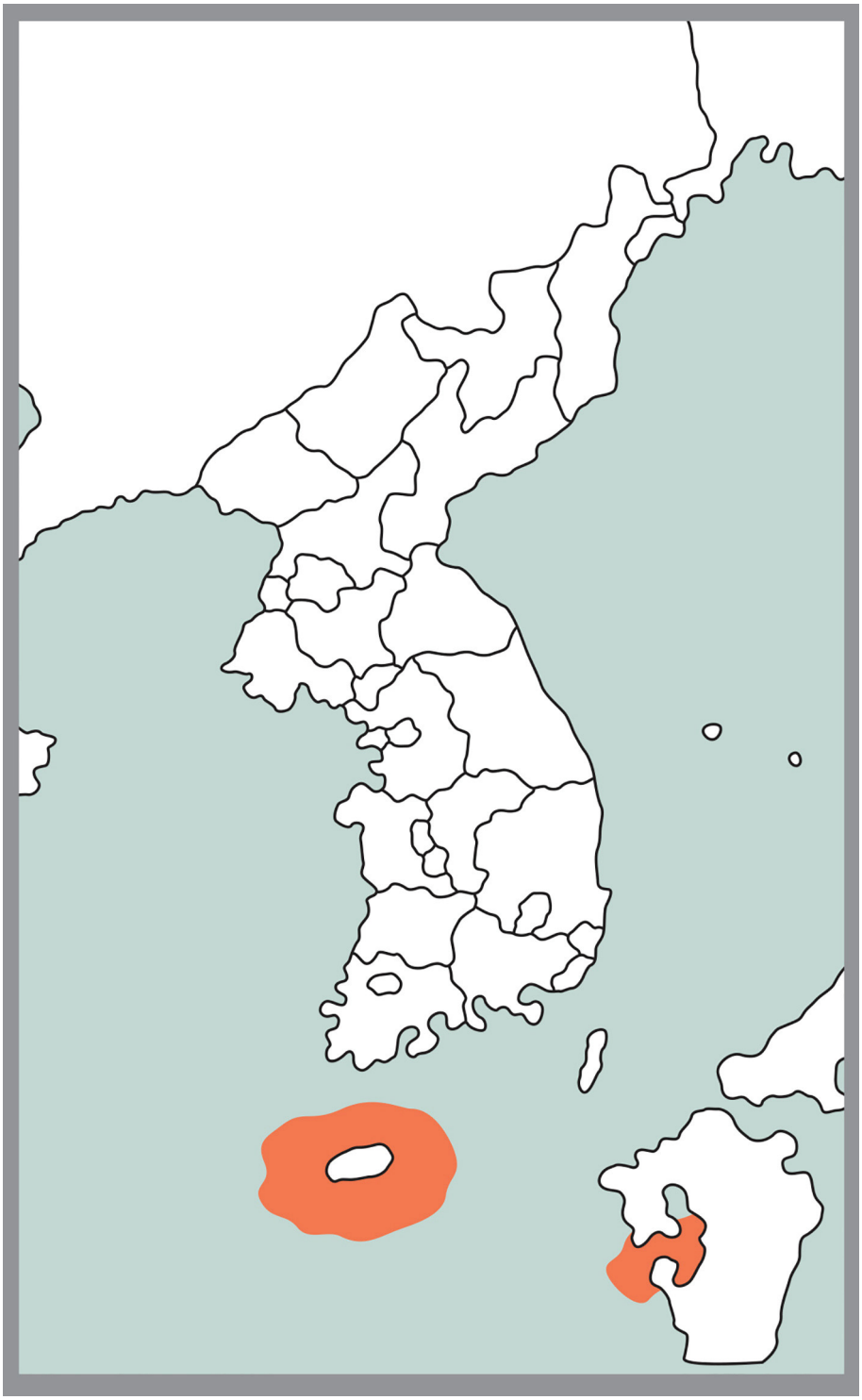

FIGURE 101. Range map of *Tursiops aduncus* in Korea.

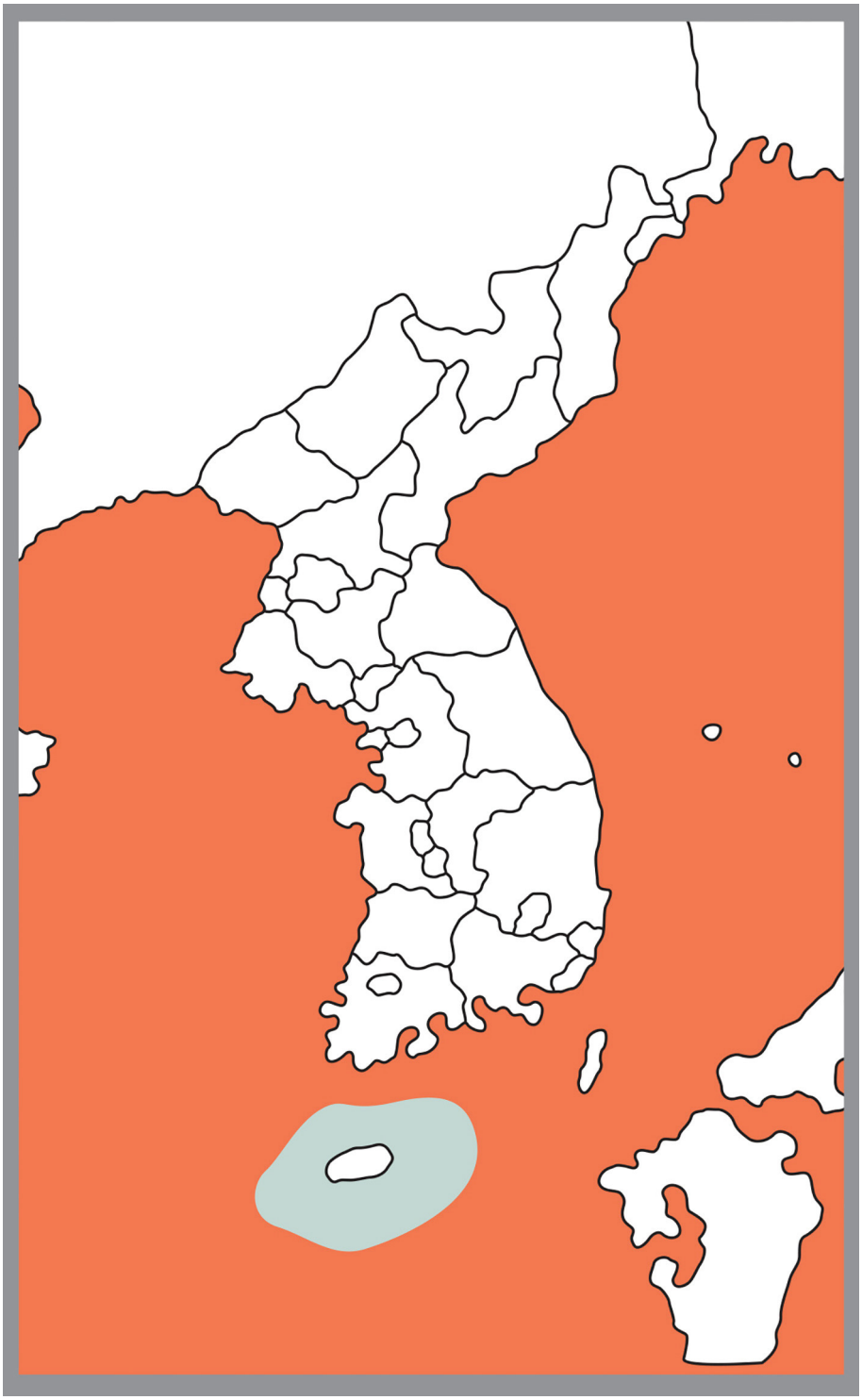

FIGURE 102. Range map of *Tursiops truncatus* in Korea.

Key to species of Genus *Delphinus* in Korea

- Stripe from eye to anus distinct; rostrum long, narrow (ratio of length of rostrum/zygomatic width >1.5). . . . . *D. capensis*
- Stripe from eye to anus faint or absent; rostrum short, wide (ratio length of rostrum/zygomatic width <1.5). . . . . *D. delphis*

Delphinus capensis Gray, 1828—Long-beaked Common Dolphin

Delphinus capensis Gray, 1828 p.2; Type locality- Cape of Good Hope, South Africa; Kuroda, 1938 p.15; Kim *et al*., 2000 p.96; Kim, 2004 p.242.
D. bairdii Dall, 1873 p.12; Type locality- Coast of California, US.

Range: *Delphinus capensis* is readily observed along the east coast of Korea during spring and autumn with the peak of occurrence in spring; this dolphin rarely occurs along the coast of Korea in winter (Fig. 103).

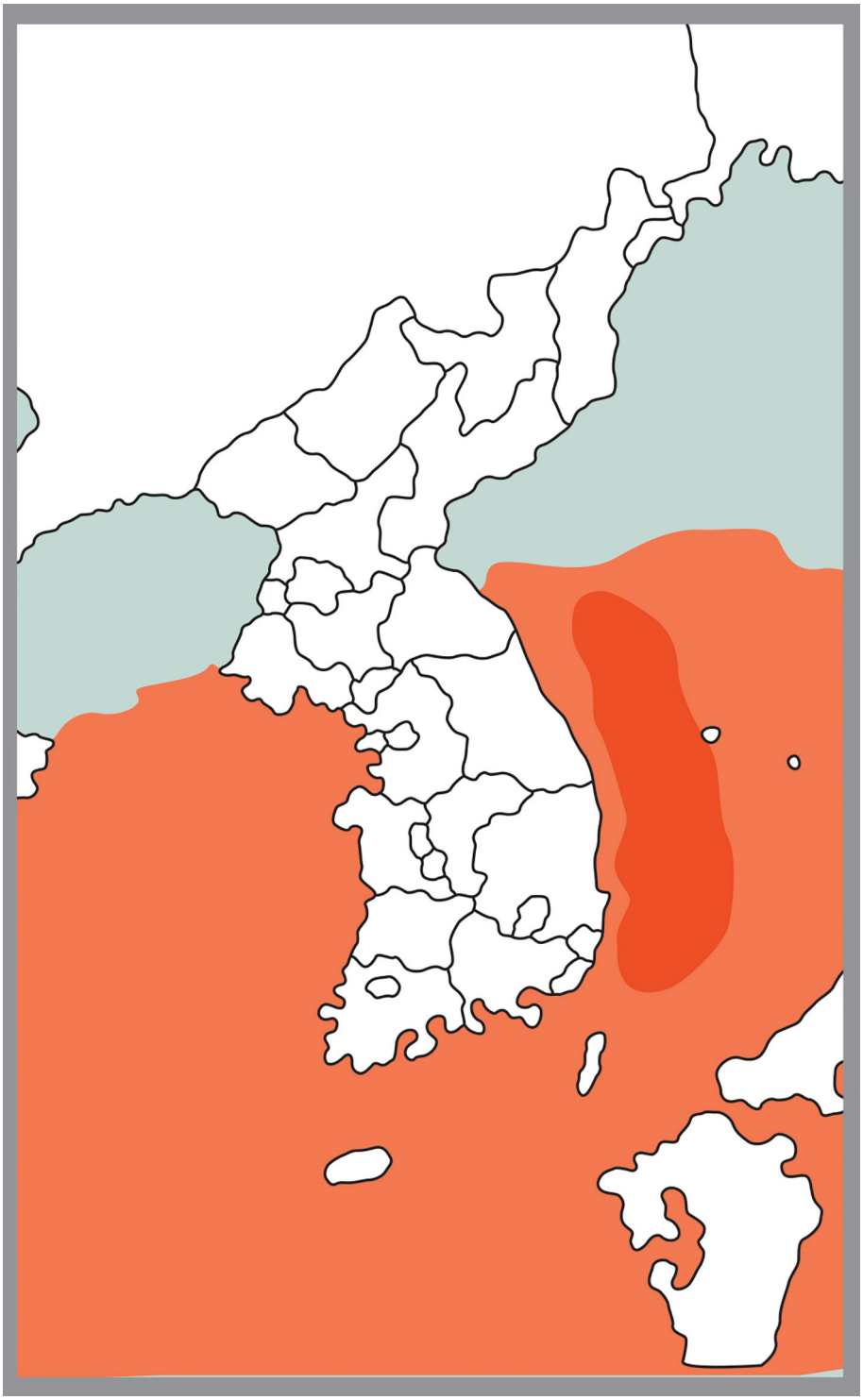

FIGURE 103. Range map of *Delphinus capensis* in Korea.

Remarks: All common dolphins were classified in a single species, *D. delphis*, until 1994. Heyning and Perrin (1994), later confirmed by Kingston and Rosel (2004), recognized two distinct species: the long-beaked common dolphin (*D. capensis*) and the short-beaked common dolphin (*D. delphis*). The taxonomic status of *D. capensis* has been further clarified in a morphometric study (Jefferson & Van Waerebeek 2002). *Delphinus capensis* may be difficult to distinguish from *D. delphis*, especially at sea. The slender body and longer beak contrast with the short-beaked common dolphin. The beak has a sharp demarcation from the somewhat flattened melon. The slightly muted coloration and a chin-to-flipper stripe, which often merges with the lip patch, thus darkening the lower jaw, is broader (Jefferson *et al*. 2008). Since *D. delphis* is very rare in Korean waters (Amano 2009a, b), previous records of *D. delphis* in Korea were mostly *D. capensis*. The Subspecies, *D. c. capensis* Gray, 1828, occupies the waters of Korea.

Delphinus delphis Linnaeus, 1758—Short-beaked Common Dolphin, saddleback dolphin

Delphinus delphis Linnaeus, 1758 p.77; Type locality- eastern North Atlantic (European Seas); Kuroda, 1938 p.15; Won, 1968 p.221; Kim *et al*., 2000 p.94; Kim, 2004 p.243.
D. pomeegrea Owen, 1866 [1869] p.23; Type locality- India.

Range: A school of 100 short-beaked whales was observed once in 2007 in the East Sea (Cetacean Research Institute 2007), but compared to *D. capensis*, the short-beaked common dolphin is rare in Korean waters (Fig. 104).

Remarks: A discontinuity exists in the distribution of the central and northern stocks of the eastern Pacific short-beaked common dolphins (Perrin *et al*., 1985) as well as documented differences in average adult size, reproductive seasonality and genetics (Chivers *et al*. 2003). Records of *D. delphis* before the 1990s mostly refer to *D. capensis* in the North Pacific Ocean (Amano 2009a, b). The Subspecies, *D. d. delphis* Linnaeus, 1758 inhabits the waters of Korea.

Genus *Stenella* Gray, 1866

Three species with a worldwide distribution inhabit the waters of Korea. Recent genetic studies identified the Genus *Stenella* as paraphyletic (LeDuc *et al*. 1999).

Key to species of Genus *Stenella* in Korea

1	Body spotted; mandibular symphysis relatively long (>17% of mandible length)	*S. attenuata*
-	Body not spotted; mandibular symphysis short (<17% of mandible length)	2
2	Stripe from eye to anus present; rostrum short and wide (length/breadth ratio <3)	*S. coeruleoalba*
-	Stripe from eye to anus absent; rostrum long and slender (length/breadth ratio >3)	*S. longirostris*

Stenella attenuata (Gray, 1846)—Pantropical Spotted Dolphin

Steno attenuates Gray, 1846 p.44; Type locality- unknown but possibly India (Gray, 1843).
Prodelphinus froenatus: Kuroda, 1938 p.16.
Stenella frontalis: Won, 1958 p.434; Won, 1967 p.84.
Stenella attenuate: Kim *et al*., 2000 p.103; Kim, 2004 p.248.

Range: The species is most common in the East China Sea at the interface of the Yellow Sea and East Sea of Korea (Kim 2004; Fig. 105).

Remarks: *Stenella attenuata* was initially included in *S. frontalis* and regarded as a distinct species. Two subspecies of Pantropical spotted dolphin were recognized by mtDNA analysis (Escorza-Trevino *et al.* 2005): *S. a. attenuata* in tropical oceanic waters worldwide, and *S. a. graffmani* in the coastal waters of the eastern tropical Pacific Ocean (Perrin 2002). *Stenella a. attenuata* (Gray, 1846) inhabits the waters of Korea.

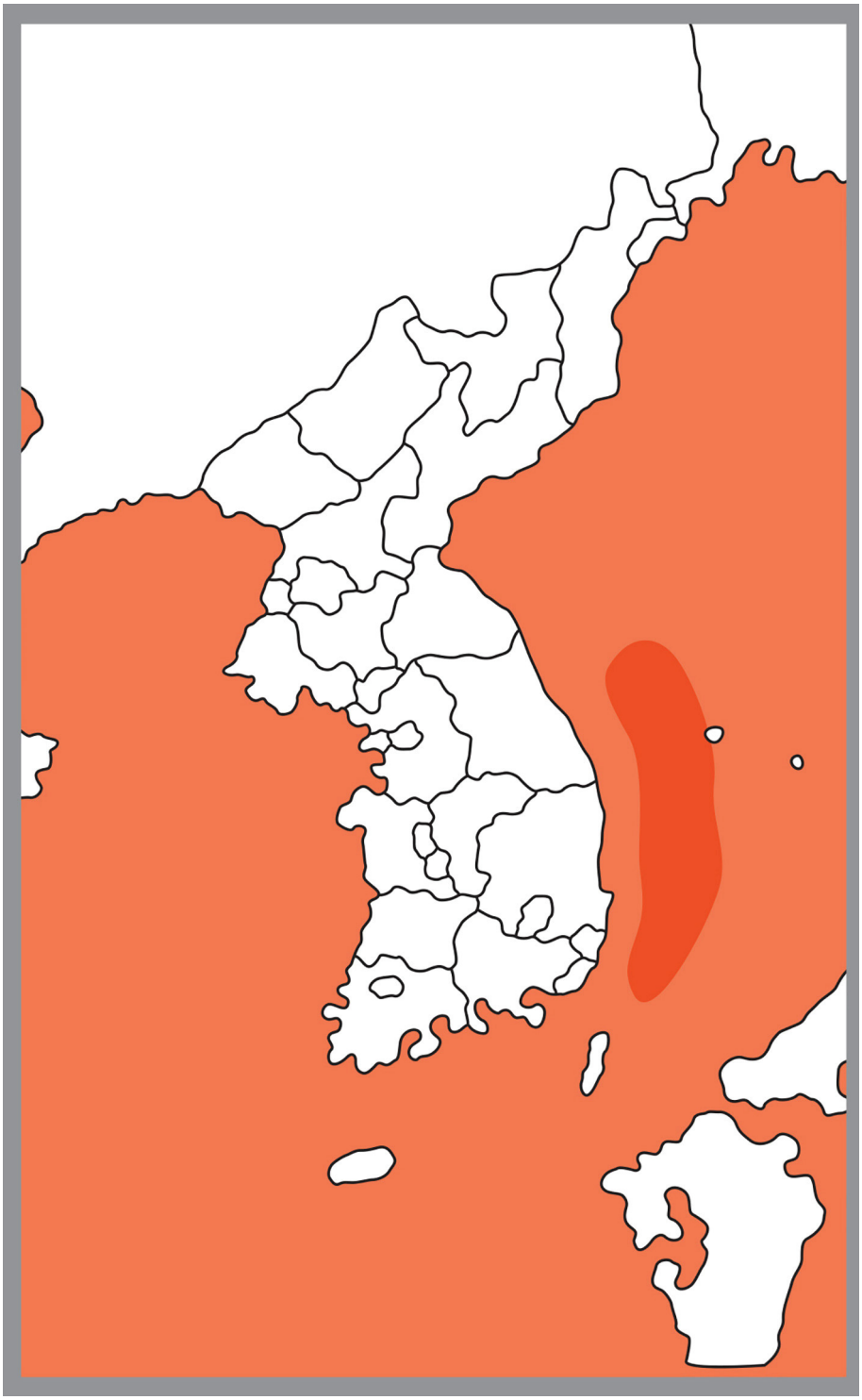

FIGURE 104. Range map of *Delphinus delphis* in Korea.

Stenella coeruleoalba (Meyen, 1833)—Striped Dolphin

Delphinus coeruleo-albus Meyen, 1833 p.43; Type locality- South Atlantic near Rio de la Plata (off coast of Argentina and Uruguay).
Prodelphinus coeruleo-albus: Kuroda, 1938 p.15.
Stenella coeruleoalba: Kim *et al*., 2000 p.102; Kim, 2004 p.247.

Range: The range of *S. coeruleoalba* follows the path of the Kuroshio Current around Korea (Kim *et al.* 2000; Fig. 106).

Remarks: Genetic studies confirmed that the Genus *Stenella* was paraphyletic (LeDuc *et al*. 1999), but so far no taxonomic decision has been made. Based on cytochrome *b*, *S. coeruleoalba* is closer to *Delphinus* and *Tursiops* than other species from the Genus *Stenella* (LeDuc *et al.* 1999).

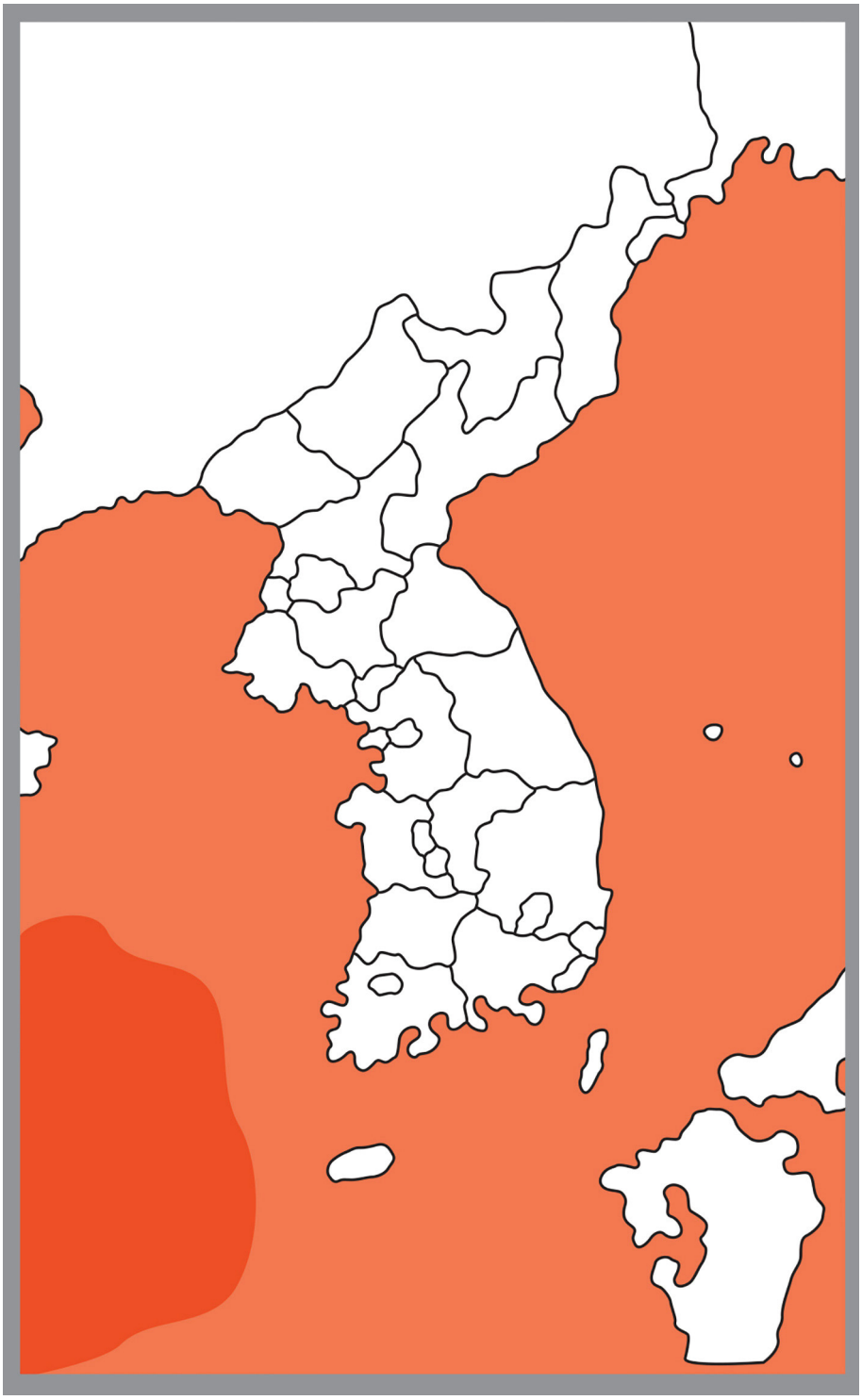

FIGURE 105. Range map of *Stenella attenuata* in Korea.

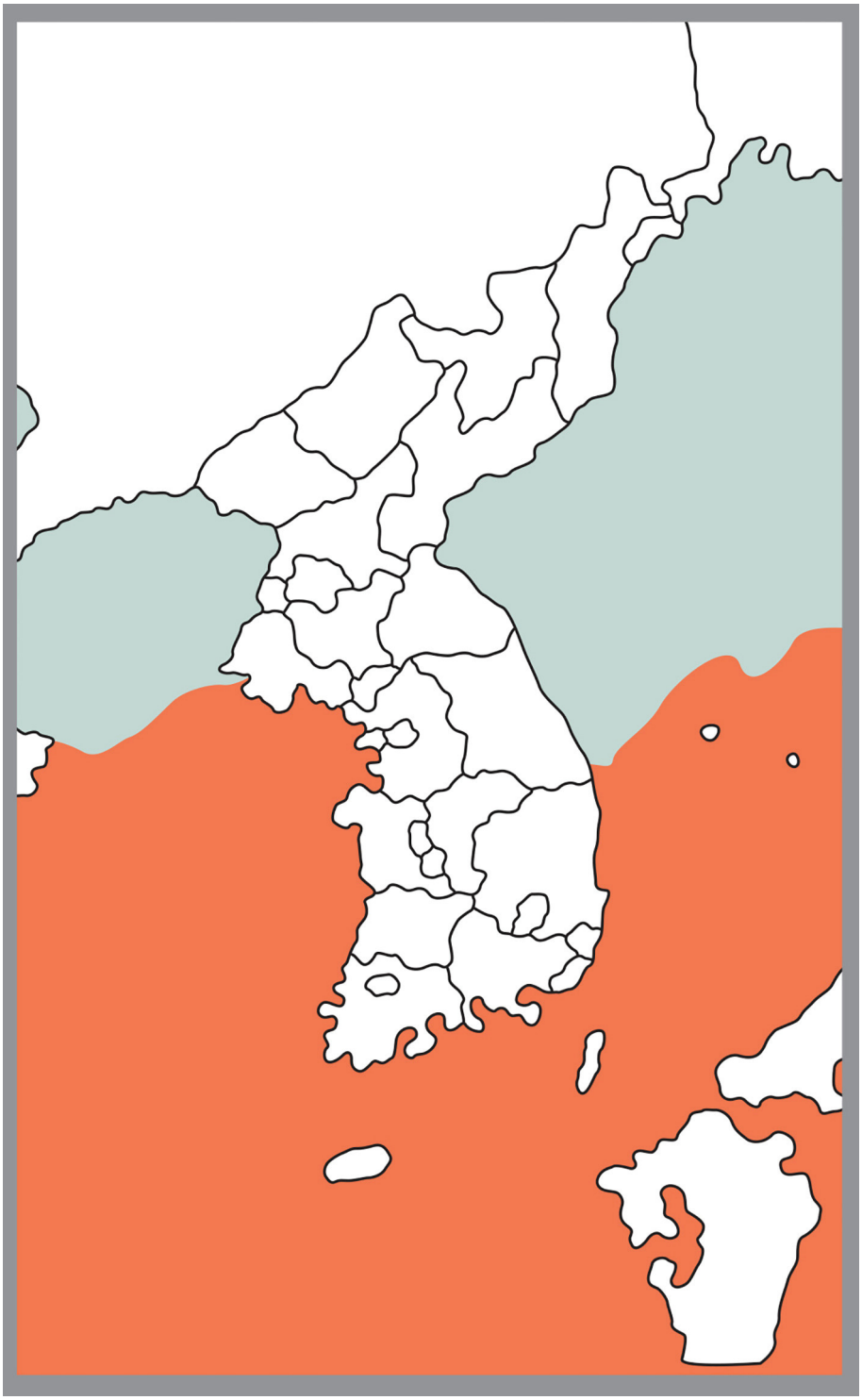

FIGURE 106. Range map of *Stenella coeruleoalba* in Korea.

Stenella longirostris (Gray, 1828)—Spinner Dolphin

Delphinus longirostris Gray, 1828 p.1; Type locality- Unknown.
Prodelphinus longirostris: Kuroda, 1938 p.16.
Stenella longirostris: Kim *et al.*, 2000 p.104; Kim, 2004 p.248.

Range: The northern limit reaches the South Sea of Korea. The species is seldom observed around the coast of Korea (Kim 2004; Fig. 107).

Remarks: Based on morphological differences (body size and skull), four subspecies of spinner dolphins are currently recognized: *S. l. longirostris* (Gray's spinner), *S. l. orientalis* (eastern spinner), *S. l. centroamericana* (Central American spinner) and *S. l. roseiventris* (dwarf spinner) (Perrin 2002). Only *S. l. longirostris* (Gray, 1828) occurs in the waters of Korea.

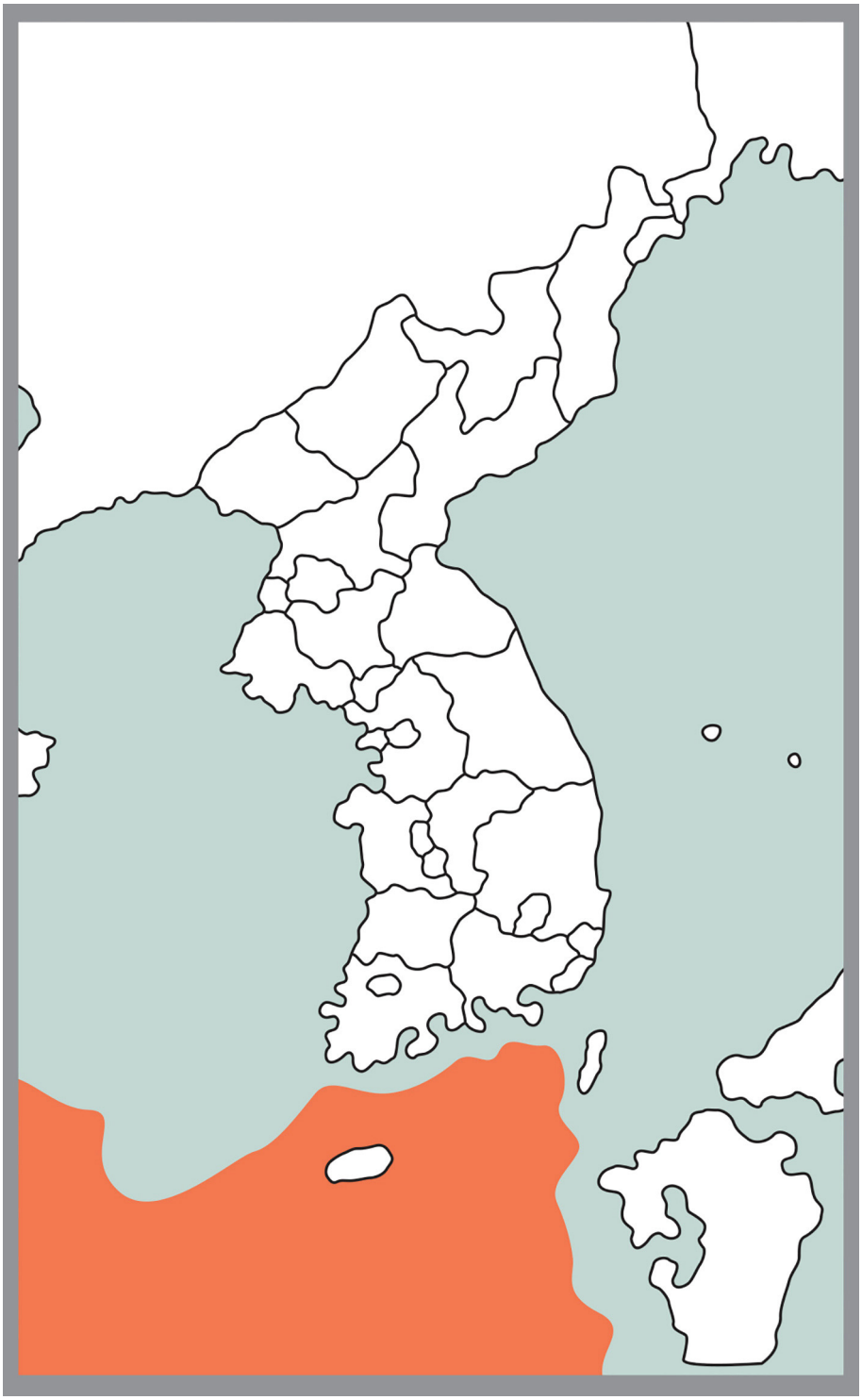

FIGURE 107. Range map of *Stenella longirostris* in Korea.

Family PHOCOENIDAE Gray, 1825

Due to their morphological similarity with Delphinidae, the Phocoenidae were formerly included as a subfamily in the Delphinidae (Mead & Brownell 2005). Based on differences in both morphology and mtDNA, Phocoenidae tends to be regarded as a distinct family (Nowak 2003; Mead & Brownell 2005). Three genera representing three species occur in the waters of Korea. Only *Neophocaena asiaeorientalis* is a common resident.

Key to genera of Phocoenidae in Korea

1 Dorsal fin absent; 15–22 teeth on each tooth row; maximum size about 2,3 m . . . . . *Neophocaena*
- Dorsal fin present 2
2 Dorsally dark gray and ventrally white . . . . . *Phocoena*
- Black body with white flank-ventral patch between anus and mid-belly . . . . . *Phocoenoides*

Genus *Neophocaena* Palmer, 1899

Two sympatric species are recognized, *N. asiaeorientalis* and *N. phocaenoides* (Wang *et al.* 2008).

Neophocaena asiaeorientalis (Pilleri and Gihr, 1972)—Narrow-ridged Finless Porpoise

Neomeris asiaeorientalis Pilleri and Gihr, 1972 p.126; Type locality- Yangtze River, China.
Delphinus melas Schlegel, 1841 p.32; Type locality- off coast of Japan.
Neomeris kurrachiensis Murray, 1884 p.351; Type locality- Kurrachee (Karachi), Pakistan.
Neophocaena phocaenoides: Kuroda, 1938 p.19; Kim *et al*., 2000 p.112; Kim, 2004 p.253.
Neomeris phocaenoides: Won, 1958 p.435; Won, 1967 p.86; Won, 1968 p.226.

Range: Narrow-ridged finless porpoises inhabit coastal waters between 5 and 15 km from the coast of the Korean Peninsula and nearby islands (Fig. 108). This species rarely occurs West of 124? 30' E (Choi *et al.* 2010). The peak observation period lasts from March to June in the waters of Korea. Although rarely observed, *N. asiaeorientalis* can inhabit freshwater streams such as the Amnok, Han and Nakdong rivers (Kim 2004).

Remarks: *N. asiaeorientalis* was formerly classified as a subspecies of *N. phocaenoides* but was elevated to the species level based on morphological and genetic differences (Wang *et al*. 2008). Korean populations belong to the Subspecies *N. a. sunameri* Pilleri and Gihr, 1975, the East Asian finless porpoise or sunameri.

Conservation status: CITES listed the species on Appendix I (under *N. phocaenoides*). The South Korean government designated *N. asiaeorientalis* a Protected Marine Species in 2016 due to a severe decline in recent years.

Genus *Phocoena* G. Cuvier, 1816

Four species are recognized within the genus, with two species in the Southern Hemisphere and two species in the Northern Hemisphere. Only *P. phocoena* occurs in the waters of Korea.

Phocoena phocoena (Linnaeus, 1758)—Harbor Porpoise, common porpoise

Delphinus phocoena Linnaeus, 1758 p.77; Type locality- Baltic Sea.
Phocoena vomerina Gill, 1865 p.178; Type locality- North Pacific.
P. phocoena: Kuroda, 1938 p.19 Kim *et al.*, 2000 p.110; Kim, 2004 p.252.

Range: In Korea, *P. phocoena* occurs in the cold waters of the East Sea (Kim 2004; Fig. 109).

Remarks: A western Pacific stock has been identified as distinct from the eastern Pacific stock based on differences in the skull / jaw morphology and mtDNA (Shirihai & Jarrett 2006). Following these authors, the subspecies in the waters of Korea is the Eastern Pacific harbor porpoise, *P. p. vomerina* (Gill, 1865).

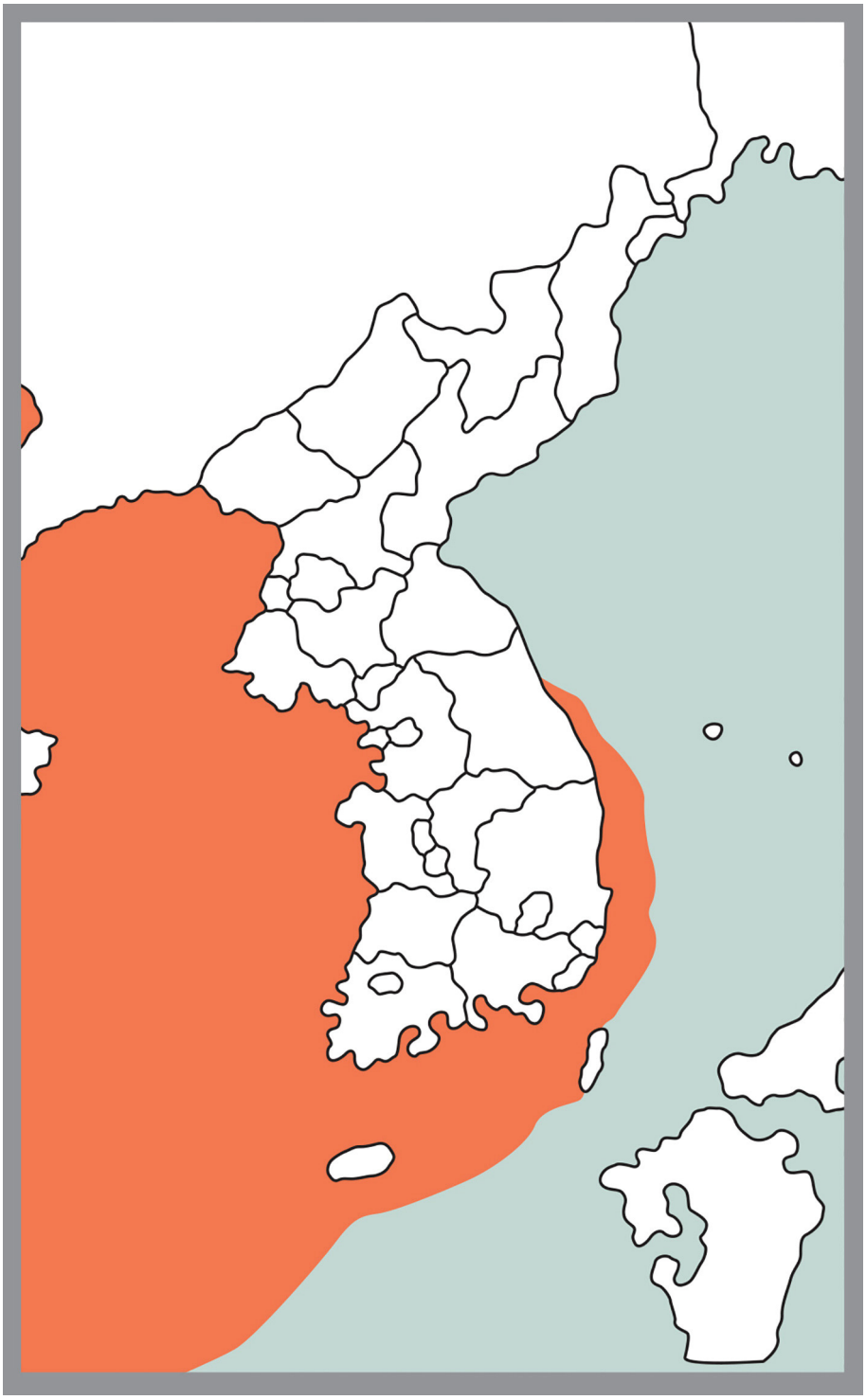

FIGURE 108. Range map of *Neophocaena asiaeorientalis* in Korea.

Genus *Phocoenoides* Andrews, 1911

Phocoenoides is a monotypic genus from the North Pacific Ocean. '*Phoc**a**en-*' is a later spelling (Mead & Brownell 2005).

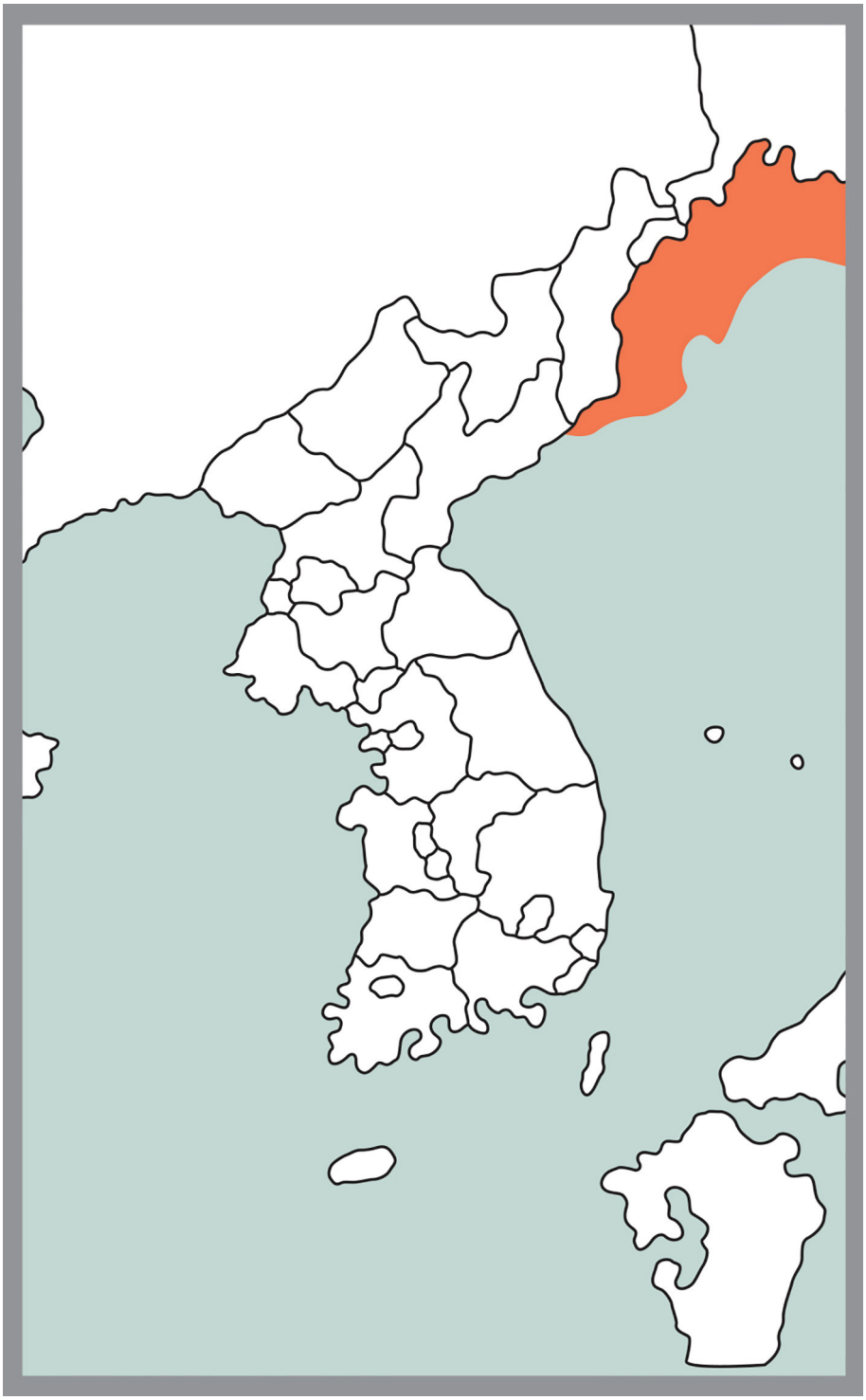

FIGURE 109. Range map of *Phocoena phocoena* in Korea.

Phocoenoides dalli **(True, 1886)—Dall's Porpoise, Dall porpoise**

Phocaena dalli True, 1885 [1886] p.95; Type locality- one of Aleutian groups, Alaska, US.
Phocoenoides truei Andrews, 1911a p.32; Type locality- Japan.
Phocoenoides dallii truei: Kuroda, 1938 p.20.
Phocoenoides dallii dallii: Kuroda, 1938 p.20.
Phocaenoides dalli: Won, 1968 p.224; Kim *et al*., 2000 p.108; Kim, 2004 p.251.
Phocaenoides dalli dalli: Won, 1968 p.225.

Range: *Phocoenoides dalli* occurs in the northern East Sea (north from 35? latitude; Fig. 110). The distribution moves closer to the east coast of Korea during winter (Kim 2004).

Remarks: A controversy exists on whether the two well-defined co-occurring color morphs forms '*dalli'* and '*truei'* represent distinct species, subspecies or color morphs (Escorza-Trevino *et al.* 2004).

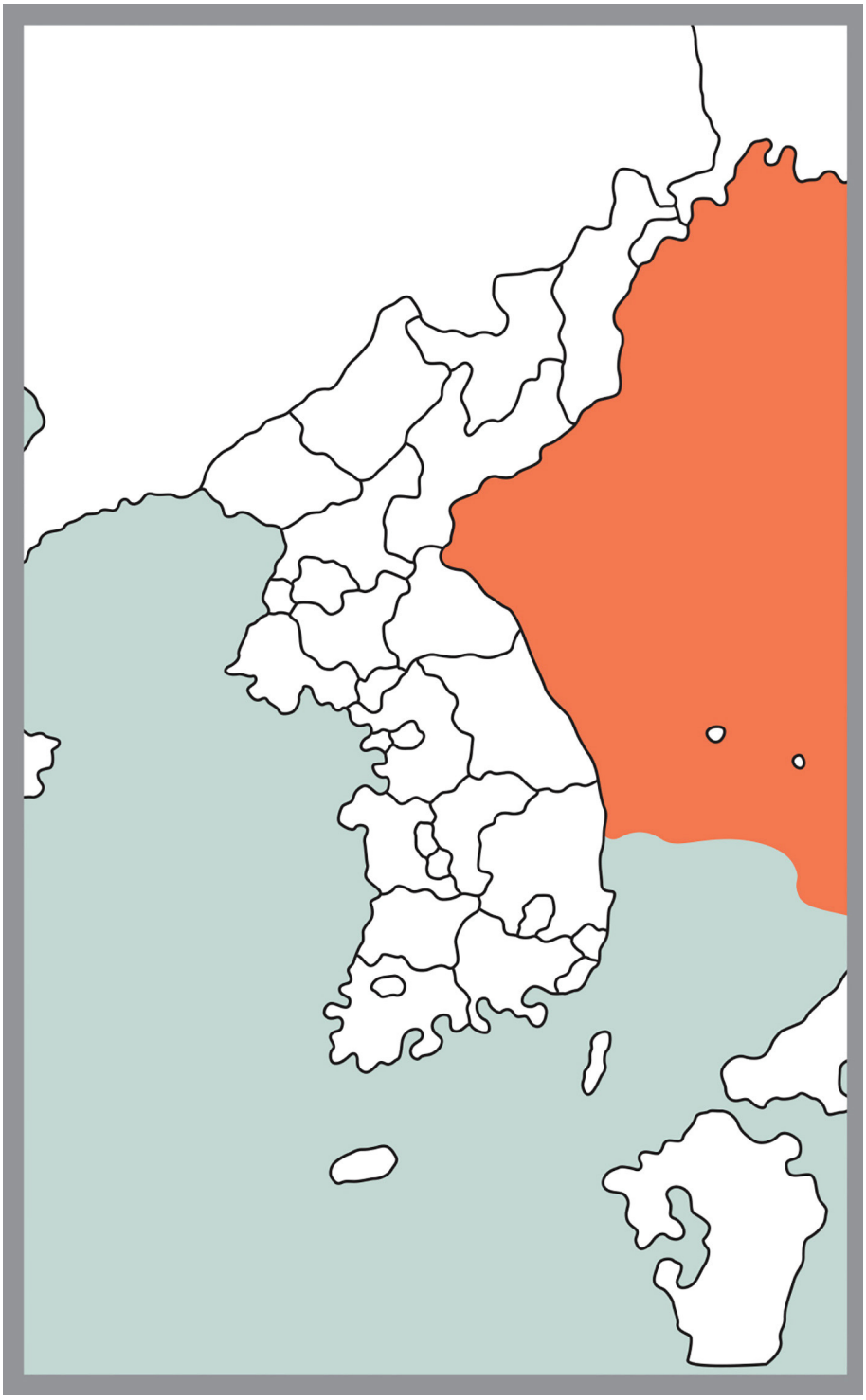

FIGURE 110. Range map of *Phocoenoides dalli* in Korea.

ORDER RODENTIA Bowdich, 1821

Four native families and one invasive Family Echimyidae, representing 21 species and 16 genera, occur in Korea.

We regard the report of *Petaurista leucogenys* (Sciuridae) as unlikely because it is based on an imported skin from Japan (Jones & Johnson 1965). The possible presence of *Apodemus sylvaticus* (Muridae) is a misidentification of *A. peninsulae* (Han 2004c). Ellerman and Morrison-Scott (1951) included Korea within the distribution of *Allactaga sibirica* (Dipodidae). However, the record for Korea was based on specimens from Jehol, China (Jones & Johnson, 1965; Corbet 1978).

Key to families of Rodentia in Korea

1	Hind leg 4 times length of fore leg	Sminthidae
-	Hind leg <4 times length of fore leg	2
2	Cheek teeth >3 in upper jaw, 3 in lower jaw	3
-	Cheek teeth 3 in upper jaw, 3 in lower jaw	4
3	Cheek teeth 5 in upper jaw, 4 in lower jaw; prominent postorbital process, small body size (<500 g) with hairy tail	Sciuridae
-	Cheek teeth 4 in upper jaw, 4 in lower jaw; postorbital bar present; upper incisors orange; length of maxillary tooth row >23 mm; large body size (>2 kg) with naked tail	Echimyidae
4	Cricetine dental plan: prismatic cheek teeth without prominent cusps (teeth line even in side view); short tail hairy	Cricetidae
-	Murine dental plan: cuspidate cheek teeth with cusps in 3 longitudinal rows; long tail with scale and hairs	Muridae

Family SMINTHIDAE Brandt, 1855

Based on molecular analysis, Lebedev *et al.* (2013) elevated the Subfamily Sicistinae J. A. Allen, 1901 to the Family Sminthidae Brandt, 1855.

Genus *Sicista* Gray, 1827

A single Genus, *Sicista* represents the Subfamily Sicistinae. One species, *S. caudata* inhabits Korea.

Sicista caudata Thomas, 1907—Long-tailed Birch Mouse

Sicista caudata Thomas, 1907a p.413; Type locality- 17 miles Northwest of Korsakov, Sakhalin Island, Russia; Won, 1968 p.167; Han, 1994 p.47; Won & Smith, 1999 p.24; Han, 2004c p.115.
S. concolor caudata: Yoon, 1992 p.88.

Range: Collected in the far northern area of Korea, BujeonCounty (main collection site), Jangjin Lake of Hamgyeongnam Province and Samjiyeon of Ryanggang Province (Fig. 111). No record exists in South Korea.

Remarks: *Sicista caudata* was considered a subspecies of *S. concolor* (Corbet, 1978). Karyological studies distinguished *S. caudata* from *S. concolor* (Holden & Musser 2005).

Conservation status: The North Korean Red Data Book classified *S. caudata* as 'Rare' (MAB National Committee of DPR Korea 2002).

Family SCIURIDAE Fischer, 1817

Flying squirrels appearing in Korea were formerly grouped into a distinct Family Pteromyidae but all are currently treated under the Tribe Pteromyini in the Subfamily Sciurinae (Thorington *et al*. 2012). Four genera and four species have usually been listed in Korea. A skin of the Japanese giant flying squirrel, *Petaurista leucogenys,* purchased at Seoul in 1920 became the basis for listing this species as a Korean mammal (Kuroda & Mori 1923). An erroneous report had this squirrel captured at Naemujae, Mt. Geumgang, but this locality did not occur within the distribution, and it was an implausible record (Won 1967, 1968). The presence of Japanese giant flying squirrels in Korea remains doubtful, and the skin was regarded as imported from another country (Won & Smith 1999).

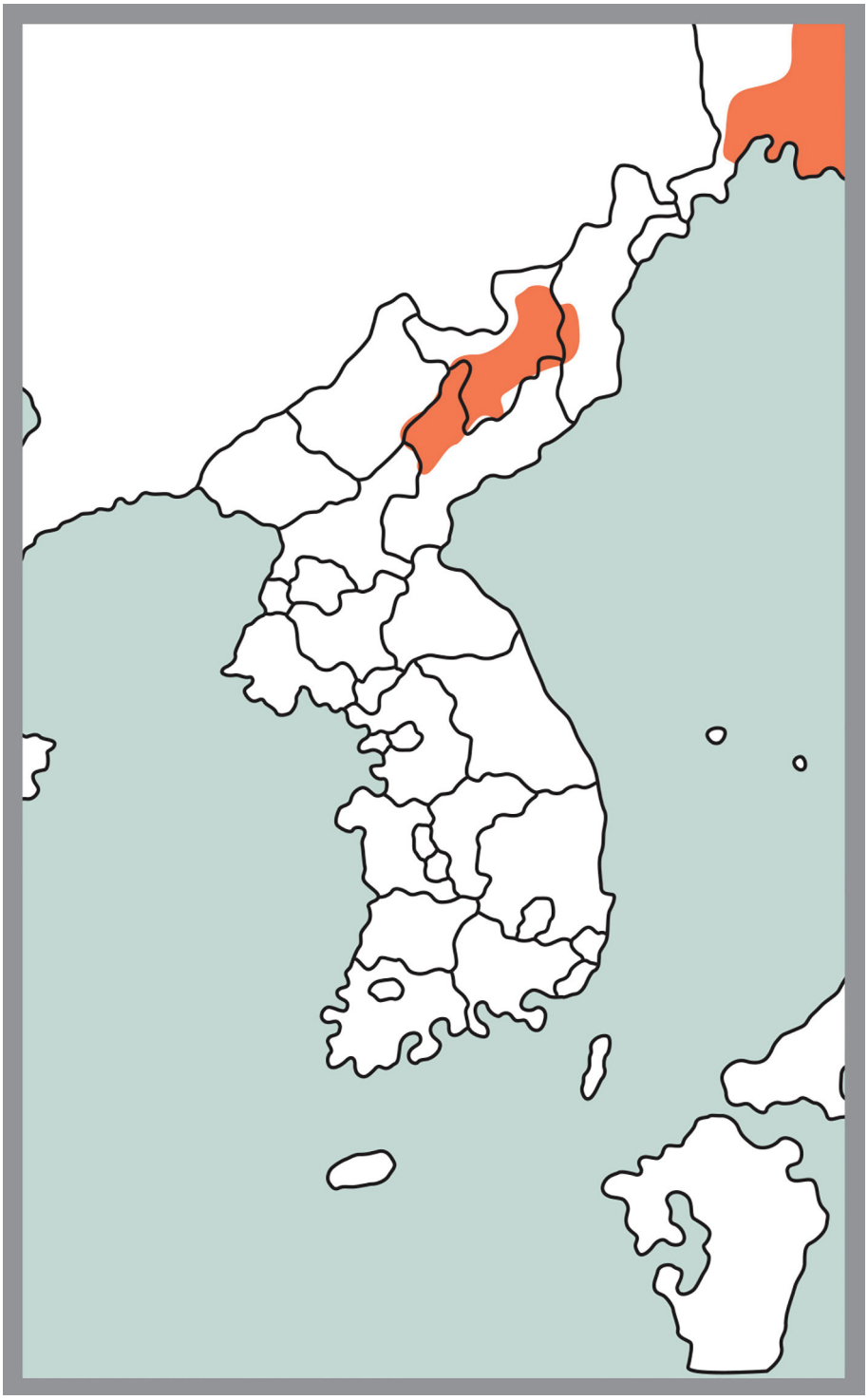

FIGURE 111. Range map of *Sicista caudata* in Korea.

Key to genera of Sciuridae in Korea

1	Patagium present between fore limb and hind limb	*Pteromys*
-	Patagium absent	2
2	No dorsal stripe; ear tuft present	*Sciurus*
-	Five dorsal stripes; ear tuft absent	*Eutamias*

Genus *Pteromys* G. Cuvier, 1800

The Genus *Pteromys* is classified in the Tribe Pteromyni and the Subtribe Pteromynia (Thorington & Hoffmann 2005).

Pteromys volans (Linnaeus, 1758)—Siberian Flying Squirrel

Sciurus volans Linnaeus, 1758 p.64; Type locality- Finland.
Sciuropterus aluco Thomas, 1907b p.464; Type locality- Kaloguai, 55 miles northeast of Seoul (Kaloguai is 'Galugae' in Wonju and 55 miles southeast Seoul); Kishida & Mori, 1931 p.378.
Sciuropterus russicus aluco: Kuroda, 1938 p.51.
Pteromys volans aluco: Ellerman, 1940 p.294; Tate, 1947 p.248; Jones & Johnson, 1965 p.369; Won, 1967 p.180; Won, 1968 p.151.
P. volans arsenjevi Ognev, 1934 p.314; Type locality- Source of River Kulume, Ussuri, Siberia; Jones & Johnson, 1965 p.369.
P. russicus aluco: Ellerman & Morrison-Scott, 1951 p.466; Won, 1958 p.445.
P. volans: Ellerman & Morrison-Scott, 1951 p.466; Won, 1968 p.151; Corbet, 1978 p.86; Han, 1994 p.47; Won & Smith, 1999 p.24; Han, 2004c p.112.
P. volans volans: Corbet, 1978 p.86; Yoon, 1992 p.70.
P. volans buechneri: Thorington *et al.*, 2012 p.129.

Range: The Siberian flying squirrel occurs throughout Korea except on remote islands (Fig. 112).

Remarks: Three lineages (Hokkaido, Russian Far East, and northern Eurasia) were identified based on cytochrome *b* gene analysis (Oshida *et al.* 2005). However, whether populations in Korea coincide with the Russian Far East lineage or northern Eurasian lineage remains unassessed. Lee *et al*. (2008) showed a clear maternal DNA differentiation among three regions, including Korea (i.e., South Korea, northeastern China and Russian Far East). Although two subspecies have been proposed for Korea (*P. v. aluco* in central Korea and *P. v. arsenjevi* in the northeastern peninsula), Siberian flying squirrels are generally reported as *P. v. buechneri* (Thorington *et al*. 2012).

Conservation Status: Populations of *P. volans* in South Korea are regarded as 'Vulnerable' in South Korean red lists (NIBR 2012) and 'Rare' in North Korea in North Korean redlists (MAB National Committee of DPR Korea 2002). In 1980, North Korea designated *P. volans* on Mt. Myohyang as a Natural Monument. Also, in South Korea, the Cultural Heritage Administration made *P. volans* a Natural Monument in 1982 and the Ministry of Environment listed *P. volans* an Endangered Species in 1998.

Genus *Sciurus* Linnaeus, 1758

Although *Sciurus* is the largest taxon with 28 species in the Family Sciuridae, only one species *S. vulgaris* inhabits Korea (Thorington *et al*. 2012).

Sciurus vulgaris Linnaeus, 1758—Eurasian Red Squirrel

Sciurus vulgaris Linnaeus, 1758 p.63; Type locality- Uppsala, Sweden; Thomas, 1907b p.464 (Kaloguai, Korea see *S. vulgaris coreae*); Ellerman & Morrison-Scott, 1951 p.472; Won, 1968 p.157; Corbet, 1978 p.77; Han, 1994 p.47; Won & Smith, 1999 p.23; Han, 2004c p.107; Jo *et al*., 2012 p.253.
S. vulgaris orientis Thomas, 1905 p.345; Type locality- Noboribetsu, near Moruran, Hokkaido, Japan; Thomas, 1909 p.501 (Hokkaido and Korea); Tate, 1947 p.213.
S. vulgaris mantchuricus Thomas, 1909 p.501; Type locality- Khingan, China; Ognev, 1940 p.364; Koh *et al*., 2006 p.1.
S. vulgaris coreae Sowerby, 1921 p.250; Type locality- Kaloguai, 55miles Northeast of Seoul (Kaloguai is 'Galugae' in Wonju and 55 miles Southeast of Seoul); Kuroda, 1938 p.46; Ellerman & Morrison-Scott, 1951 p.474; Won, 1958 p.443; Jones & Johnson, 1965 p.364; Won, 1967 p.171; Won, 1968 p.158.
S. vulgaris coreanus (misprint of *coreae*): Kishida, 1924 p.153; Kishida & Mori, 1931 p.378.
S. vulgaris vulgaris: Corbet, 1978 p.77; Yoon, 1992 p.66.

Range: The Eurasian red squirrel inhabits coniferous forests throughout the Korean Peninsula (Fig. 113). *Sciurus vulgaris* is native to the Korean Peninsula, but the population on Jeju Island probably originated from pets that escaped in ca. 2000.

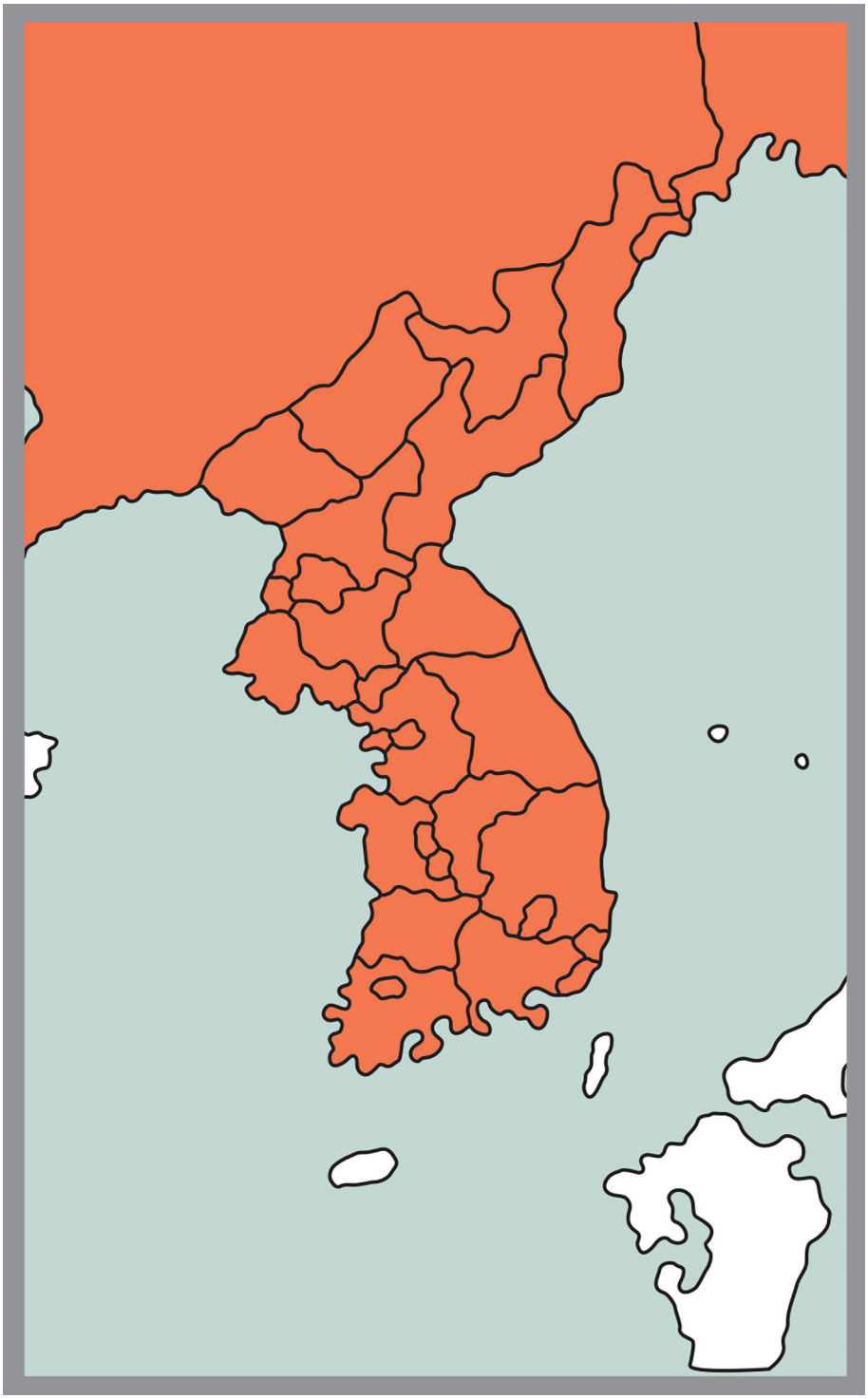

FIGURE 112. Range map of *Pteromys volans* in Korea.

Remarks: Three subspecies (*orientis, mantchuricus* and *coreae*) were historically listed for Korea, but only one subspecies of Eurasian red squirrel, *S. v. mantchuricus* Thomas 1909 represents the subspecies in the country (Koh *et al*. 2006). This subspecies has a black tail year-round and dark grey winter pelage. Based on a specimen collected near Seoul, *S. v. orientis* was reported to inhabit the peninsula (Thomas 1909; Ognev 1940; Ellerman & Morrison Scott 1951). However, no further reports or evidence have supported its presence in the last 60 years. It

appears that Thomas (1909) regarded populations in Korea as *S. v. orientis* (present in Hokkaido) instead of *S. v. mantchuricus* from Manchuria. Our opinion was supported by a recent genetic study by Koh *et al*. (2006) showing no mitochondrial differentiation between red squirrels from South Korea and northeastern China.

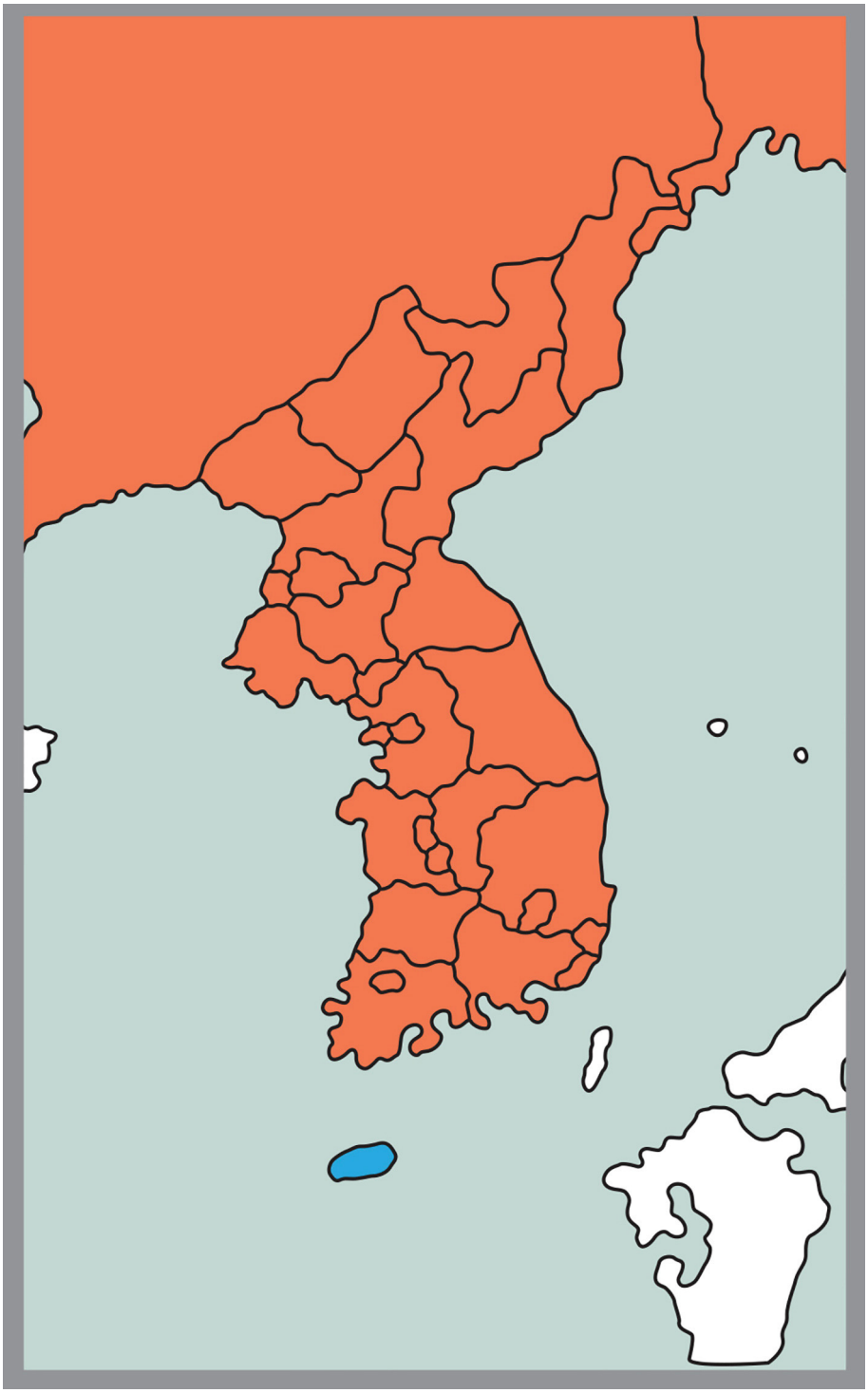

FIGURE 113. Range map of *Sciurus vulgaris* in Korea.

Genus *Eutamias* Trouessart, 1880

The Genus *Eutamias* is regarded as a subgenus and included in the Genus *Tamias* (Thorington & Hoffmann 2005). Patterson and Norris (2016) promoted *Eutamias* to a distinct genus based on morphological and genetic differences.

Eutamias sibiricus (Laxmann, 1769)—Siberian Chipmunk

Sciurus sibiricus Laxmann, 1769 p.69; Type locality- Barnaul, Siberia, Russia.
S. ftriatus α. *afiaticus* (misprint of *S. striatus* α. *asiaticus*) Gmelin, 1788 p.150; Type locality- Kichiga (Gichiga), eastern Siberia.
S. uthensis Pallas, 1814 [1831] p.189; Type locality- Uda River, northeastern Siberia.
Tamias orientalis Bonhote, 1899 p.385; Type locality- Upper Ussuri River (Sungatscha River), Siberia.
Eutamias asiaticus: Allen, 1903 p.137.
E. orientalis: Kishida & Mori, 1931 p.378; Tate, 1947 p.235.
E. asiaticus uthensis: Kuroda, 1938 p.48 (Korea).
E. sibiricus orientalis: Ognev, 1940 p.487; Jones & Johnson, 1965 p.367.
E. sibiricus barberi Johnson and Jones, 1955b p.175; Type locality- Central National Forest (37° 44' N, 127° 12' E), near Pup'young-ni (Bupyeong-ri, Namyangju-si), Korea; Won, 1958 p.444; Jones & Johnson, 1965 p.366.
T. sibiricus asiaticus: Ellerman & Morrison-Scott, 1951 p.503; Won, 1958 p.444; Won, 1967 p.173.
E. sibiricus: Won, 1968 p.162.
E. sibiricus orientalis: Won, 1968 p.162.
T. sibiricus barberi: Corbet, 1978 p.86.
T. sibiricus sibiricus: Yoon, 1992 p.67.
T. sibiricus: Han, 1994 p.47; Won & Smith, 1999 p.24; Han, 2004c p.109; Jo *et al.*, 2012 p.253.

Range: The distribution of the Siberian chipmunk includes the Korean Peninsula, but this species does not inhabit the remote islands (Fig. 114). The population on Jeju Island originated from pets released in the 1980s that became invasive residents (Jo *et al*. 2014).

Remarks: Two subspecies of Siberian chipmunks, *E. s. barberi* Johnson and Jones 1955 and *E. s. orientalis* (Bonhote, 1899) have been proposed to occur in Korea. The latter only inhabits the extreme northeastern peninsula, whereas, the former occurs across all the Korean Peninsula. Obolenskaya *et al*. (2009) suggested *E. s. sibiricus* inhabited the extreme northeast Korean Peninsula, Russia, Mongolia, Hokkaido and northeast China. We concur that two subspecies, *E. s. sibiricus* and *E. s. barberi,* occur in Korea (Koh *et al*. 2010b). The Korean subspecies *E. s. barberi* was imported and introduced in Europe as a pet where it became an invasive species (Jo *et al*. 2014).

Family ECHIMYIDAE Gray, 1825

A South American species, the coypu *Myocastor coypus,* has been introduced in Korea. *Myocastor coypus* was formerly classified as a single species in the Family Myocastoridae (Carleton & Musser 2005). Molecular evidence supported the placement of the coypu as a monotypic Subfamily (Myocastorinae) under the Family Echimyidae (Galewski *et al.* 2005; Upham & Patterson 2012).

Genus *Myocastor* Kerr, 1792

Myocastor coypus (Molina, 1782)—Coypu, Nutria

Mus coypus Molina, 1782 p.287; Type locality- Rio Maipo, Santiago, Chile.
Myocastor coypus: Han, 2004c p.141.

Range: Despite few occurrences at several sites in South Korea from Jeju Island to the Han River (Jo *et al.* 2017a), the distribution of this semi-aquatic, invasive species is limited to the Nakdong River system with the Upo Wetlands in Gyeongsangnam Province (Jo *et al.* 2017a; Fig. 115). However, transient individuals often disperse north and west of Gyeongsangnam Province.

Remarks: The first importation occurred in 1985 for fur farming, with 470 coypu farms housing about 150,000 animals (Jo *et al.* 2017a). Due to a decline in the market demand for fur and failure of the development of a market for the meat, most farms closed for business with some farmers releasing the animals into the environment, the coypu became an invasive species by 2001 (Jo *et al.* 2017a). Even with the decrease in fur demand, some coypu farms have continued to import nutrias, further reinforcing risks of release into the wild. The

source populations for these imported rodents are unknown because no data exist for animals on farms or feral animals in the environment. Microsatellite analysis of nutria in the Upo Wetlands showed considerable genetic diversity and indicated, at least, two source populations (Jung & Jo 2012). The Ministry of Environment and local governments nearby the Nacdong River system have actively eradicated coypus by bounty money (about $30 USD) or hiring trappers (Jo *et al.* 2017a).

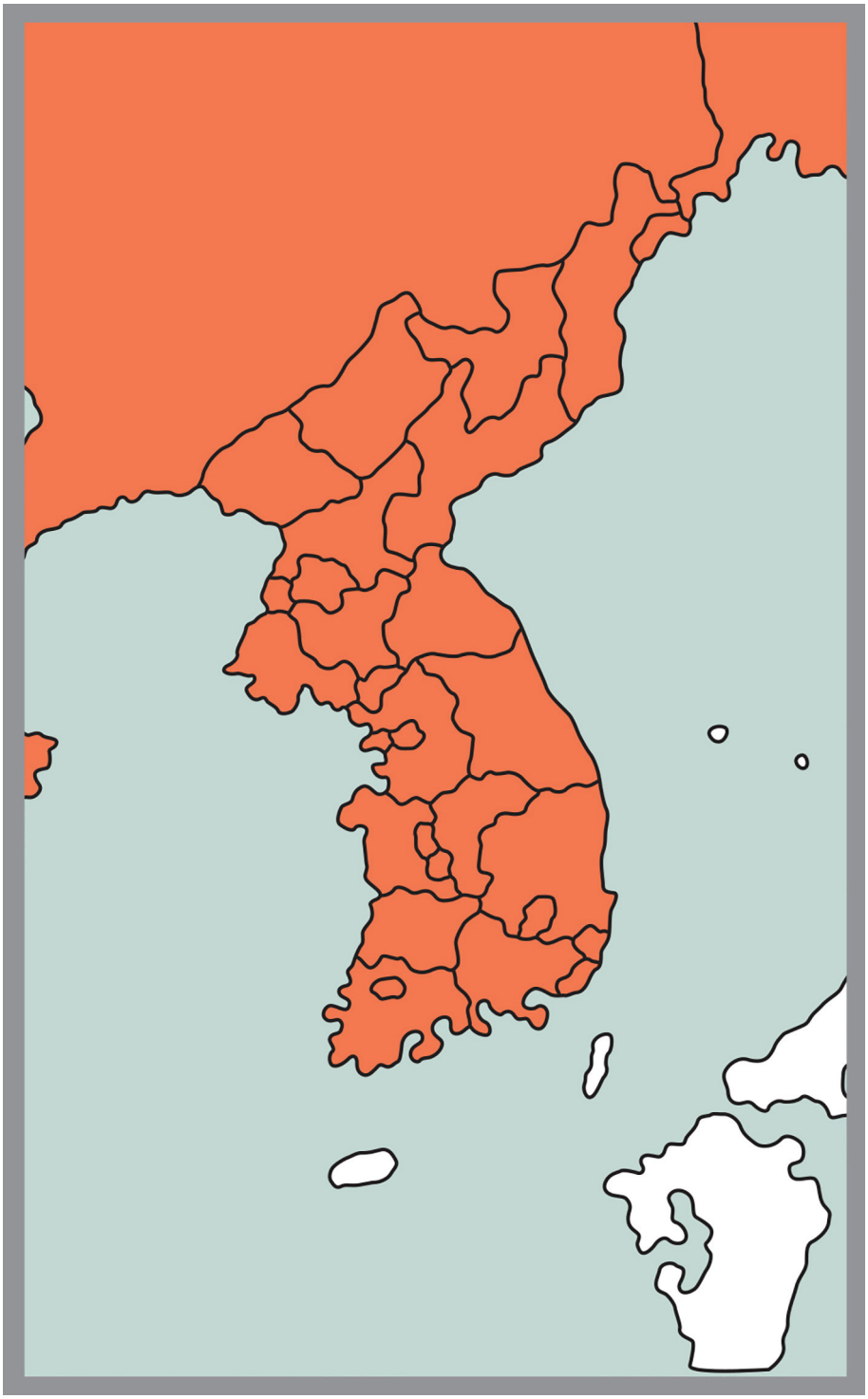

FIGURE 114. Range map of *Eutamias sibiricus* in Korea.

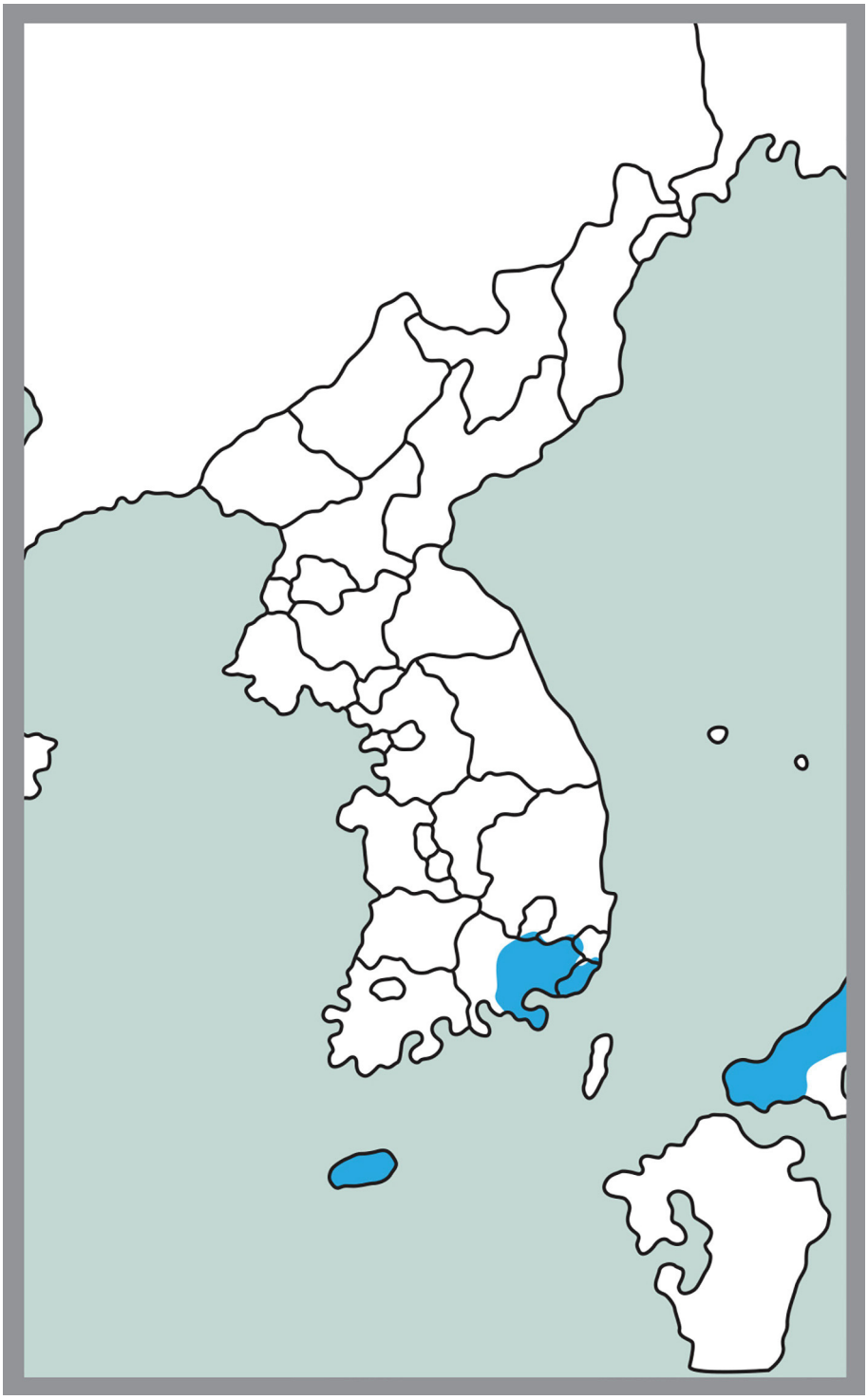

FIGURE 115. Range map of *Myocastor coypus* in Korea.

Family CRICETIDAE Fischer, 1817

We followed Musser and Carleton (2005) in recognizing the Family Cricetidae.

Five genera consisting of seven species of native Cricetidae and one genus representing an invasive species (*Ondatra zibethicus*) compose the seven genera and eight species of the Cricetidae present in Korea.

Key to genera of Cricetidae in Korea

1	Two lines of cusps on upper cheek teeth; length upper molar row <20% basal length skull	2
-	Upper cheek teeth even (crown series with connected prisms); length upper molar row >20% basal length skull	3
2	Dorsal pelage stripe absent; tail 50% of head-body length; head-body length >150 mm	*Tscherskia*
-	Narrow dark dorsal pelage stripe present; tail 30% of head-body length; head-body length <130 mm	*Cricetulus*
3	Head-body length >260 mm; tail vertically flattened	*Ondatra*
-	Head-body length <200 mm; tail cylindrical	4
4	Posterior edge hard palate pointed, reaches middle of third molar; molar unrooted in adult	5
-	Posterior edge hard palate blunt, reaches back of the third molar; molar rooted in adult.	6
5	Last cheek tooth has 3 ridges lingual side.	*Lasiopodomys*
-	Last cheek tooth has > 4 ridges lingual side	*Microtus*
6	Greatest length of skull <25mm; ridges absence on frontal bone; tail clearly bi-color	*Myodes*
-	Greatest length of skull >25mm; frontal bone has 2 ridges from parietal toward to nasal bone; tail dully bi-color	*Craseomys*

Genus *Tscherskia* Ognev, 1914

Tscherskia was formerly classified as a subgenus of *Cricetulus.* Based on its unique morphology, *Tscherskia* was elevated to a monotypic genus (Musser & Carleton 2005).

Tscherskia triton (de Winton, 1899)—Greater Long-tailed Hamster

Cricetus (*Cricetulus*) *triton* de Winton *in* Winton & Styan, 1899 p.575; Type locality- northern Shandon (Shantung), China.
Cricetulus nestor Thomas, 1907b p.466; Type locality- Gimhwa (Kim-hoa), Gangwon Province, Korea; Kishida & Mori, 1931 p.377.
Tscherskia triton albipes Ognev, 1914 p.102; Type locality- southern Ussuri, Siberia.
Cricetulus triton nester: Howell, 1929 p.50; Kuroda, 1938 p.58; Ellerman & Morrison-Scott, 1951 p.626; Won, 1958 p.446; Jones & Johnson, 1965 p.370; Won, 1967 p.202; Won, 1968 p.195; Yoon, 1992 p.73.
Asiocricetus bampensis Kishida, 1929 p.150; Type locality- Manpo, Korea; Kishida & Mori, 1931 p.377; Tate, 1947 p.257 (*hampensis* likely a misprint of *bampensis*).
A. yamashinai Kishida, 1929 p.156; Type locality- Manpo; Kishida & Mori, 1931 p.377; Tate, 1947 p.257.
Cricetulus triton: Ellerman & Morrison-Scott, 1951 p.626; Won, 1968 p.194; Corbet, 1978 p.92.
Tscherskia triton: Han, 1994 p.47; Won & Smith, 1999 p.26; Han, 2004c p.139; Jo *et al.*, 2012 p.253.

Range: The greater long-tailed hamster occurs throughout the Korean Peninsula and Jeju Island (Fig. 116).

Remarks: Thomas (1907b) found specimens from Korea larger in size than those from China. In Korea, including Jeju Island, the Subspecies *T. t. nestor* occurs (Jones & Johnson 1965). Koh *et al*. (2013) showed that the subpopulation from Jeju Island was an allopatric phylogroup. However, the subspecific status of greater long-tailed hamster from Jeju Island remains uncertain.

Conservation status: Koh *et al*. (2013) advocated that the rare, endemic, genetically distinct, population of *T. t*. *nestor* Thomas, 1907 on Jeju Island required special protection as an endangered species.

Genus *Cricetulus* Milne-Edwards, 1867

One species, *Cricetulus barabensis* appears in Korea.

Cricetulus barabensis (Pallas, 1773)—Striped Dwarf Hamster, Chinese striped hamster

Mus barabensis Pallas, 1773 p.704; Type locality- Kasmalinskii Bor (village in Altai mountain), bank of Ob River, west Siberia, Russia.
Cricetulus griseus Milne-Edwards, 1867 p.376; Type locality- Beijing, China.
C. griseus fumatus Thomas, 1909 p.503; Type locality- Changchun, Jirin, China; Tate, 1947 p.256.
C. manchuricus Mori, 1930a p.419; Type locality- Harbin, Manchuria.

C. barabensis fumatus: Chaworth-Musters, 1933 p.223; Won, 1958 p.446; Jones & Johnson, 1965 p.370; Won, 1967 p.209; Won, 1968 p.197; Yoon, 1992 p.72.
C. barabensis: Won, 1968 p.197; Han, 1994 p.47; Won & Smith, 1999 p.26; Han, 2004c p.138.

Range: The striped dwarf hamster has a distribution limited to northern Korea, especially the extreme northwestern and northeastern areas (Fig. 117). Striped dwarf hamsters have been collected in Sinuiju City, Cheolsan County, Pyeonganbuk Province (northwestern province) and Onseong-County, Hamgyeongbuk-Province (northeastern province) (Han 2004c).

Remarks: Morphometric analysis of the *C. barabensis* group supported *griseus* as a subspecies (Lebedev & Lissovsky 2008). *Cricetulus barabensis griseus* is the subspecies in Korea.

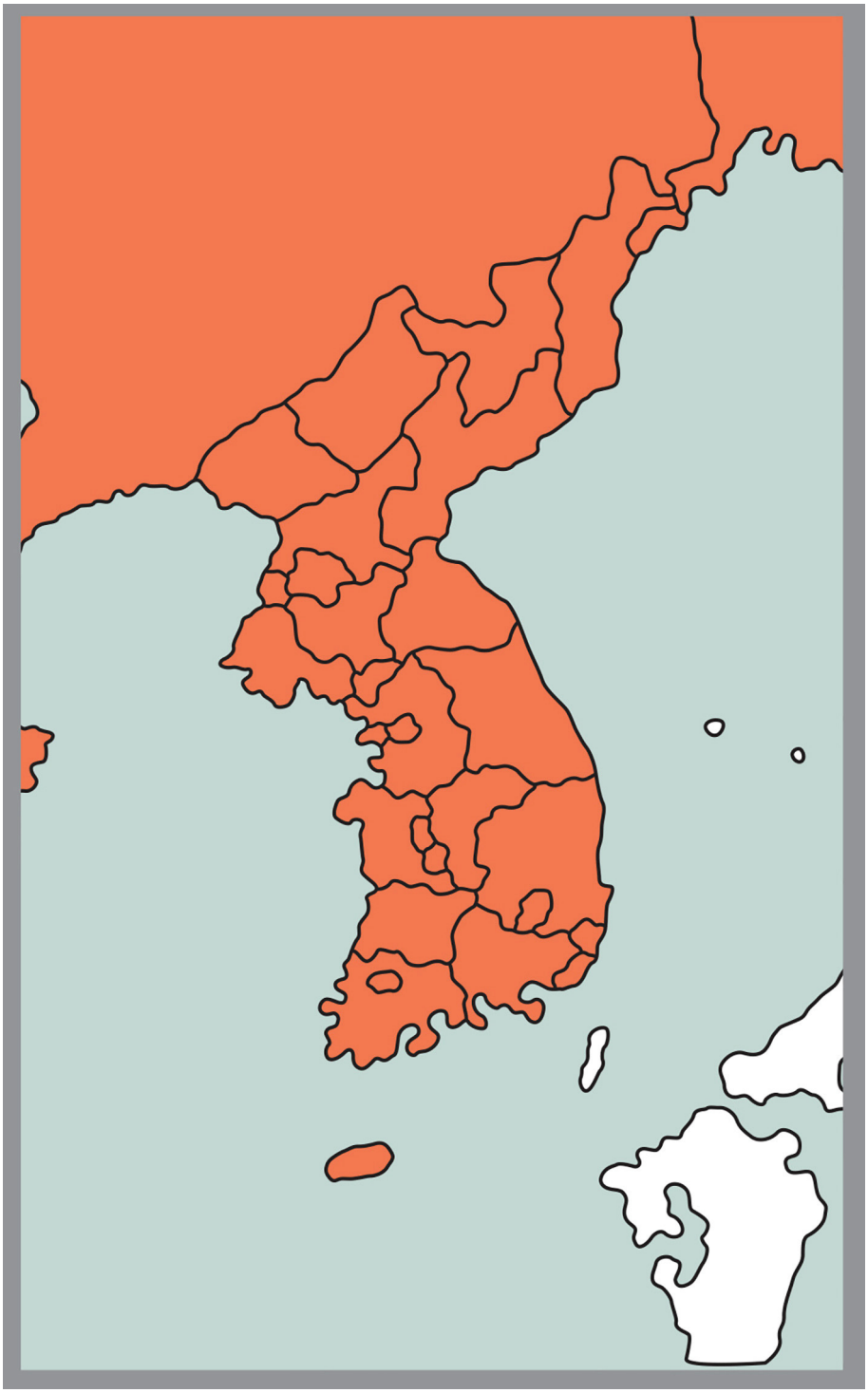

FIGURE 116. Range map of *Tscherskia triton* in Korea.

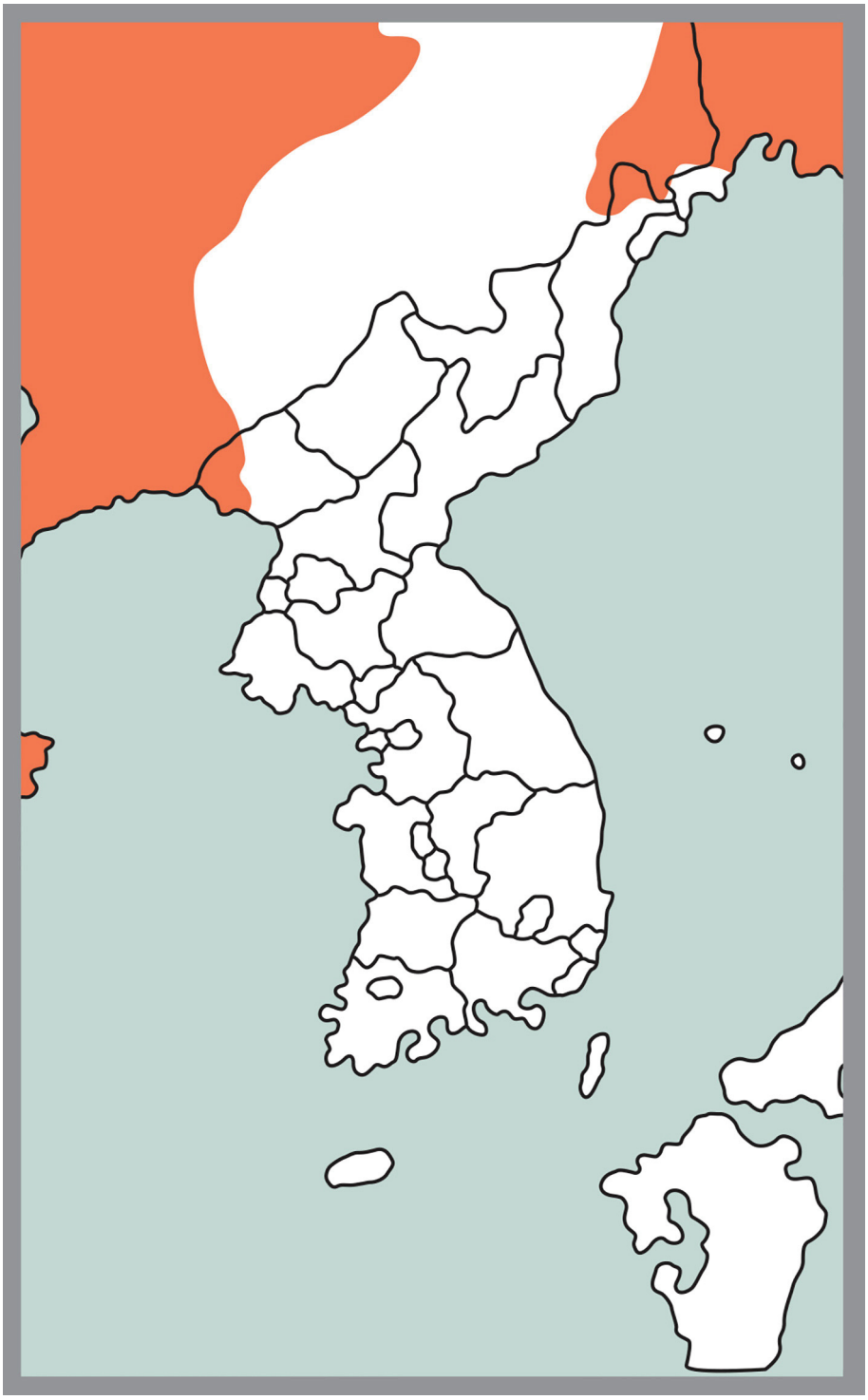

FIGURE 117. Range map of *Cricetulus barabensis* in Korea.

Genus *Ondatra* Link, 1795

Ondatra is a monospecific genus from North America bred in fur farms.

Ondatra zibethicus (Linnaeus, 1766)—Common Muskrat

Castor zibethicus Linnaeus, 1766 p.79; Type locality- East Canada.

Ondatra zibethicus: Won, 1968 p.200; Yoon, 1992 p.76; Han, 1994 p.47; Won & Smith, 1999 p.26; Han, 2004c p.140.

Range: The species has a distribution from the lower reaches of Duman River (river on the border between North Korea and China or North Korea and Russia) and adjacent lakes or reservoirs to the northeastern tip of the Korean Peninsula (Fig. 118). Although muskrat farms exist in South Korea, no established wild population exists. One escapee was caught in 2014 during nutria control at Geum River, Cheonju, South Korea (Jo *et al.* 2017a).

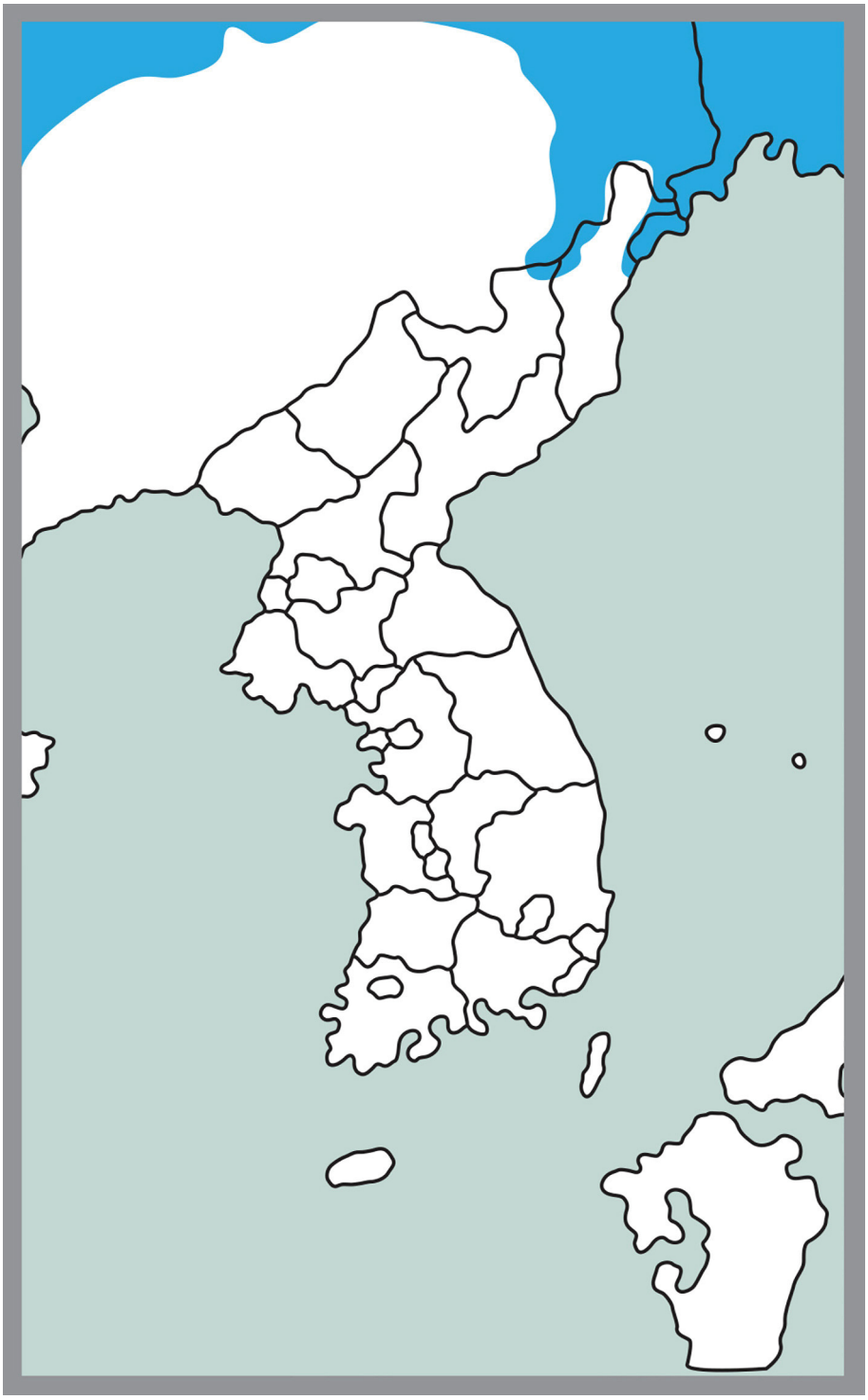

FIGURE 118. Range map of *Ondatra zibethicus* in Korea.

Remarks: Muskrats appeared on the Korean Peninsula in 1965 after introduced populations from the Russian Far East had expanded into extreme northeastern Korea. More recently, fur farmers in South Korea have started to

import this species in 2005. Due to the high market value of the animal (the price of one live muskrat is $600–1000 USD), breeders rarely lose this expensive animal and only one confirmed escape of a muskrat from a farm occurred in South Korea in 2014. However, there is a high risk that this species is released and invade wetlands in South Korea, similarly to what happened with nutria (*Myocastor coypus*).

Genus *Lasiopodomys* Lataste, 1887

Lasiopodomys was considered a subgenus of *Microtus* or a full synonym of *Phaiomys.* Gromov and Polyakov (1992) regarded *Lasiopodomys* as a distinct genus from *Microtus* based on morphology (claw of the middle digit of the forelimb 2/3 of digit length in *Lasiopodomys*, much shorter in *Microtus*; tail length 1/5 trunk length in *Lasiopodomys*, greater than 1/5 in *Microtus*; auditory bullae do not protrude downward beyond molar row in *Lasiopodomys*, protrude beyond molar row in *Microtus*; three denticles on medial side M^3 in *Lasiopodomys*, more than three in *Microtus*). Musser and Carleton (2005) recognized three species in this genus, with only *L. mandarinus* occurring in Korea.

Lasiopodomys mandarinus (Milne-Edwards, 1871)—Mandarin Vole

Arvicola mandarinus Milne-Edwards, 1871 p.93; Type locality- Near Saratsi, Shanxi, China.
Microtus kishidai Mori, 1930b p.53; Type locality- Cheongnyangni, Seoul, Korea; Kishida & Mori, 1931 p.377; Kuroda, 1938 p.54; Won, 1968 p.214.
M. mandarinus: Ellerman & Morrison-Scott, 1951 p.709; Won, 1967 p.187; Corbet, 1978 p.116.
M. mandarinus kishidai: Ellerman & Morrison-Scott, 1951 p.710; Won, 1958 p.445; Jones & Johnson, 1965 p.378; Yoon, 1992 p.78.
Lasiopodomys mandarinus: Han, 1994 p.47; Won & Smith, 1999 p.25; Han, 2004c p.137.

Range: Occurs in lowland areas from western-central to southwestern Korea (Fig. 119). Specimens have been collected in the western part of South Korea (Seoul, Gyeonggi Province, Jeollabuk Province and Jeollanam Province), but the distribution extends presumably, at least, to western areas of North Korea (Kim *et al.* 2015).

Remarks: *Microtus kishidai* first reported in Korea in 1930 and treated as the Subspecies *M. mandarinus kishidai*. Gromov and Polyakov (1992) placed *Microtus mandarinus* in a new genus as *Lasiopodomys mandarinus*. Based on its darkest fur, *Lasiopodomys m. kishidai* Mori, 1930 is the subspecies present in Korea (Jones & Johnson 1965).

Genus *Microtus* Schrank, 1798

Blanfordimys, Chiomonys, Lasiopodomys, Neodon, Phaiomys, and *Proedromys* were regarded as synonyms of *Microtus,* but all are now classified as distinct genera. Although Conroy and Cook (2000) recognized the Subgenus *Alexandromys* for the Asian clade of *Microtus* based on mtDNA, Jaarola *et al*. (2004) did not support a distinct subgenera for the Asian lineage (including *Alexandromys, Pallasiinus* and *Volemys*). Galewski *et al.* (2006) considered *Alexandromys* a distinct subgenus of *Microtus* based on a combined analysis of cytochrome *b* and a nuclear gene (exon 10 of growth hormone receptor). Although Pavlinov and Khlyap (2012) treated *Alexandromys* as a distinct genus, mammologists frequently considered *Alexandromys* as a subgenus of *Microtus* (Lemskaya *et al.* 2015). Since no taxonomic consensus exists, we followed Musser and Carleton (2005) in considering that the reed vole in Korea is *Microtus fortis*.

Microtus fortis Büchner, 1889—Reed Vole

Microtus fortis Büchner, 1889 p.99; Type locality- Huang He (the Yellow River) valley, Ordos desert, Nei Mongol, China; Ellerman & Morrison-Scott, 1951 p.701; Jones & Johnson, 1965 p.376; Won, 1968 p.211; Corbet, 1978 p.114; Han, 1994 p.47; Won & Smith, 1999 p.26; Han, 2004c p.135.

M. pelliceus Thomas, 1911b p.383; Type locality- Ussuri River, southeastern Siberia; Kuroda, 1938 p.54.
M. fortis pelliceus: Allen, 1940 p.860; Ellerman & Morrison-Scott, 1951 p.702; Won, 1958 p.445; Jones & Johnson, 1965 p.376; Won, 1967 p.190; Won, 1968 p.212.
M. fortis uliginosus Jones and Johnson, 1955 p.193; Type locality- Jipo-ri (Chip'o-ri; 38° 08' N, 127° 19' E), Cheolwon, Korea; Jones & Johnson, 1965 p.376.

Range: The reed vole occupies wetland habitats in central and extreme northeastern Korea (Kim *et al.* 2015) and western islands (including Dadohaesang National Marine Park) close to the peninsula (Han 2004c; Fig. 120).

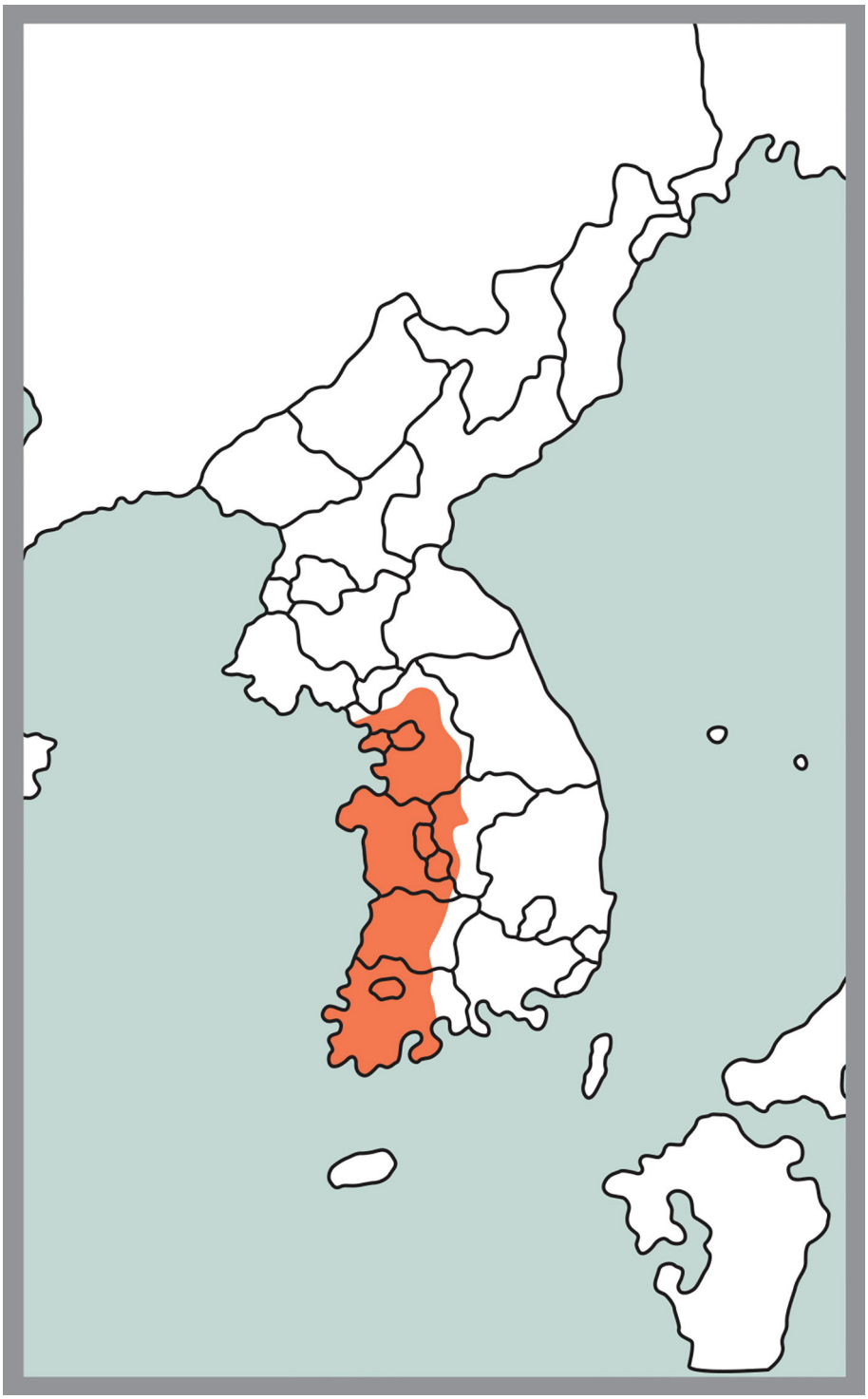

FIGURE 119. Range map of *Lasiopodomys mandarinus* in Korea.

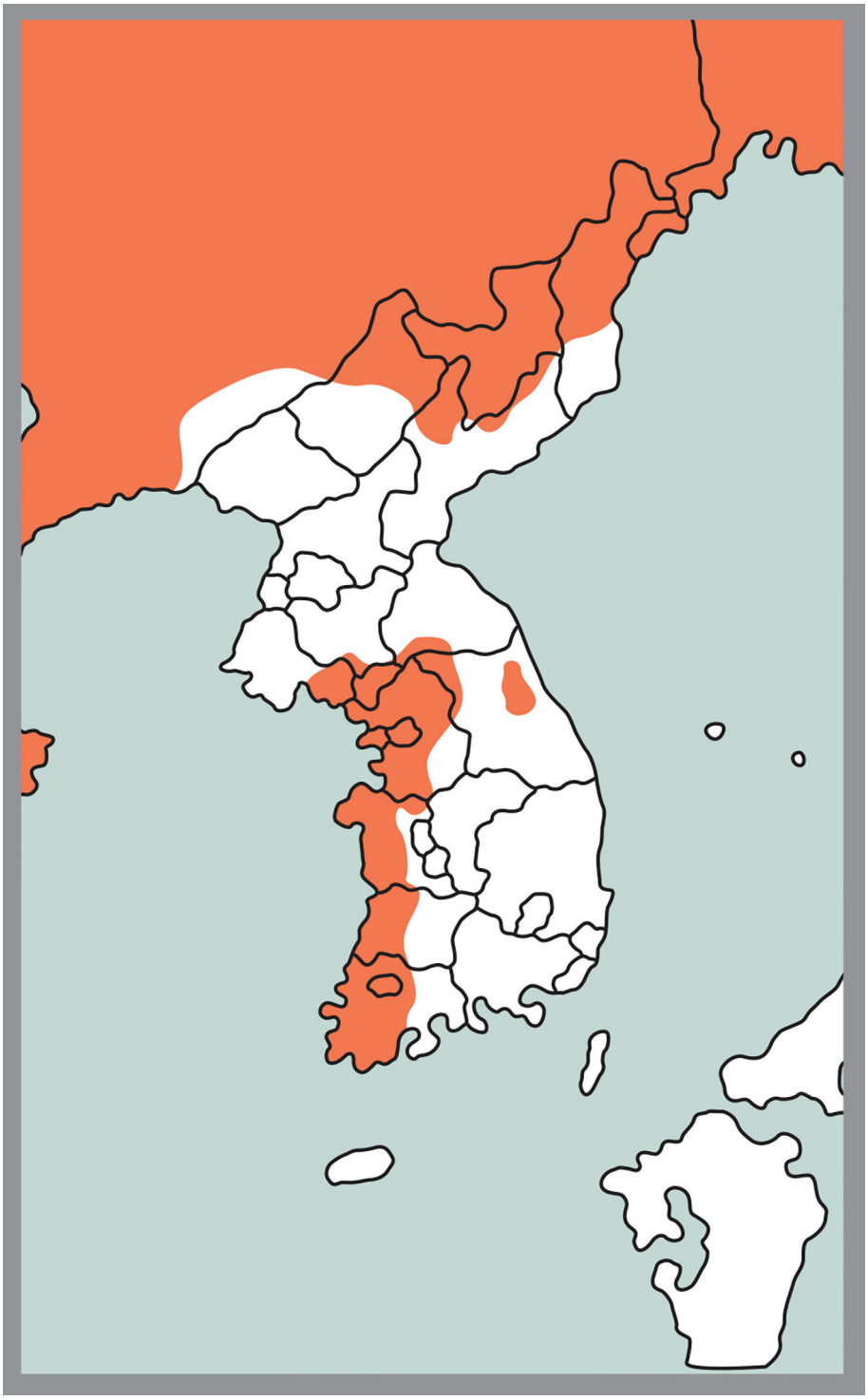

FIGURE 120. Range map of *Microtus fortis* in Korea.

Remarks: *Microtus fortis* consists of a species group including *M. sachalinensis, M. hyperboreus* and *M. gromovi* (Haring *et al.* 2011). Both morphological and genetic divergence estimates were close to levels observed among sibling species (Haring *et al.* 2011; Lissovsky & Obolenskaya 2011). *Microtus f. pelliceus* Thomas, 1911 occurs in northern Korea, while central and southern populations are generally considered a distinct Subspecies, *M. f. uliginosus* Jones and Johnson, 1955 (Won 1967; Won & Smith 1999).

Genus *Myodes* Pallas, 1811

Because molecular analysis did not support *Myodes* as a monotypic genus (Lebedev *et al*. 2007; Buzan *et al*. 2008), Pavlinov and Khlyap (2012) separated *Craseomys* from *Myodes.* As a consequence, a single species, *Myodes rutilus* characterizes the Genus *Myodes* in Korea.

Myodes rutilus (Pallas, 1778)—Northern Red-backed Vole

Mus rutilus Pallas, 1778 p.246; Type locality- Center of Ob River delta, Siberia, Russia.
Arvicola (*Hypudaeus*) *amurensis* Schrenck, 1858 p.129; Type locality- Mouth of Amur River, Siberia.
Clethrionomys rutilus hintoni Vinogradov *in* Zolotarev, 1936 p.81; Type locality- Iman River, Ussuri, southeastern Siberia; Jones & Johnson, 1965 p.375.
C. amurensis amurensis: Kuroda, 1938 p.5.
C. rutilus: Won, 1968 p.207; Corbet, 1978 p.98; Han, 1994 p.47; Won & Smith, 1999 p.25; Han, 2004c p.134.
C. rutilus amurensis: Won, 1968 p.208; Yoon, 1992 p.74.
Myodes rutilus: Musser & Carleton, 2005 p.1027.

Range: *Myodes rutilus* occurs in the extreme northeastern region of the Korean Peninsula (Fig. 121). The southern limit of the range is in Chail Peak, Ryanggang-Province (Kim *et al.* 2015).

Remarks: The northern red-backed vole in Korea has been regarded as *M. r. hintoni* or *M. r. amurensis*. Although *hintoni* is now considered a synonym of *amurensis* (Won 1968), a re-examination of the subspecific status for Korean populations of *Myodes rutilus* seems necessary due to considerable local variation such as shorter tail with long hairs on a floccus (Won 1968). In northeastern Asia, four lineages of *M. rutilus* (central Siberia, far-eastern Siberia, Alaska-Kamchatka/Sakhalin and Hokkaido) were identified by using cytochrome *b* (Iwasa *et al.* 2002). Kohli *et al.* (2015) analyzed the same gene and confirmed similar lineages (western = central Siberia; central = far eastern Siberia; and eastern clade with 3 subgroups, Bering, Sakhalin, and Hokkaido), but nuclear gene analysis showed poor structuring among lineages.

Genus *Craseomys* Miller, 1900

Craseomys was considered a subgenus of *Myodes* (Musser & Carleton 2005). Based on cytochrome *b*, Lebedev *et al*. (2007) suggested the usage of a separate genus, *Craseomys* Miller, 1900 for the group *Clethrionomys rufocanus, Clethrionomys rex, Clethrionomys andersoni* and the *Clethrionomys smithii* complex. Both mtDNA and nDNA analyzes by Kohli *et al*. (2014) supported the taxonomic revision proposed by Lebedev *et al*. (2007). *Craseomys* includes two Korean species, *C. rufocanus* and *C. regulus*. Although *C. regulus* was once included in *Eothenomys,* molecular phylogeny placed *Eothenomys* as the closest taxon to *Craseomys* (Kohli *et al*. 2014).

Key to species of Genus *Craseomys* in Korea

- Molars unrooted . . . . . *C. regulus*
- Molars rooted . . . . . *C. rufocanus*

Craseomys regulus Thomas, 1907—Korean Red-backed Vole

Craseomys regulus Thomas, 1906 [1907] p.863; Type locality- Mungyeong (Mingyong), Gyeongsangbuk Province, Korea.
Clethrionomys rufocanus regulus: Howell, 1929 p.51; Kuroda, 1938 p.58; Tate, 1947 p.263; Ellerman & Morrison-Scott, 1951 p.666; Won, 1958 p.445; Jones & Johnson, 1965 p.374; Won, 1967 p.195; Won, 1968 p.204.
Clethrionomys regulus: Kishida & Mori, 1931 p.377.
Eothenomys regulus: Corbet, 1978 p.102; Yoon, 1992 p.74; Han, 1994 p.47; Won & Smith, 1999 p.25; Han, 2004c p.130.
Myodes regulus: Musser & Carleton, 2005 p.1025.

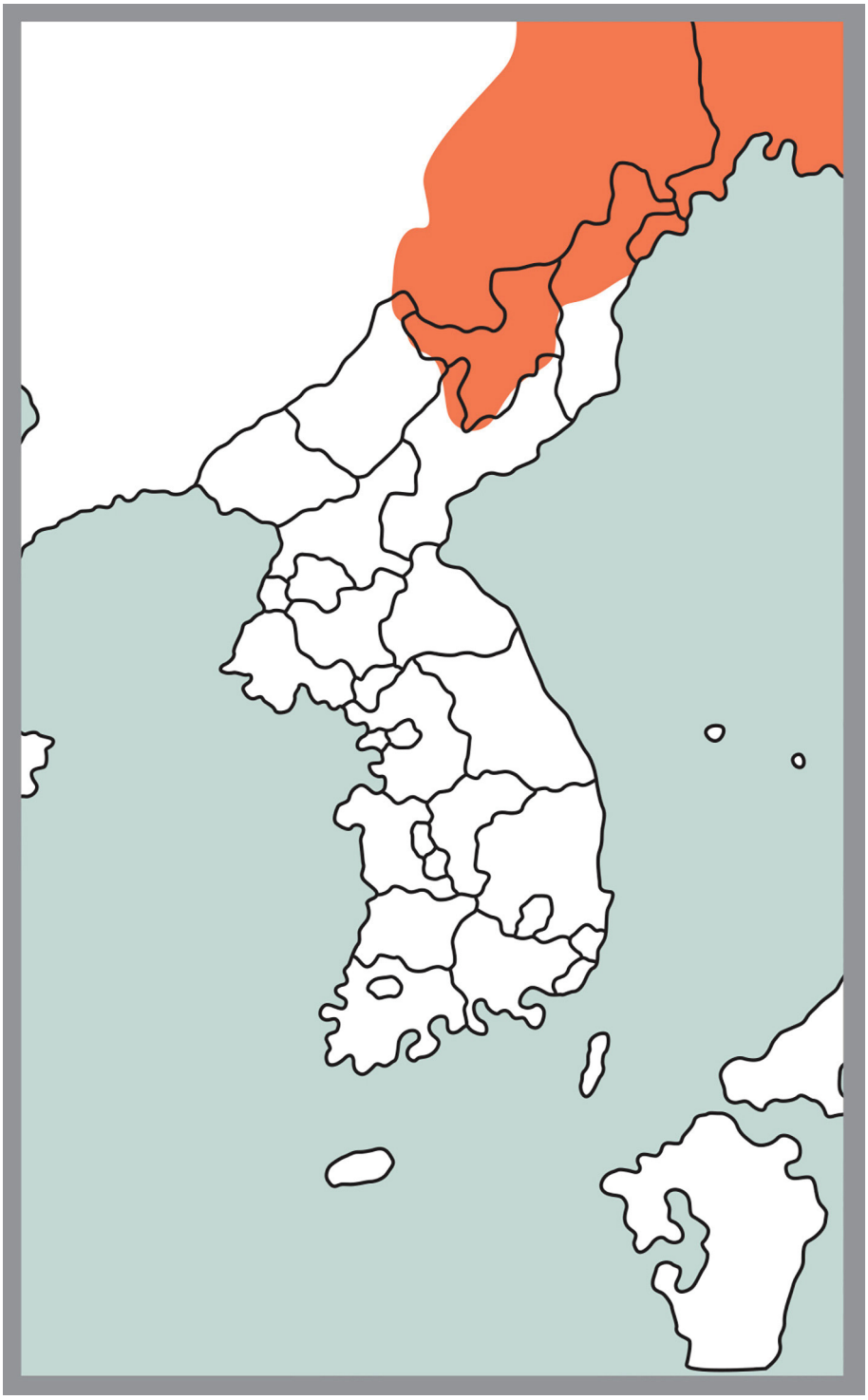

FIGURE 121. Range map of *Myodes rutilus* in Korea.

Range: The distribution for Korean red-backed voles covers most of the Korean Peninsula, except the extreme northeastern region and remote islands (Fig. 122). The northern limit of this species reaches Gaemagowon.

Remarks: The species, endemic to the Korean Peninsula, was formerly classified under *Clethrionomys rufocanus* (Hinton 1926; Ellerman & Morrison-Scott 1951; Gromov & Polyakov 1992; Kaneko 1990), but when Corbet (1978) promoted the Subspecies *C. rufocanus regulus* to the species *C. regulus*, he placed *C. regulus* in the Genus *Eothenomys*. Kaneko (1990) in a study of red-backed voles inhabiting Russia, northeastern China, and Korea documented morphological distinctions between *C. rufocanus* and *C. regulus* and considered the latter to be an endemic species in Korea. The author proposed that the geographical demarcation line between the two species

occurred on the western and southern boundary of Gaemagowon (Kaima Plateau), North Korea. Subsequent mitochondrial and nuclear ribosomal DNA analyzes conclusively demonstrated that *C. regulus* was phylogenetically closer to *C. rufocanus* (Suzuki *et al*. 1999). Wakana *et al*. (1996) noted that an absence of rooting of molars in the Korean vole was a characteristic that may have developed within a short period of evolutionary time in the population in Korea. The G-banding pattern of *regulus* was essentially identical to *C. rufocanus*. Koh *et al*. (2011) used cytochrome *b* to confirm that red-backed voles from Korea were *Myodes* (*Craseomys*) *regulus*. Interspecific distances (4.55%) between *C. regulus* from Korea and *C. rufocanus* from northeast of Gaemagowon indicated that *C. regulus* was an endemic, monotypic species in Korea (Koh *et al*. 2011).

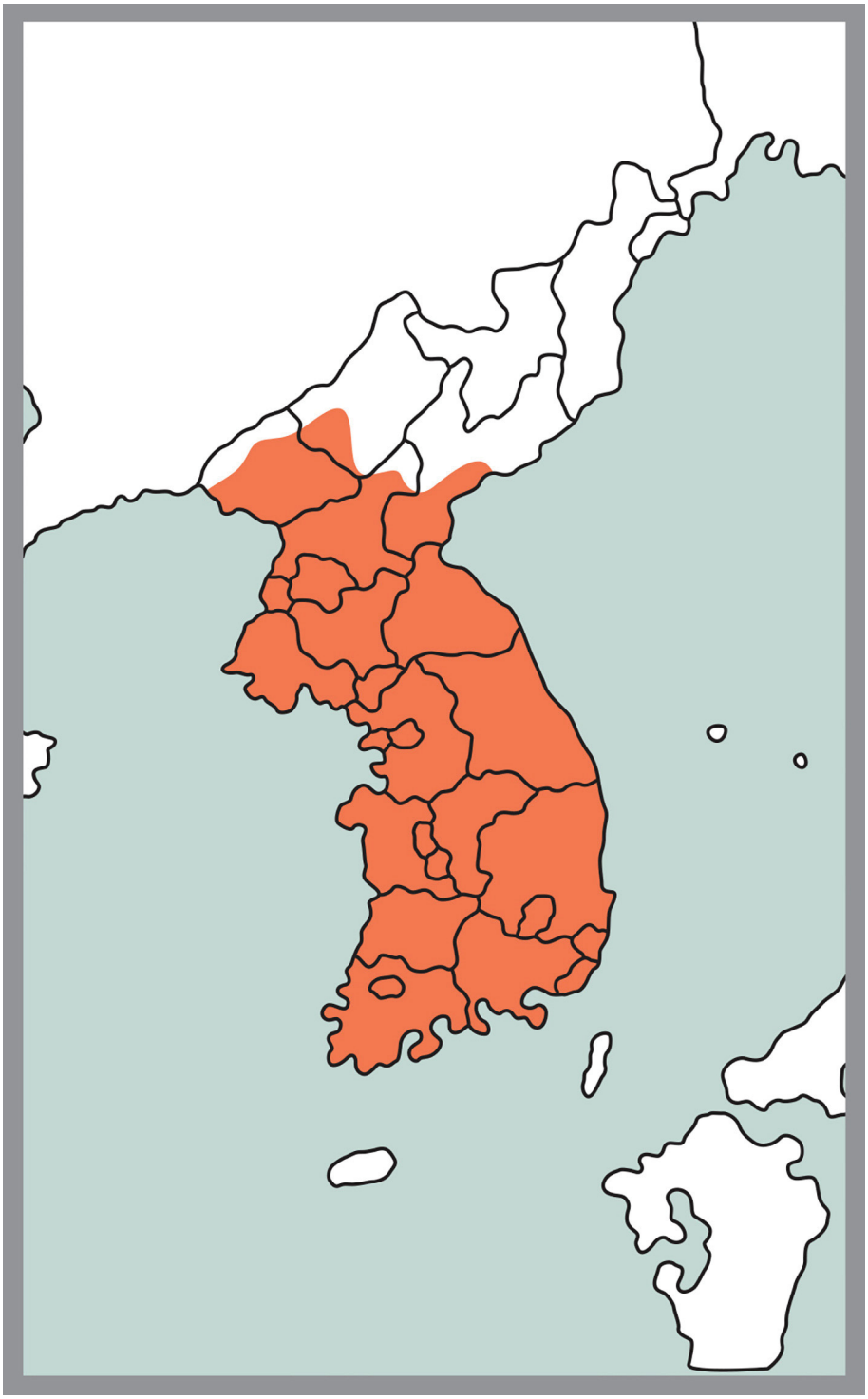

FIGURE 122. Range map of *Craseomys regulus* in Korea.

Craseomys rufocanus (Sundevall, 1846)—Grey Red-backed Vole

Hypudaeus rufocanus Sundevall, 1846 p.122; Type locality- Lappmark, Sweden.
Evotomys (*Craseomys*) *arsenjevi* Dukelski, 1928 p.40; Type locality- Stekljannaja Padj (50 miles northeast Vladivostok), Siberia.
Clethrionomys rufocanus arsenjevi: Goodwin, 1933 p.12; Jones & Johnson, 1965 p.342.
Clethrionomys rufocanus: Jones & Johnson, 1965 p.372; Won, 1968 p.204; Corbet, 1978 p.99; Han, 1994 p.47; Won & Smith, 1999 p.25; Han, 2004c p.132.
Myodes rufocanus: Musser & Carleton, 2005 p.1026.

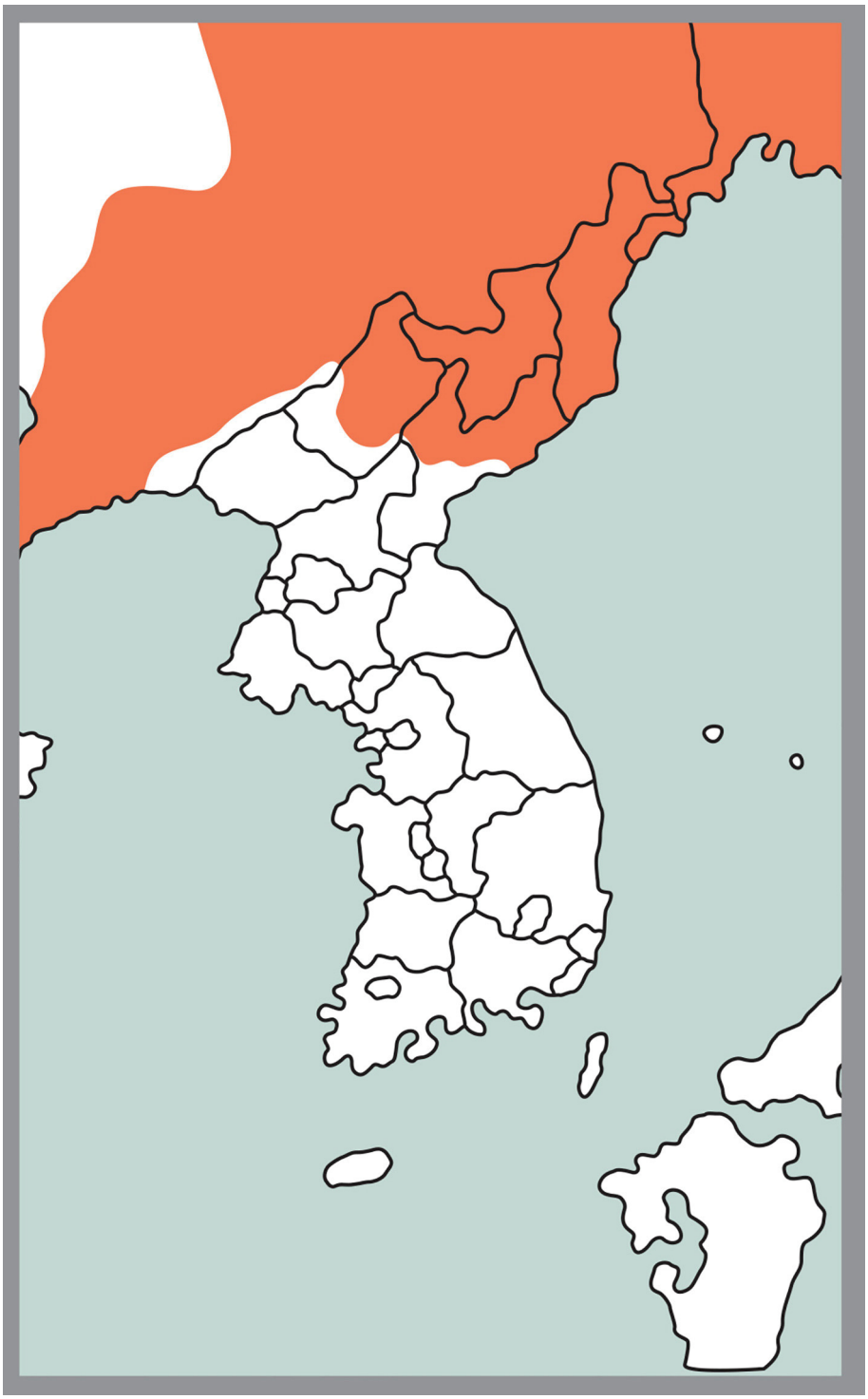

FIGURE 123. Range map of *Craseomys rufocanus* in Korea.

Range: In Korea, the grey red-backed vole has a range limited to the extreme northeastern area around Gaemagowon and further north of the plateau (Fig. 123).

Remarks: Specimens identified from China as *Clethrionomys rufocanus regulus* (Won 1968) belong to *Craseomys rufocanus*, since *C. regulus* is now considered to be endemic to the Korean Peninsula (Musser & Carleton 2005). Based on cytochrome *b* and a Y-linked gene (Sry), there are four lineages; 1) Primorsky, Russia and extreme northeastern Korea, 2) Kamchatka, 3) Sakhalin, and 4) Hokkaido (Iwasa *et al*. 2000).

Family MURIDAE Illiger, 1811

Although the European species *Apodemus sylvaticus* has been mentioned as a species occurring in Korea (Lee & Lim 1974), we here consider that records of the species originated from erroneous identifications (Pavlinov & Khlyap 2012). Although Musser and Carleton (2005) listed *A. chejuensis* as a subspecies on Jeju Island, we treat the taxon at the specific level based on reproductive isolation with *A. agrarius* on the Korean Peninsula. Therefore, we list eight species of Muridae (and four genera) for Korea.

Key to genera of Muridae in Korea

1	Head-body length >250 mm; hind foot >30 mm.	*Rattus*
-	Head-body length <150 mm	2
2	Tip of upper incisor notched from side view.	*Mus*
-	Tip of upper incisor smooth without notch	3
3	Head-body length <75 mm; hind foot <20 mm.	*Micromys*
-	Head-body length >100 mm; hind feet >20 mm	*Apodemus*

Genus *Rattus* Fischer, 1803

Rattus has become a taxonomically confusing genus. Musser and Carleton (2005) supported six forms or species groups. The *Rattus norvegicus* and *R. tanezumi* species groups inhabit Korea. Because of recent taxonomic debates (Heaney & Molur 2016), whether *R. rattus* and *R. tanezumi* coexist or only *R. tanezumi* inhabits Korea remains uncertain. Although there is a little possibility of coexisting *R. rattus* and *R. tanezumi* in Korea, we suggest populations of *R. tanezumi* instead of *R. rattus* live in Korea. Therefore, we delitsted *R. rattus* and assigned two species accounts for the Genus *Rattus* in Korea.

Key to species of Genus *Rattus* in Korea

-	Tail length shorter than head-body length; ear cannot reach to eye	*R. norvegicus*
-	Tail length longer than head-body length; ear can reach to eye	*R. tanezumi*

Rattus norvegicus (Berkenhout, 1769)—Brown Rat, common rat, Norway rat

Mus norvegicus Berkenhout, 1769 p.5; Type locality- United Kingdom.
M. caraco Pallas, 1778 p.91; Type locality- China and far eastern Siberia.
Epimys norvegicus caraco: Sowerby, 1923 p.154.
Rattus norvegicus caraco: Vinogradov & Obolensky, 1927 p.237; Won, 1958 p.449; Jones & Johnson, 1965 p.389; Won, 1967 p.248.
R. norvegicus: Kishida & Mori, 1931 p.378; Won, 1958 p.448; Won, 1967 p.239; Won, 1968 p.172; Yoon, 1992 p.85; Han, 1994 p.47; Won & Smith, 1999 p.27; Han, 2004c p.118.
R. norvegicus norvegicus: Kuroda, 1938 p.69; Won, 1968 p.173.

Range: The brown rat is commensal everywhere people live on the Korean Peninsula and associated islands (Fig. 124).

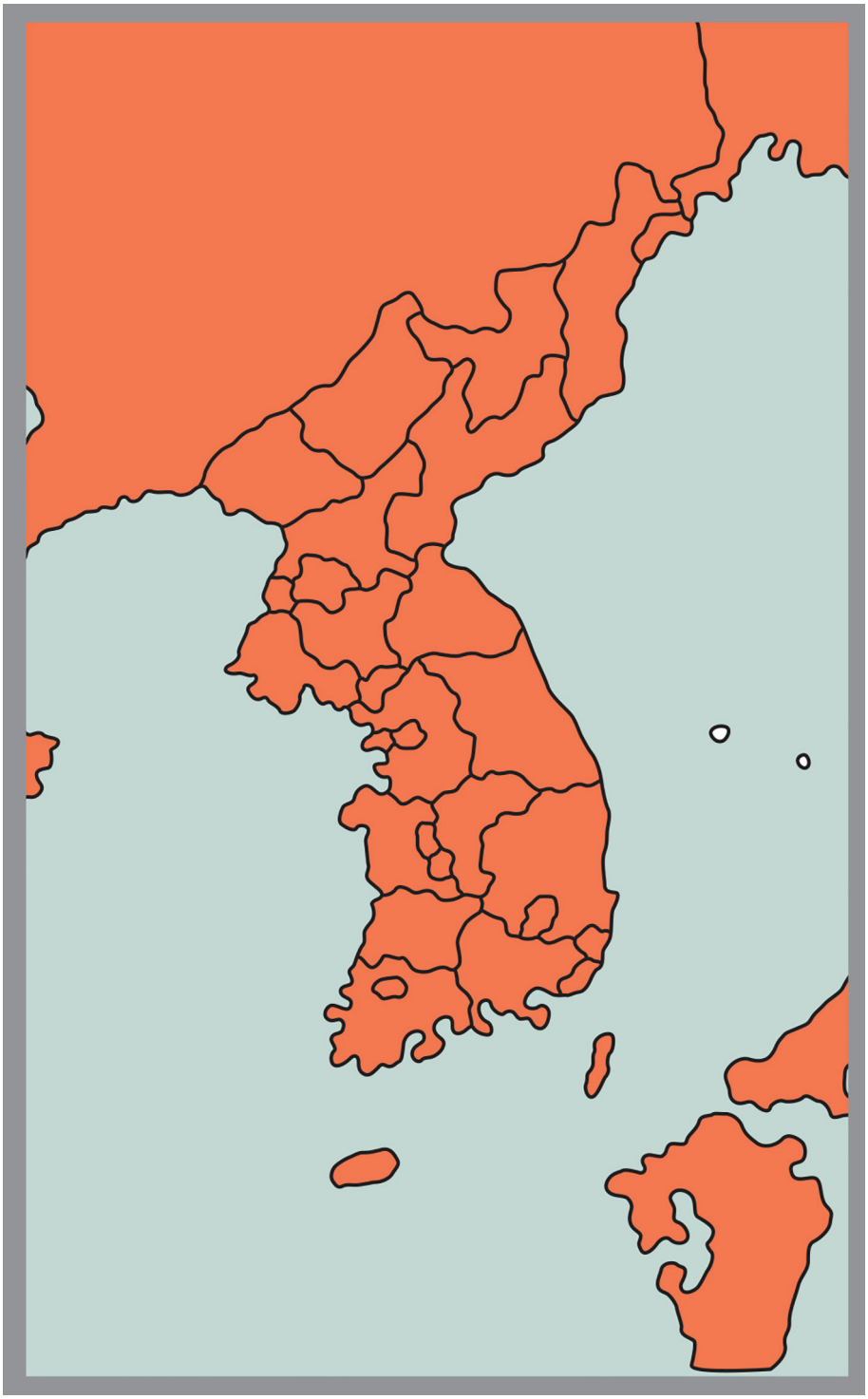

FIGURE 124. Range map of *Rattus norvegicus* in Korea.

Remarks: Corbet (1978) noted that the common rat, *Rattus norvegicus*, had an extensive distribution in the world and recognized two subspecies (*R. norvegicus norvegicus* in the western Palearctic and *R. norvegicus caraco* in eastern Asia). Won (1967) reported two subspecies of *R. norvegicus* in Korea (*R. n. norvegicus* in most of the peninsula and *R. n. caraco* in the extreme northern part). Nevertheless, Jones and Johnson (1965) suggested that only one subspecies; *R. n. caraco*, inhabited the entire peninsula. Kral (1971) reported that the two subspecies of common rats (*R. n. norvegicus*; *R. n. caraco*) in Russia had identical karyotypes (seven metacentric, nine telocentric, four subtelocentric autosome pairs); the same karyotype was reported by Kang and Kim (1963) for *R. n. norvegicus* in Korea. On the basis of C-banding patterns and morphometric variation, Koh (1992) suggested that a single subspecies inhabited Korea, namely *R. n. caraco*. The subspecies on Ulleung Island was classified as *R. n.*

longicaudus by Mori (1937) but was erroneously identified as a subspecies of *R. norvegicus* (Jones & Johnson 1965). The subspecies on Ulleung Island is *Rattus rattus tanezumi*.

Rattus tanezumi (Temminck, 1844)—Oriental House Rat

Mus tanezumi Temminck *in* Siebold, Temminck, and Schlegel, 1844 p.51; Type locality- Nagasaki (restricted by Jones & Johnson, 1965), Japan.
Rattus rattus alexandrinus: Kishida & Mori, 1931 p.378; Kuroda, 1938 p.65.
R. rattus rattus: Kishida & Mori, 1931 p.378; Won, 1968 p.176.
Rattus norvegicus longicaudus Mori, 1937 p.42; Type locality- Ulleung (Dagelet) Island, Korea; Won, 1958 p.449; Won, 1968 p.176.
R. tanezumi: Kuroda, 1938 p.69; Musser & Carleton, 2005 p.1489; Kim *et al*., 2013 p.550.
R. rattus flavipectus: Ellerman, 1949 p.58; Jones & Johnson, 1965 p.390.
R. rattus: Ellerman & Morrison-Scott, 1951 p.581; Won, 1958 p.448; Won, 1968 p.176; Yoon, 1992 p.82; Han, 1994 p.47; Won & Smith, 1999 p.28; Han, 2004c p.119; Jo *et al.*, 2012 p.253.
R. alexandrinus: Won, 1958 p.448.
R. rattus rufescens: Won, 1967 p.236.

Range: The range of *R. tanezumi* converges in the central and southern regions of Korea, with populations especially prominent in and near port cities including Jeju Island and Ulleung Island (Fig. 125). Interactions with *R. norvegicus* limit the distribution of the roof rat. On Jeju Island, the range of *R. tanezumi* was restricted to within 1 km of the port (Won 1967).

Remarks: The population on Ulleung Island was mistakenly identified as *R. n. longicaudus* but corrected as *R. rattus tanezumi*. Corbet (1978) regarded the Korean population as *R. r. tanezumi* along with China and Japan. Jones and Johnson (1965) described black rats in Korea as *R. rattus flavipectus*; Won (1967) disagreed and proposed that the black rat in Korea should be *R. rattus rufescens*. Won (1968) disputed this subspecies with a classification of *R. r. rattus* instead. Corbet (1978) questioned *R. rattus flavipectus* stating that *R. r. flavipectus* was a synonym for *R. rattus tanezumi*. Koh (1992) confirmed *R. r. tanezumi* (Temminck, 1844) as the subspecies name for roof rats in Korea. However, Carleton and Musser (2005) elevated *R. r. tanezumi* to *Rattus tanezumi* as a monotypic species but mammalogists in Korea rarely accepted *R. tanezumi*. Based on mtDNA analysis, Kim *et al*. (2013b) confirmed the correct identity of *R. rattus* on Jeju Island as *R. tanezumi*. Since apparently, *R. rattus* and *R. tanezumi* are cryptic species, and morphological identification of specimens was involved, the classification of most *R. rattus* in Korea must change to *R. tanezumi*.

Genus *Mus* Linnaeus, 1758

Four subgenera, *Coelomys, Mus, Nannomys,* and *Pryomys* are recognized within the genus (Musser & Carleton 2005). *Mus musculus,* which occurs in Korea, is classified in the Subgenus *Mus*.

Mus musculus Linnaeus, 1758—House Mouse

Mus musculus Linnaeus, 1758 p.62; Type locality- Uppsala, Sweden; Jones & Johnson, 1965 p.393; Won, 1968 p.178; Corbet, 1978 p.141; Han, 1994 p.47; Won & Smith, 1999 p.27; Han, 2004c p.121.
M. molossinus Temminck and Schlegel *in* Siebold, 1842 p.51; Type locality- Japan; Won, 1967 p.249.
M. kambei Kishida and Mori, 1931 p.378 (*Nomen nudum*).
M. takagii Kishida and Mori, 1931 p.378 (*Nomen nudum*).
M. bactrianus yamashinai Kuroda, 1934a p.234; Type locality- Mokpo, Korea; Kuroda, 1938 p.74.
M. molossinus utsuryonis Mori, 1938 p.17; Type locality- Ulleung (Utsuro) Island, Korea.
M. musculus molossinus: Ellerman, 1941 p.248; Ellerman & Morrison-Scott, 1951 p.606; Jones & Johnson, 1965 p.395; Won, 1968 p.178; Jo *et al.*, 2012 p.252.
M. musculus yamashiani: Ellerman, 1941 p.248; Won, 1958 p.449; Jones & Johnson, 1965 p.395.
M. musculus utsuryonis: Won, 1958 p.450; Won & Woo, 1958 p.88; Jones & Johnson, 1965 p.395.
M. musculus musculus: Yoon, 1992 p.86.

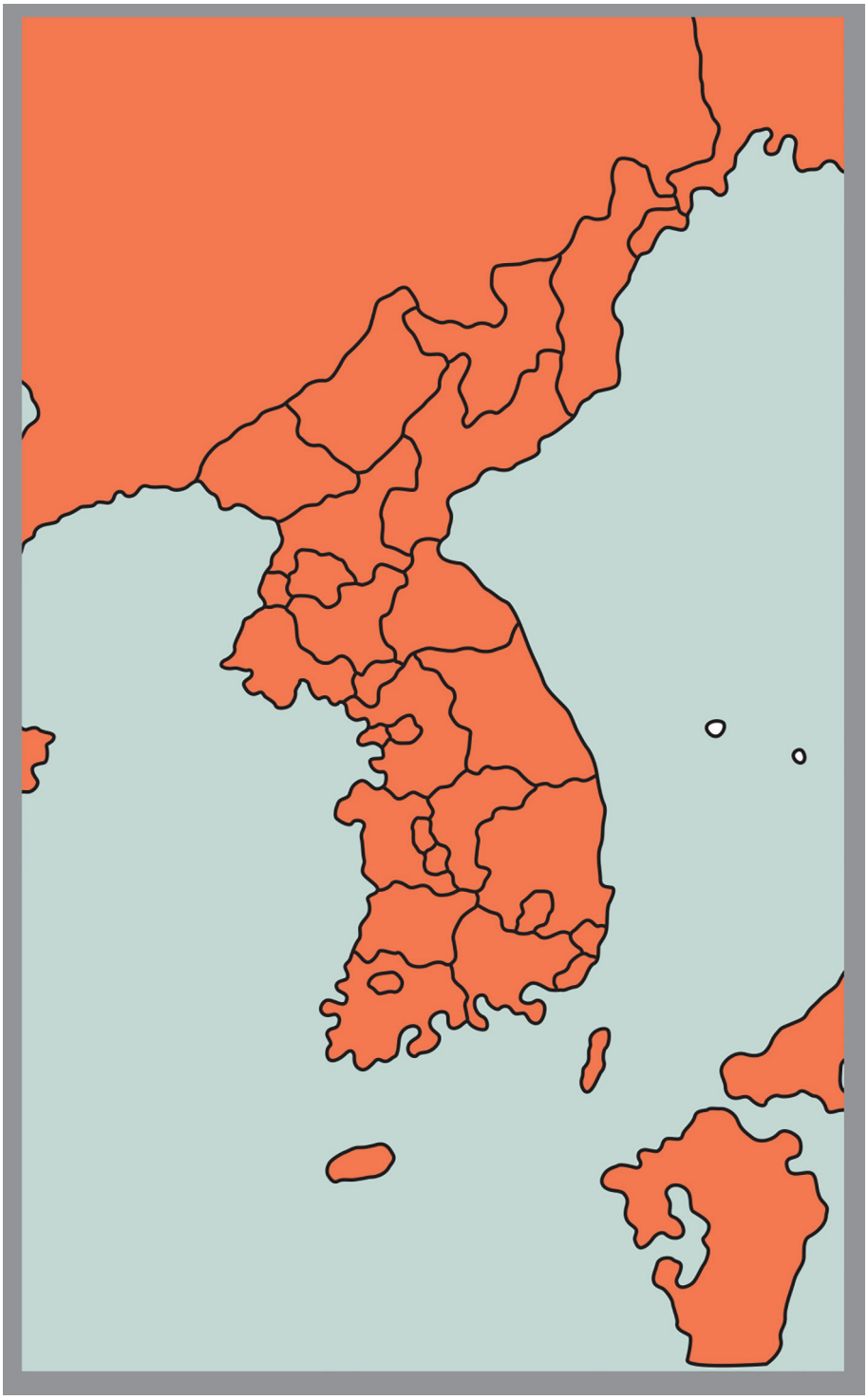

FIGURE 125. Range map of *Rattus tanezumi* in Korea.

Range: Often house mice occur arable lands, pastures, coastal sand dunes, salt marshes and scrubby road verges (Macdonald & Barrett 1993). However, feral house mice are extremely rare in Korea (Won 1967). On the Korean Peninsula and islands, the distribution of *M. musculus* is closely associated with human habitations (Jo *et al.* 2012; Fig. 126).

Remarks: Suzuki *et al.* (2013) identified five distinct clades of house mouse; *musculus* in northern Eurasia; *castanes* in India and southeast Asia; an unspecified Nepali clade; *domesticus* in western Europe; and *gentilulus* in Yemen. Populations from Korea belong to the *musculus* clade. House mice in Korea originate from multiple and non-coincidental dispersals from the West (Suzuki *et al.* 2013). Three subspecies, *M. m. yamashinai* Kuroda, 1934

on the peninsula, *M. m. molossinus* Temminck, 1845 on Jeju Island and *M. m. utsuryonis* Mori, 1938 on Ulleung Island, have been described from Korea. Some taxa hybridize with different subspecies, including the Japanese house mouse (*M. m. molossinus*) (Yonekawa *et al*. 1998). DNA analysis supported either *M. m. molossinus* or *M. m. musculus* as the primary subspecies of house mouse for all of northeastern Asia, including Korea, northern China and Japan and therefore, Korean house mice are polymorphic (Yonekawa *et al*. 1998, Musser & Carleton 2005).

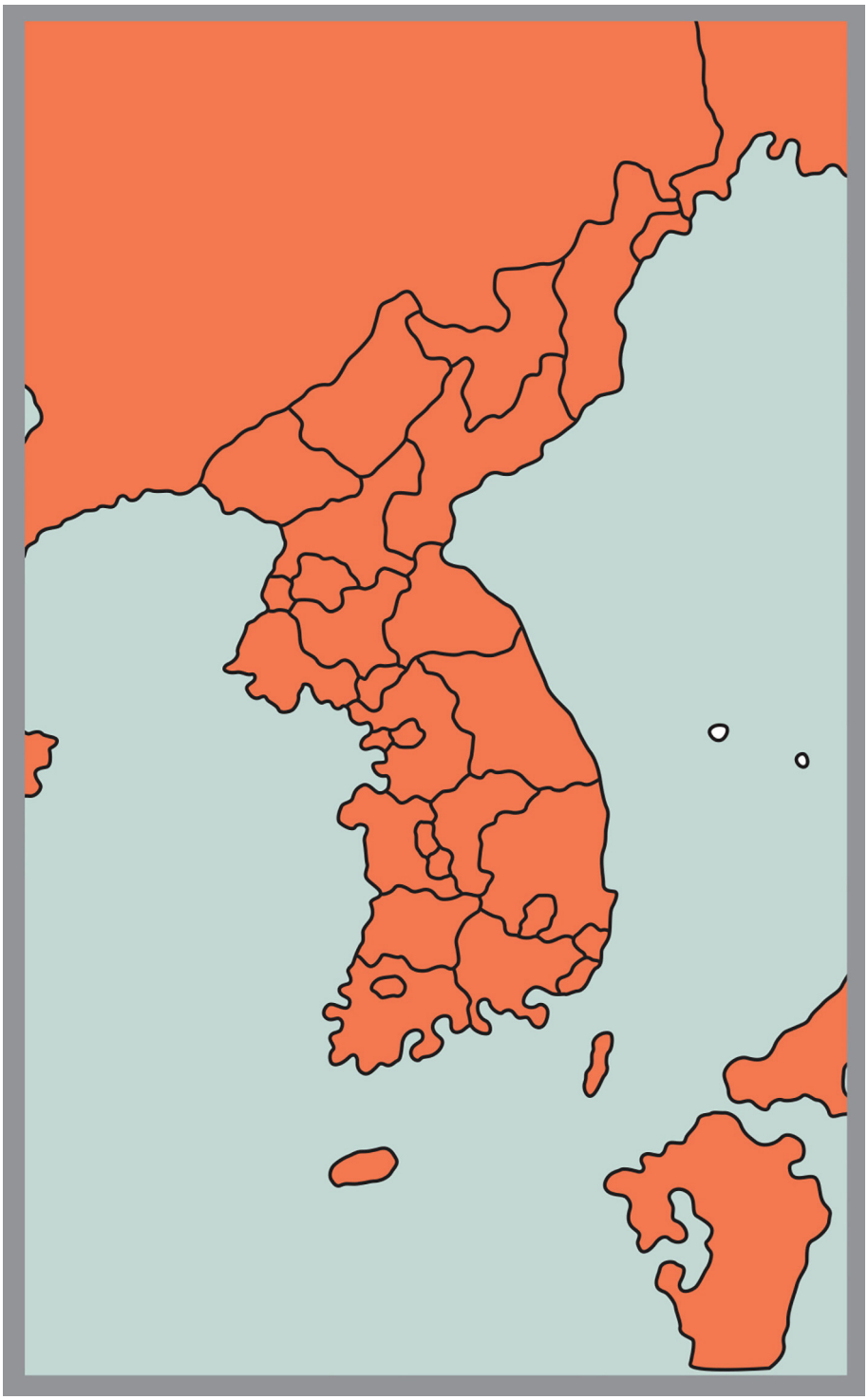

FIGURE 126. Range map of *Mus musculus* in Korea.

Genus *Micromys* Dehne, 1841

The monospecific Genus *Micromys* has a distribution that covers most of the Palearctic and northeastern Oriental regions.

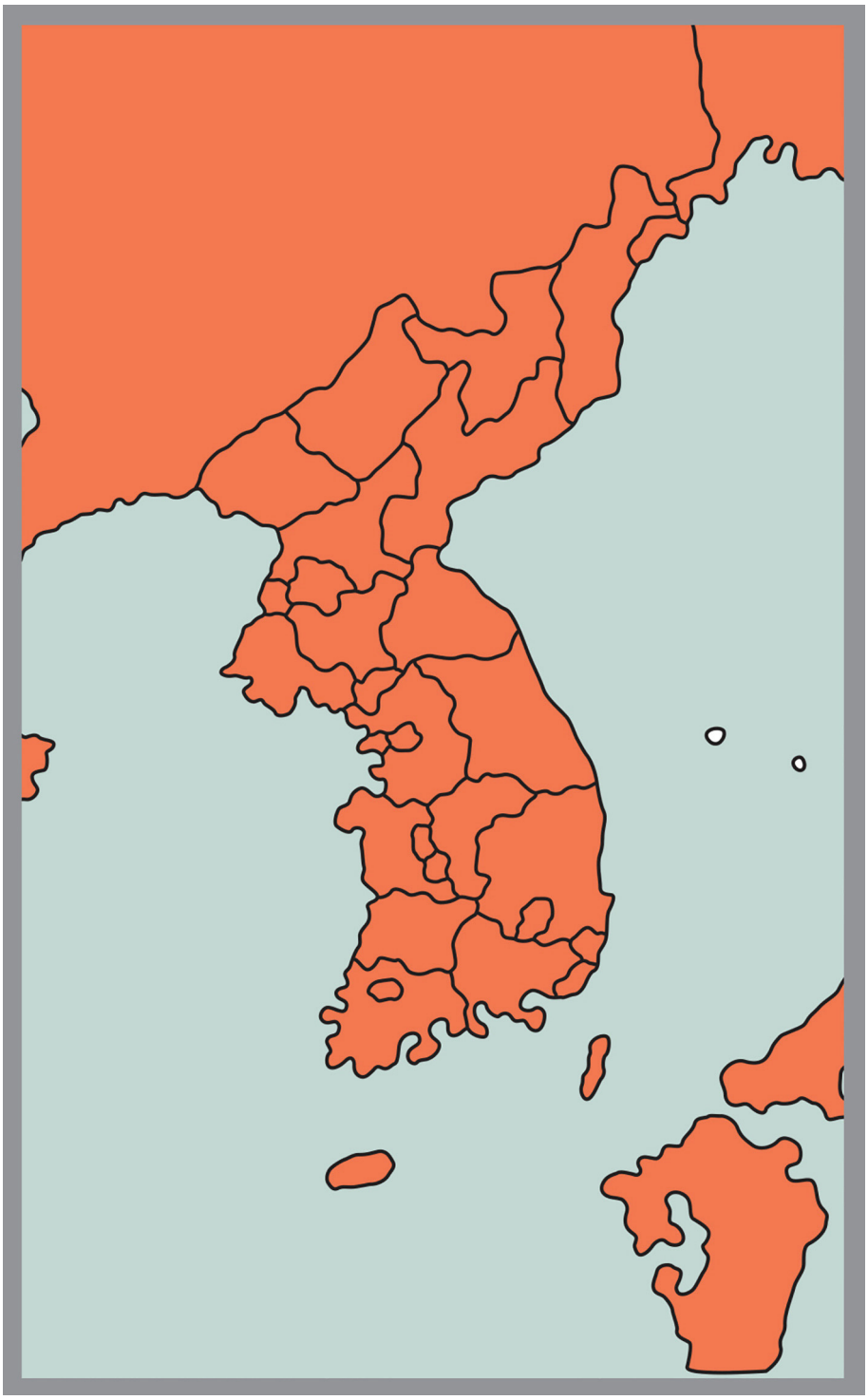

FIGURE 127. Range map of *Micromys minutus* in Korea.

Micromys minutus (Pallas, 1771)—Eurasian Harvest Mouse, harvest mouse

Mus minutus Pallas, 1771 p.454; Type locality- Ulyanovsk (Simbirsk), Middle Volga River, Russia.

Mus minutus ussuricus Barrett-Hamilton, 1899 p.344; Type locality- Ussuri, Siberia.
Micromys minutus ussuricus: Thomas, 1906 p.863; Kishida & Mori, 1931 p.378; Kuroda, 1938 p.64; Ellerman & Morrison-Scott, 1951 p.562; Won, 1958 p.448; Jones & Johnson, 1965 p.380; Won, 1967 p.231; Won, 1968 p.189; Yoon, 1992 p.79.
Micromys minutus hertigi Johnson and Jones, 1955a p.167; Type locality- 2 miles southeast Mosulpo, Jeju Island, Korea; Won, 1958 p.448; Jones & Johnson, 1965 p.379; Corbet, 1978 p.132; Jo *et al*., 2012 p.253.
Micromys minutus: Ellerman & Morrison-Scott, 1951 p.561; Won, 1968 p.188; Corbet, 1978 p.131; Han, 1994 p.47; Won & Smith, 1999 p.27; Han, 2004c p.123.

Range: The distribution of the harvest mouse covers the Korean Peninsula and Jeju Island (Fig. 127).

Remarks: Yasuda *et al.* (2005) identified five mtDNA clades across the species range (Europe; Russia; China; Taiwan; Korea-Japan). Abramov *et al.* (2009) divided the harvest mouse into two species (*M. minutus* in the northern part and *M. erythrotis* in the southern range). The higher nucleotide diversity in populations of Korea than Japan suggested that harvest mice crossed from Korea to Japan during the last glacial period (Yasuda *et al.* 2005). Two subspecies of *M. minutus* occur in Korea, *M. m. ussuricus* Kuroda, 1934 on the peninsula and *M. m. hertigi* Johnson and Jones 1955 on Jeju Island (Jo *et al.* 2012).

Conservation status: Incheon and Daejeon Metropolitan governments and Jeollanam Province, South Korea provide local protection for this species as a Provincially Protected Species.

Genus *Apodemus* Kaup, 1829

The records for *A. sylvaticus* in Korea are based on specimens collected in the 1960s (Lee & Lim 1974). Since then, few were observed or collected, and the presence of *A. sylvaticus* in Korea appears questionable (Han 1994, 2004c). We regard these records as erroneous identifications of *A. peninsulae*. The identifications of *A. sylvaticus* were based on the presence of a long tail, long hind foot and long ears (especially the tail longer than the head-body length), but measurements overlapped those of *A. peninsulae*, previously a subspecies of *A. sylvaticus* and later a subspecies of *A. speciosus*. Also, the location of Korea is substantially beyond the eastern limit of the distribution for *A. sylvaticus*. Thus, we removed *Apodemus* (or *Sylvaemus*) *sylvaticus* (Linnaeus, 1758) from the list of Korean mammals.

Although some references used *chejuensis* as a subspecies of *A. agrarius*, we considered *A. chejuensis* a distinct species because a reproductive barrier was confirmed between the two species (Jo *et al*. 2017b). Thus, we list three species of *Apodemus* in Korea.

Key to species of Genus *Apodemus* in Korea

1	Pelage with black middle dorsal stripe	2
-	Pelage with no dorsal stripe absent	*A. peninsulae*
2	Present only on Jeju Island	*A. chejuensis*
-	Present on Korean Peninsula	*A. agrarius*

Apodemus peninsulae (Thomas, 1907)—Korean Field Mouse

Micromys speciosus peninsulae Thomas, 1906 [1907] p.862; Type locality- Mungyeong, Korea; Kuroda, 1938 p.63.
Apodemus peninsulae: Miller, 1914 p.89; Kishida & Mori, 1931 p.378; Corbet, 1978 p.136; Han, 1994 p.47; Won & Smith, 1999 p.27; Han, 2004c p.127.
A. praetor Miller, 1914 p.89; Type locality- Upper Songhua (Sungari) River, Manchuria.
A. specious peninsulae: Allen, 1927 p.2; Kuroda, 1938 p.62; Tate, 1947 p.282; Won, 1958 p.447; Won, 1967 p.222; Won, 1968 p.185.
A. flavicollis: Ellerman & Morrison-Scott, 1951 p.565.
A. flavicollis peninsulae: Ellerman & Morrison-Scott, 1951 p.566.
A. sylvaticus: Ellerman & Morrison-Scott, 1951 p.568.
A. sylvaticus draco: Ellerman & Morrison-Scott, 1951 p.571; Won, 1958 p.447.
A. peninsulae peninsulae: Jones & Johnson, 1965 p.387; Yoon, 1992 p.81.
A. specious: Won, 1968 p.184.

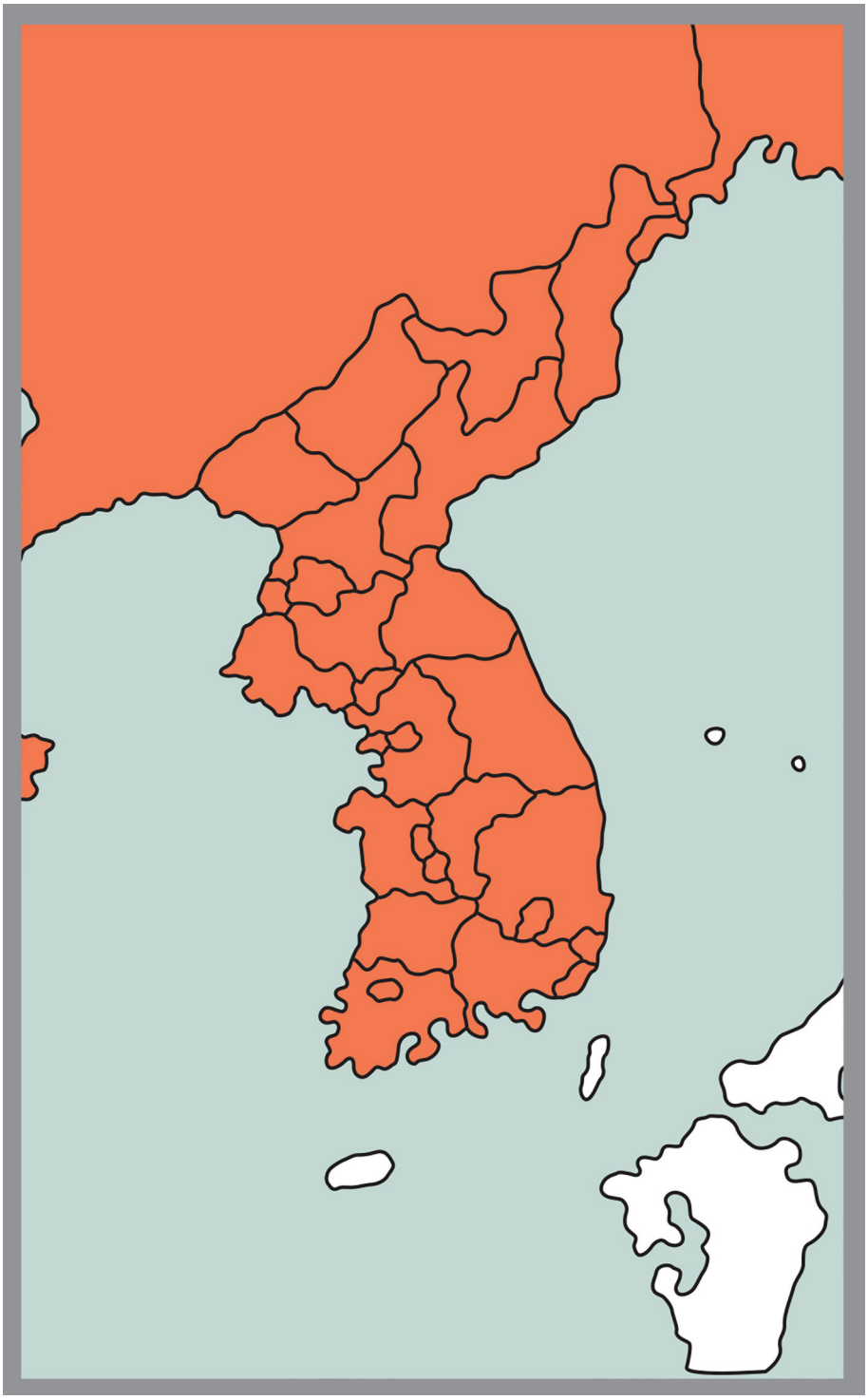

FIGURE 128. Range map of *Apodemus peninsulae* in Korea.

Range: The Korean field mouse commonly occurs throughout Korea, except in remote islands (Fig. 128).

Remarks: Due to morphological differences such as the number of mammae, skull, and teeth, Jones (1956) promoted *peninsulae* to a distinct species. The presence of three region-specific mtDNA types of ancient divergence likely resulted from the regions of Primorye, Siberia and the Korean Peninsula functioning as refugia for *A. peninsulae* during a substantial period of the Quaternary glacial ages (Serizawa *et al*. 2002). According to a phylogenetic study based on cytochrome *b*, the Korean population is closer to populations from Shandong and Ningxia, China than from those of the Russian Far East (Sakka *et al.* 2010). A numerical taxonomy and genetic study suggests the occurrence of two subspecies (*A. p. peninsulae* and *A. p. sowerbyi*) in Korea (Heo 2002).

Apodemus chejuensis Johnson and Jones, 1955—Jeju Striped Field Mouse

Apodemus agrarius chejuensis Johnson and Jones, 1955a p.171; Type locality- 10 miles northeast Mosulpo, Jeju Island, Korea; Won, 1958 p.447; Jones & Johnson, 1965 p.382; Corbet, 1978 p.137; Han, 2004c p.126.
Micromys agrarius mantchuricus: Thomas, 1906 p.863 (Quelpart Island= Jeju Island).
A. chejuensis: Won & Smith, 1999 p.27; Jo *et al*., 2012 p.253.

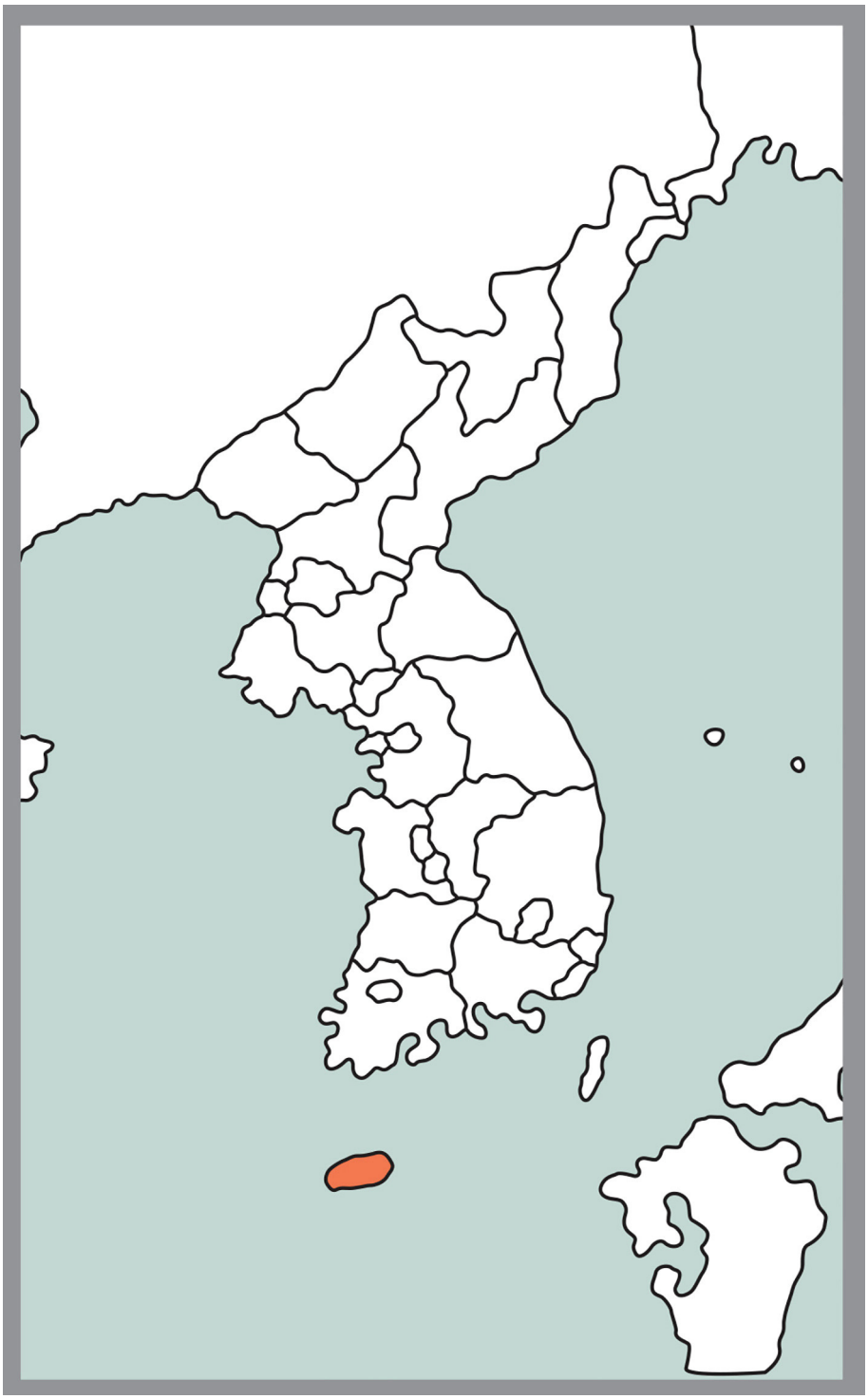

FIGURE 129. Range map of *Apodemus chejuensis* in Korea

Range: The Jeju striped field mouse is endemic to Jeju Island (Jo *et al.* 2012; Fig. 129).

Remarks: The striped field mice on Jeju Island was first considered a subspecies of *A. agrarius*. Koh (1986, 1987, 1991) and Koh and Yoo (1992) reported an apparent distinction in morphological characters and mtDNA

restriction fragment length polymorphisms between *chejuensis* and *agrarius coreae*. Koh *et al*. (1997) compared morphometric characteristics and also reached the conclusion that among the eight subspecies (*agrarius*, *ningpoensis*, *pallidior*, *chevrieri*, *insulaemus*, *manchuricssssus*, *coreae, chejuensis*) of the striped field mice in Asia, *chejuensis* had a distinct (largest body size) difference supporting its status of different species. Koh and Yoo (1992) suggested that *chejuensis* had distinct mtDNA haplotypes and elevated it to the species level as *Apodemus chejuensis* Johnson and Jones, 1955. Oh and Mori (1998) showed post-mating isolation between *chejuensis* and *agrarius,* through very low reproductive success rate of the first crossbred generation notably linked to an anomalous reproductive organ in F_1 males.

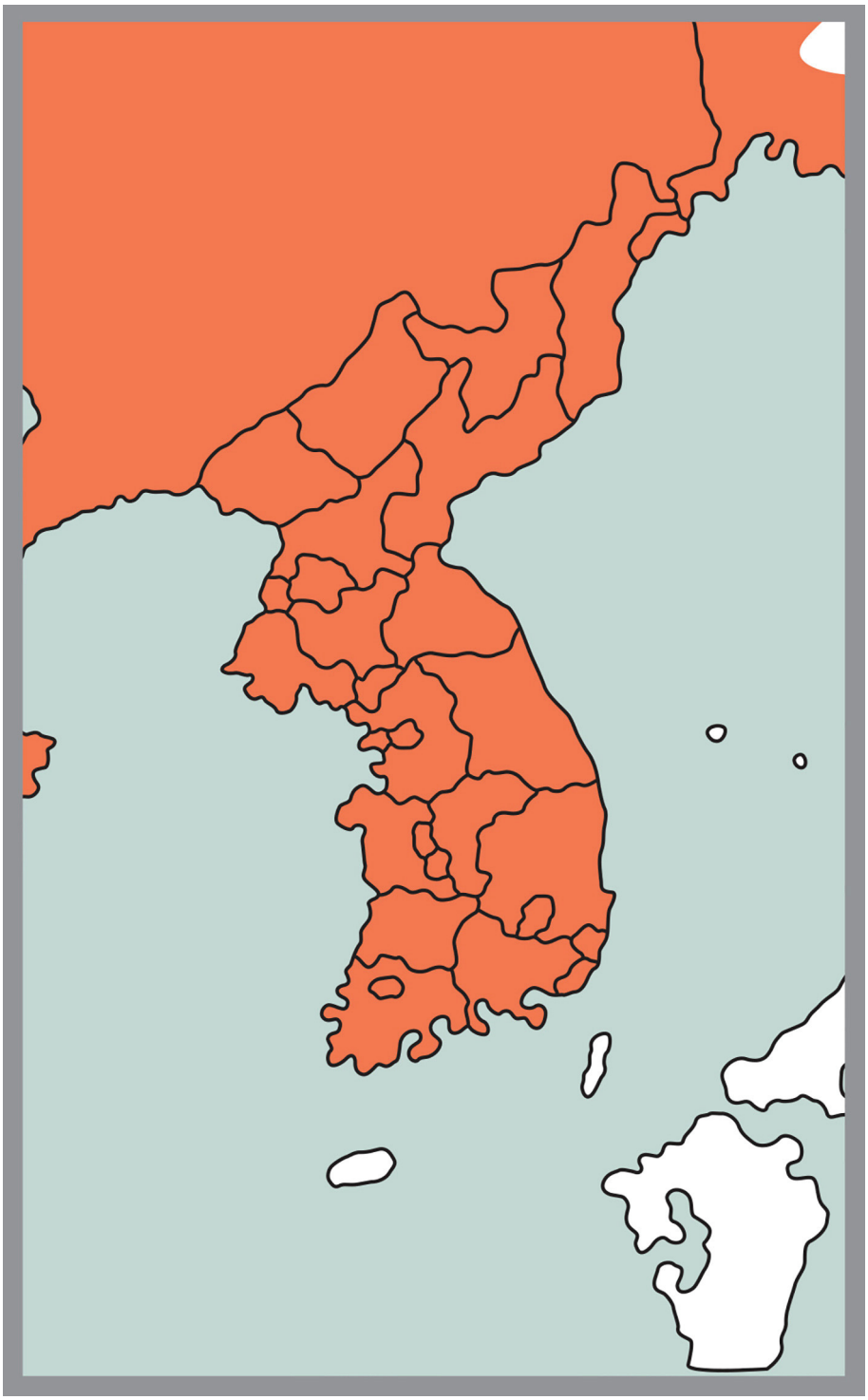

FIGURE 130. Range map of *Apodemus agrarius* in Korea.

Although striped field mice from Wan Island have been assigned to *coreae*, these mice have a large body size and cluster with *chejuensis* in morphometric analyses (Koh 1986, 1989) as in genetic analysis (Koh *et al.* 2000). It is possible that the mice from Wan Island were introduced to Jeju Island. Indeed, Koh *et al*. (2000) found that most Wan Island specimens clustered with the Jeju Island population; but other Wan Island specimens belonged to another subgroup from mainland Korea.

Apodemus agrarius (Pallas, 1771)—Striped Field Mouse

Mus agrarius Pallas, 1771 p.454; Type locality- Ulyanovsk (Simbirsk), middle Volga River, Russia.
Mus agrarius mantchuricus Thomas, 1898 p.774; Type locality- Manchuria, near Korean border.
Micromys agrarius mantchuricus: Thomas, 1906 p.863.
Apodemus agrarius coreae Thomas, 1908a p.8; Type locality- Mungyeong, Korea; Kishida & Mori, 1931 p.378; Kuroda, 1938 p.59; Tate, 1947 p.282; Won, 1958 p.446; Jones & Johnson, 1965 p.383; Won, 1967 p.214; Won, 1968 p.182.
A. agrarius mantchuricus: Thomas, 1908a p.8; Kishida & Mori, 1931 p.378; Ellerman & Morrison-Scott, 1951 p.574.
A. agrarius pallenscens Johnson and Jones, 1955a p.169; Type locality- Gunsan, Korea; Won, 1958 p.447; Jones & Johnson, 1965 p.386; Corbet, 1978 p.137.
A. agrarius: Ellerman & Morrison-Scott, 1951 p.574; Jones & Johnson, 1965 p.381; Won, 1968 p.181; Corbet, 1978 p.137; Han, 1994 p.47; Won & Smith, 1999 p.26; Han, 2004c p.125.
A. agrarius ningpoensis: Corbet, 1978 p.137; Yoon, 1992 p.82.

Range: As the most common small mammal in Korea, the distribution of *A. agrarius* covers most of the Korean Peninsula and most islands (except Jeju Island; Jo *et al.* 2017b; Fig. 130).

Remarks: Jones and Johnson (1965) reported four subspecies of *A. agrarius* principally based on body color and size: *mantchuricus* in the extreme northern part of the peninsula, *pallescens* in the coastal lowlands of southern Korea; *coreae* throughout a significant portion of the peninsula; and *chejuensis* on Jeju Island. Koh (1986, 1987, 1991) and Koh and Yoo (1992) proposed placing *pallenscens* as a synonym of *A. agrarius coreae*. Populations on the mainland and the two islands, Jeju Island and Wan Island had significant genetic differences (Koh 1986). However, three mainland localities shared several haplotypes, suggesting a considerable gene flow among populations. A morphometric study of these populations found two distinct morphotypes (*coreae*, small-sized group; *chejuensis*, large-sized group) and implied different species (Koh 1986). Recent microsatellite analysis (Jo *et al.* 2017b) showed that populations of striped field mouse on Heuksan Island, Jeju Island, and mainland clustered in three different groups. Additional studies are needed to resolve the taxonomy of *Apodemus* in Korea.

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