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# Biodiversity in Space and Time: Towards a Grid Mapping for Mongolia

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# Biodiversity in space and time - towards a grid mapping for Mongolia[1]

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## Abstract

In the future, grid mapping of animal and plant organisms will also play a major role in Mongolia. Based on geographical coordinates, a grid with a resolution of 100 x 100 km was created, which contained 561 cells. Methods and level of current understanding are exemplified by means of 2 raptors and 3 mammal species. This establishes a basis for an initial project, which will summarize all breeding occurrences of raptors based on all records, publications, or diary notes. For the first time, the short toed Eagle was verified in Mongolia as a breeding bird in 2004. By 2006, 10 offspring of *Circaetus gallicus* had been observed. We urge all enthusiasts of the Mongolian avi-fauna to contribute their breeding confirmations to our data review.

**Keywords:** biodiversity, Mongolia, grid mapping, raptors, mammalian species

## 1. Introduction

Along with data on habitat connectivity, biodiversity research focussing on species distribution is growing in importance. Within numerous European countries, grid mapping based on various geographic references were applied and have proved valuable. Sound spatial data on breeding birds and other organisms are available for several countries and are collated through a geographical network (HAGEMEIJER & BLAIR 1997, MITCHELL-JONES et al. 1999.)

However, higher resolution mapping is difficult to achieve in the vast and sparsely populated areas of our planet. Only repeated surveys at different timescales reveal the importance of such datasets as they help quantify changes in species distribution and biodiversity. As a basis for conservation, such data are of increasing importance. Assessments made by several organisations such as the IUCN, BIRDLIFE, and the Darwin Initiative have revealed a general lack of knowledge regarding many species, which also holds true for Central Asia.

An initial suggestion of a grid mapping for the territory of Mongolia was presented by STUBBE & DAWAA in 1983, which we continue herewith.

During the last few decades, ecological field-research has gained in importance within the country and an increase in tourism has included hobby ornithologists and other naturalists. As a result, the number and size of available databases has increased, albeit without much peer review. Changes and developments in land use have brought about tremendous changes to habitats, with increased livestock numbers, mining activities and other resource exploitation activities being the main drivers. Such developments have significantly affected flora and fauna in the region, and concerns for the conservation of species and habitats are being raised internationally. Along with anthropogenic influences, global climate change is modifying the distribution of many animal and plant species (KAPPELLE et al., 1999).

Based on a few selected species, we have striven to present a preliminary reflection of the current understanding of species and habitat distribution in Mongolia, in the hope that it may motivate further surveys and inform any conservation efforts for the region. Looking forward, in parallel to this paper an initial project was started, with financial support from the German Ornithological Society in cooperation with Mongolian Ornithologists, which will map the breeding distribu-

[1] Results of the Mongolian-German Biological Expeditions since 1962, No. 286.

tion of all raptors within Mongolia. During 2007 all records which are published or preserved in diaries will be reviewed in order to summarize all nesting sites on the resolution of the grid presented below. A raster of 100 x 100 km may appear coarse at first glance, yet may seem more appropriate when one considers the vast extend of the landscape. We therefore offer a grid which represents a first step towards creating a detailed synthesis of the various results from well aimed research and casual observation. A finer mapping resolution may form part of a later phase in the project, if so required. Important contributions to assess the precise position of the observations are GPS-units, which are of common use within field research nowadays.

## 2. Methods

First and foremost, a complete list of all raptors recorded within the territory of Mongolia was created. This was used as a main table for a shape file. Within ArcMap 8.2 a polygon-formatted shape file was created using the Hawthtool plug-in. The grid represents one degree of longitude and 0.6 degrees of latitude, and the projection includes “Asia north Lambert Conformal Conic”. Thus 561 neighbouring quadrangulars were created, which were then labelled with letters and numbers resulting in an individual label for each grid zone (see fig. 1). Using a number code, all nesting sites were incorporated into the main table (labelled "1") as well as expected breeding sites (labelled "2"). Two additional layers, which contain coordinates, were incorporated into the GIS along with settlements, altitudinal information and administrative boundaries. A standard layout completed the mapping process. All known nesting sites of *Circaetus gallicus* and *Gypaetus barbatus* were inserted into the database file of the main shape file. Further exemplary maps are presented for the three mammal species of three various orders *Neomys fodiens*, *Vespertilio murinus* and *Castor fiber*.

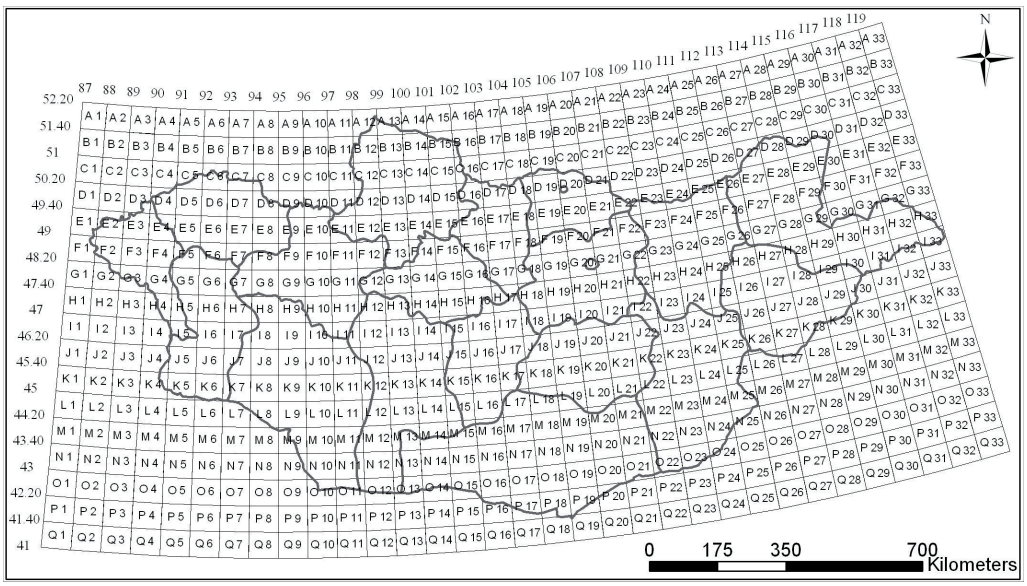


Figure 1: Grid mapping for the territory of Mongolia.

## 3. Exemplary results

### 3.1. Bearded Vulture - Bartgeier - *Gypaetus barbatus* L., 1758

Breeding observations for the bearded vulture exist for nine grid cells. The suitable combinations of breeding and feeding grounds for this species are steep mountains surrounded by vast landscapes. Almost all eyries were situated in steep and inaccessible mountain sites. As well as in the

flat steppes of eastern Mongolia and its forested northern areas, the species may be expected on numerous other spots. The oldest breeding observations were reported for the Ich-Bogd within the eastern outcrops of the Gobi-Altay (BANNIKOV & SKALON 1948, see tab. 1 and fig. 2). Various advices for breeding exist for the Yolyn Am (valley of the Bearded Vulture) in the Gurvan-Sajchan Mountains. MAUERSBERGER et al. (1982) found there two eyries. One of these was visited from adult birds several times. All other observations were made within the last 15 years. The breeding ranges were already occupied in February. Observations on eyrie construction are dated up until the middle of April. Within the second half of July the nestling(s) leaves the eyrie. In order to assess active breeding, a relatively long timeframe of four months is required. Data on the biology of the bearded vulture for its European range are summarized by BAUMGART (2001).

Fig. 2: Adult flying Bearded Vultures (photos: P.Kaczensky) and the locality of an eyrie in grid N 21, 10 km S of Chanbogd Sum (photo: M.Stubbe).

Table 1: Breeding localities of *Gypaetus barbatus* in Mongolia
(MGBE = Mongolian-German Biological Expedition)

| square | locality / date | observer / reference |
|---|---|---|
| G 19 | Hustai Nuruu National Park, 47° 43' N/ 105° 49' E; 2004 and 2005 successful hatching of one pair; 2006 (monitored but no record) | D. USUCHJARGAL (pers. com.) |
| K 6 | Chavtagijn Nuruu, Dzungarian Gobi; 30.07.2003; 2 ad. and 1 juv. around the eyrie | H. v. WEHRDEN (MGBE) |
| K 7 | Mongolian Altai, near Tachijn-tal; 6.04.1991; 2 ad. with nest material flying to the eyrie in a rocky wall | M. STUBBE (MGBE) |
| K 7 | Great Gobi B, 12.07.2006, 45° 35' N/ 93° 47' E; 1 nearly fledged juv. in the nest | P. KACZENSKY (pers. com.) |
| L 10 | Great Gobi A, 06.07.2006, 44° 35' N/ 96° 56' E; 1 juv. just leaving the nest | P. KACZENSKY (pers. com.) |
| L 14 | Ich-Bogd, several eyries; Bitjutin-ama, Churint-tal, Sebsul-tal | BANNIKOV & SKALON 1948 |
| M 17 | Gurvan Sajchan, 27.07.2004,; 43° 43' N/103° 06' E; 1 ad. feeding 1 juv. in the nest with parts from a gazelle | H. v. WEHRDEN, D. WALTHER (MGBE) |
| N 18 | Gurvan Sajchan, Yolyn Am, 03.06.1979, advices for breeding | MAUERSBERGER et al. 1982 |
| N 21 | 10 km S Chanbogd Sum, 17.07.2005; 43° 10' N/107° 16' E; 1 juv. dead 100 m from the nest | M. STUBBE, N. BATSAJCHAN (MGBE) |
| N 10 | Atas Bogd, 07.07.2004; 43°, 27' N/ 96° 47' E; 1 juv. sitting in the nest, 1 ad. nearly | H. v. WEHRDEN (MGBE) |
| O 19 | Baga Nomgony Nuruu, Bordzongijn-gobi, 25.07.2001; 2 ad. and 1 juv. above the nest (moulting feathers, feeding remains of a Khulan foal, Ibex and goats) | M. & A. STUBBE et al. (MGBE) |

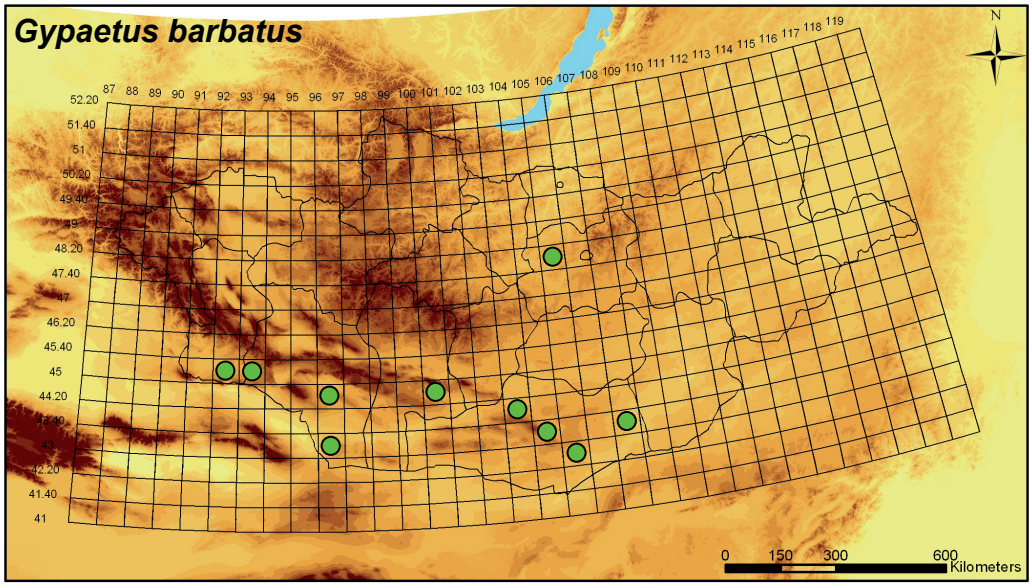


Fig. 3: Breeding sites of the Bearded Vulture.

### 3.2. Short-toed Eagle - Schlangenadler - *Circaetus gallicus* (GMELIN, 1788)

This species was recorded as a breeding bird for the first time by the Mongolian-German Biological Expedition in 2004. Since then seven eyries located in six grid cells were counted (see fig. 3, tab. 2). Typical habitats of the southern Gobi are riverine pediments (Mongolian = Sayr), which are flanked by few *Ulmus pumila* trees within a vast semi-desert matrix. The comparably small eyries were mainly found on younger trees, which were 3-4 metres high. The eyries were cushioned with green twigs. Concerning feeding behaviour, it is worth mentioning that the long-eared hedgehog (*Hemiechinus auritus*) is part of the regular diet of the Mongolian Short-toed Eagles. Within almost all eyries, hedgehog spines were observed, often in high numbers. The sole nestling leaves the eyries in the second half of August. Migration was observed until late September (19.09.2003 nearby Cogt-Ovoo Somon, three migrating *C. gallicus*).

Fig. 4: Breeding records of *Circaetus gallicus* in the Galbyn-gobi between 2004 and 2006 (photos: A. & M. STUBBE).

Table 2: Breeding localities of *Circaetus gallicus* in Mongolia
(MGBE = Mongolian-German Biological Expedition)

| square | locality / date | records of MGBE |
|---|---|---|
| L 19 | Zuun chajlaastaj, 20 km SE Cogt-Ovoo, 44° 21' N/ 105° 28' E, first breeding record for Mongolia, 1 unfertile egg, 2 ad. birds in the area 01.07.2004; 2005 and 2006 no breeding record | MGBE 2004 |
| M 22 | Öšijn-gobi, 43° 42'N/ 108° 11' E, 24.07.2005; 1 juv. was ringed; 2006 at a distance of 500 m from one unsuccessful breeding place (new nest and feathers of *C. gallicus*) | MGBE 2005 |
| O 19 | Galbyn-gobi, 42° 36' N/ 105° 46' E, 09.07.2004; 1 juv. was ringed; no breeding record for 2005 in that area; ad. bird was observed; 26.07.2006 breeding recorded in the same nest as 2004, 1 dead juv. under the nest | MGBE 2004, 2006 |
| O 20 | Galbyn-gobi, 42° 36' N/ 106° 43' E, 14.07.2005; 1 unfertile egg in the nest; 2006 controlled but no record | MGBE 2005 |
| O 20 | Galbyn-gobi, 42° 35' N/ 106° 58' E, 15.07.2005; 1 juv. was ringed; in 2006 500 m S of this place 1 successful hatching pair with 1 ringed juv. on 28.07.2006 | MGBE 2005, 2006 |
| O 21 | Galbyn-gobi, 42° 46' N/ 107° 47' E, 15.07.2004; 1 juv. was ringed; 2005 no breeding record, ad. bird in the area; 2006 in the same eyrie 1 successful hatched and ringed juv. at 29.07.2006 | MGBE 2004, 2006 |
| O 22 | Galbyn-gobi, 42° 58' N/ 108° 33' E, 30.07.2006; one successful breeding pair, 1 juv. was ringed | MGBE 2006 |

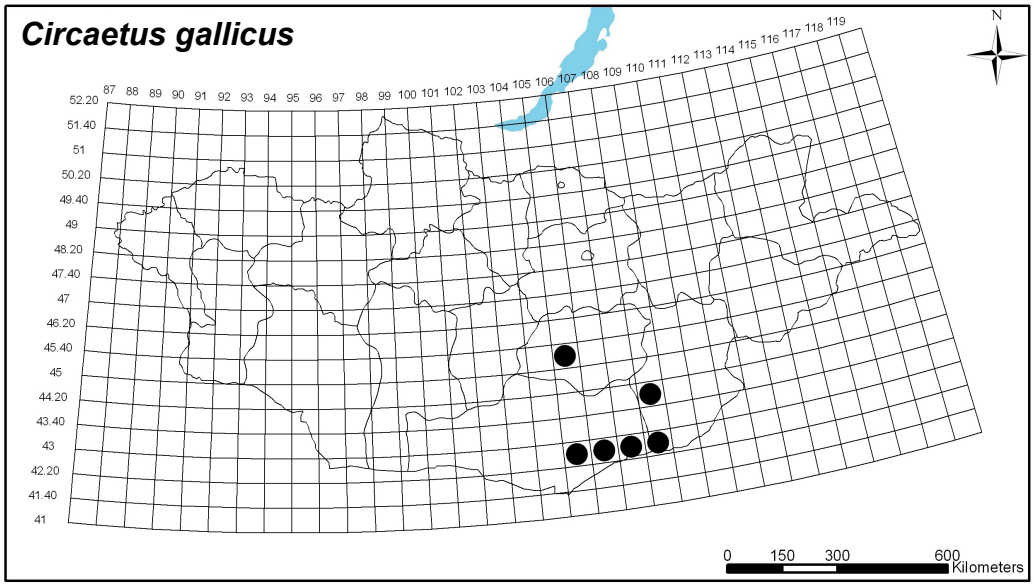


Fig. 5: Breeding localities of the Short-toed Eagle (*Circaetus gallicus*).

The short-toed Eagles presumably overwinter in India (NAOROJI 2006) and return in late April to their breeding grounds. One juvenile ringed by us in the southern Gobi (15.07.2005; ring "Hiddensee CA 008244", 46 km S Chanbogd Somon, 42°09'N/107°12'E) was found wounded after 207 days on the 07.02.2006 at a distance of 2774 km (SSW) in Burma (Myanmar), 12 km west of Minbu (20°09'N/94°45'E) at its wintering place.

The observations in Mongolia represent the eastern limit of the species distribution. From the Chinese territory the species is only mentioned as a breeding bird by CHENG (1987); in the Redlist (ZHENG & WANG 1998); and it is known from the Tienshan in Xinjing (MACKINNON & PHILLIPPS 2000). The easternmost grid cell within Mongolia represents a modification of the known distribution by some 1800 km. However, an isolated small breeding area is described by FERGUSON-LEES & CHRISTIE (2001) for the great knee of the Yellow river in the province Ningxia, along with a former breeding within Mongolia. Besides a note from KOZLOVA for the Chentey, no quotation exists regarding this matter. VAURIE (1964) quotes: "possibly in Kentei where it has been collected on June 1." The observed breeding at the Huanghe is presumably based on PRZEWALSKI (see KOZLOVA 1930), who observed a breeding male of *C. gallicus* some 60 km distant from the knee of the Yellow river and collected it. Furthermore KOZLOVA mentioned notes from DAVID & OUSTALET (1877), who recorded the species between 1860 and 1867 in China and Mongolia, albeit without giving any location names. Observation from northern Mongolia are described from KOZLOVA (1930) and STENZEL et al. (2005), where the species is present in the open forest steppe, regional Elm stands and other open tree habitats. Migrants are described from China for the provinces Gansu and Shaanxi and in the vicinity of Beijing (CHENG 1987).

### 3.3. Water Shrew - Wasserspitzmaus - *Neomys fodiens* (PENNANT, 1771)

The water shrew is currently recorded in 12 grid cells (see tab. 3, fig. 4). Five of these observations were made by the German-Mongolian Biological Expedition, where valuable results were gained from Owl-pellets. This semi-aquatic species is absent in the streamless, arid southern Mongolia and the drier eastern steppes. Its occurrence is connected to riverbanks, especially at floating runlets, and it therefore may be expected in the furthest eastern reaches of the country. The optimal microhabitat is alongside small streams bordered by cavities grown with mosses. At comparable sites the overwintering sites of the white-throated dipper (*Cinclus cinclus*) can be expected. The current observations are concentrated in the endorheic central Asian basin and in the areas discharging towards the northern ocean.

Fig. 6: Expedition camp at upper Tes-gol in September 2002 (photo: A. STUBBE).

A record at the lower stream of the Bodončijn-gol may be considered very isolated. Further searching should be done along the southern streams of the Mongolian Altay and the Changay, and likewise in eastern Mongolia at the Cherlen and the Chalchin-gol. Genetic analyses of these isolated records should be conducted.

Table 3: Distribution of *Neomys fodiens* in Mongolia (MGBE = Mongolian-German Biological Expedition)

| square | locality | date / reference |
|---|---|---|
| D 9 | Narijn-gol, Uvs-nuur region | BANNIKOV (1954) |
| D 10 | Tes-gol; 49° 35' 32.0'' N/ 96° 34' 05.7'' E | MGBE 2002 |
| D 20 | Orchon-river near Šaamar | BANNIKOV (1954) |
| E 21 | Chonninnug, Biological station | SAMJAA et al. (2003) |
| F 3 | Bajan-Ölgij, Museum of the Aimag-centre | MGBE 1980 |
| F 6 | Čonocharajchijn-gol; West-Mongolia, Chovd-Aimag | MGBE 1974, 1975, 1982, 1985, PIECHOKI et al. (1977), STUBBE et al. (1989), HOFMANN et al. (2005) |
| F 11 | Ider river, Jaru, Westchangaj | SOKOLOV et al. (1985) |
| F 20 | Charaa-gol, Buren-mountains | SOKOLOV et al. (1985) |
| G 5 | Chovd-gol, Ongocny-ulaan-ul | MGBE 1974, PIECHOKI et al. (1977) |
| G 10 | Bogd-gol | SOKOLOV & ORLOV (1980) |
| H 15 | Urd-Tamir, Cecerleg-gol, Eastchangaj | SOKOLOV et al. (1985) |
| J 6 | Bodončijn-gol | MGBE 1982, STUBBE et al. (1989) |

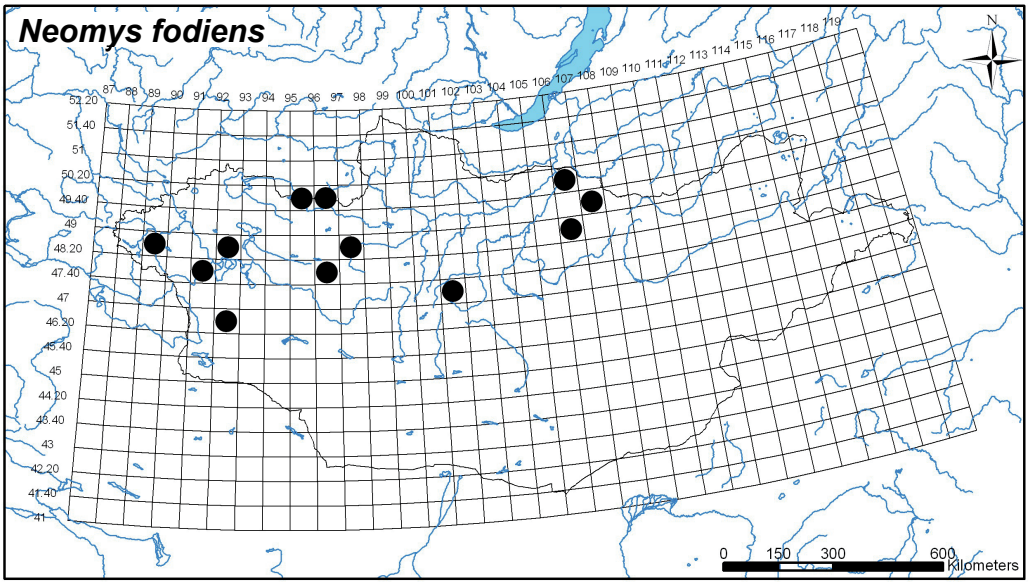


Fig. 7: Known localities of the Water Shrew *Neomys fodiens* in Mongolia (see also table 3).

Fig. 8: Collection of Micromammalia with a series of *Neomys fodiens* from upper Tes-gol area 2002.

Fig. 9: Typical habitat of *Neomys fodiens* in the surrounding of upper Tes-gol (photos: A. & M. STUBBE).

### 3.4. Parti-coloured Bat - Zweifarbfledermaus - *Vespertilio murinus* L., 1758

19 grid cell records are currently known for the Parti-coloured Bat, which is widely distributed within the country (see tab. 4, fig. 5). The first record was collected by our working group in 1964 in the Šargyn-gobi (STUBBE & CHOTOLCHU 1968). Most records were collected within the last 10 years, offering a more current insight into the species' distribution. Nursery roosts were found behind rocks and within tree trunk cracks. The offspring hunts independently from the middle of July onwards. Within late August the animals have already accumulated fat as an energy resource for their hibernation. As yet, no records of wintering places within the Mongolian territory are known. This holds true for all other Bat species known for the country.

Fig. 10: *Vespertilio murinus* from North Mongolia (valley of Orchon, 10 km S of Süchbaatar).

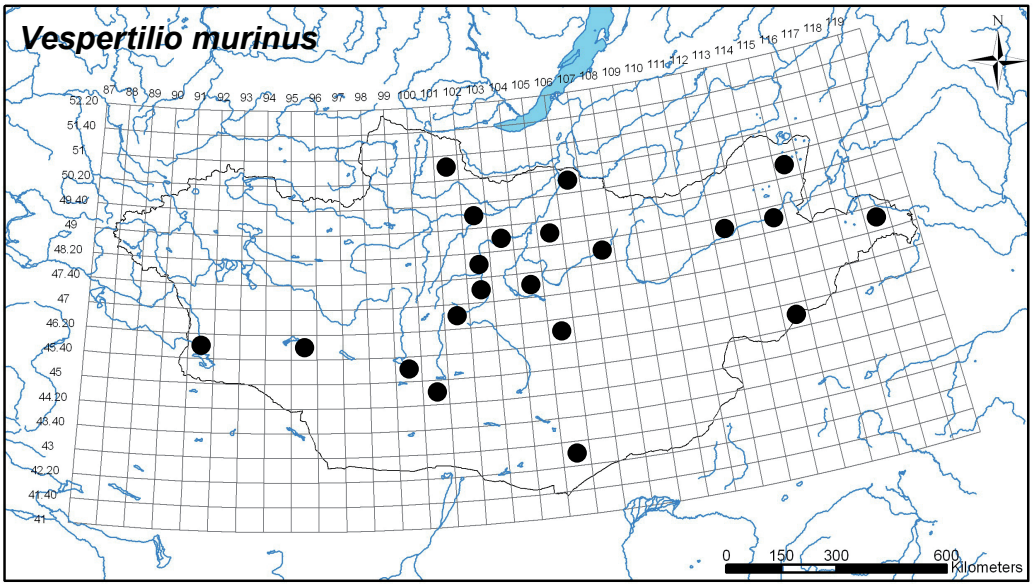


Figure 11: Records of the Parti-coloured Bat *Vespertilio murinus* in Mongolia (see also table 4).

Fig. 12: Habitat of *Vespertilio murinus* in the Orchon dunes and its roosting place (photos 10, 12: A. & M. STUBBE).

Table 4: Distribution of *Vespertilio murinus* in Mongolia (MGBE = Mongolian-German Biological Expedition)

| square | locality / date | date / reference |
|---|---|---|
| C15 | Chövsgöl, Uur Ujlgan golyn belčirt, 50°28' N/101° 44' E | DORŽDEREM (2004)<br>MGBE 2002, DOLCH et al. (2007) |
| D 20 | 10 km S Süchbaatar, Orchon 27.07.1999, 50° 09' N/106° 12' E | MGBE 1999 |
| D 20 | Orchon bridge near Šaamar, 28.07.1999, 50° 06' N/106° 12' E | MGBE 1999 |
| E 16 | Selenge mörön near Hutag Ondor, 03.08.2002, 49° 21' N/ 102° 50' E | MGBE 2002, DOLCH et al. (2007) |
| E 29 | Chöch-nuur, 49° 35' N/ 115° 35' E | ARIUNBOLD (2005) |
| F 17 | Orchon, Orchon Teeg golyn belčirt, 04.08.2002, 48° 33' N/103° 17' E | MGBE 2002, DOLCH et al. (2007) |
| F 19 | 10 km S Somon Žargalant, netting of 2 ♂♂, 13.07.1987 | MGBE 1987 |
| G 16 | Ogij-nuur, breeding colony behind a stone slab, 1977; some specimen collected | Mongolian-Tschechoslowakian Biological Expedition, JEDLIČKA (pers. comm.) |
| G 21 | Tuul-gol, Gorchi-Terelž National Park, 47° 49' N/ 107° 20' E | TINNIN et al. (2002) |
| G 26 | Cherlen river, Ich bajan cagaan uuland, 47° 41' N/ 112° 25' E | DORŽDEREM (2004) |
| G 28 | Dornodyn Tald | DMITRIEV et al. (1984) |
| H 16 | Batshaan-uul, 06.09.2005; 47° 11' N/ 104° 12' E | MGBE 2005, DOLCH (pers. comm.) |
| H 18 | Orchon river near Chužirt, 03.09.2005 47° 38' N/ 102° 40' E | MGBE 2005, DOLCH et al. (2007) |
| H 32 | Ganga-nuur, 47° 15' N/ 118° 33' E | DORŽDEREM (2004) |
| I 15 | Ulaan Tsutgalan, Changaj | TINNIN et al. (2002) |
| J 5 | Bulgan-gol N Sum Bulgan, 21.08.2002 46° 09' N/ 91° 30'E | MGBE 2002 |
| J 9 | Šargyn-gobi, first evidence for Mongolia | MGBE 1964, STUBBE et al. (1968) |
| J 19 | 25 km S Adaatsag, Sum Hoh Burd, 17.08.2005; 46° 10' N/ 105° 45' E | MGBE 2005, DOLCH et al. (2007) |
| K 13 | Böön-cagaan-nuur, 29.08.2005 45° 37' N/ 99° 15' E | MGBE 2005, DOLCH et al. (2007) |
| K 28 | Dornod Mangold, 45° 15' N/ 114° 00' E | DORŽDEREM (2004) |
| L 14 | Orog-nuur, 26.08.2005 44° 49' N/ 100° 48' E | MGBE 2005, DOLCH et al. (2007) |
| O 19 | Bordzongijn-gobi, 05.08.1997 42° 29' N/ 105° 15' E | MGBE 1997 |

### 3.5. Centralasiatic beaver - Mongolischer Biber - *Castor fiber birulai* SEREBRENNIKOV, 1929

The autochthon occurrence of the beaver is at the Bulgan-gol in south-western Mongolia. In 1974, 1975 and 1978 beavers were caught by the Mongolian-German Biological Expedition at this river and introduced at the Chovd-gol in western Mongolia, where a stable population became established. This central Asian sub-species was introduced in 1985, 1988 and 2002 at the Tes-gol in the Uvs-nuur basin in north-western Mongolia (see tab. 5, fig. 6). The specimen expanded from there through the lower river into the Tes-gol situated in the Mongolian-Tuvinian border region of the Zavchan-Aimag (STUBBE et al. 2005). As is presently the case, future priority lies with the protection of the gene-pool of this geographically isolated sub-species, which is restricted to the central Asian endorheic basin. An introduction or immigration of the Tuvinian castor may be possible in the Darchat depression western of the lake Chövsgöl, thus local nature conservation institutions should intensify conservation efforts.

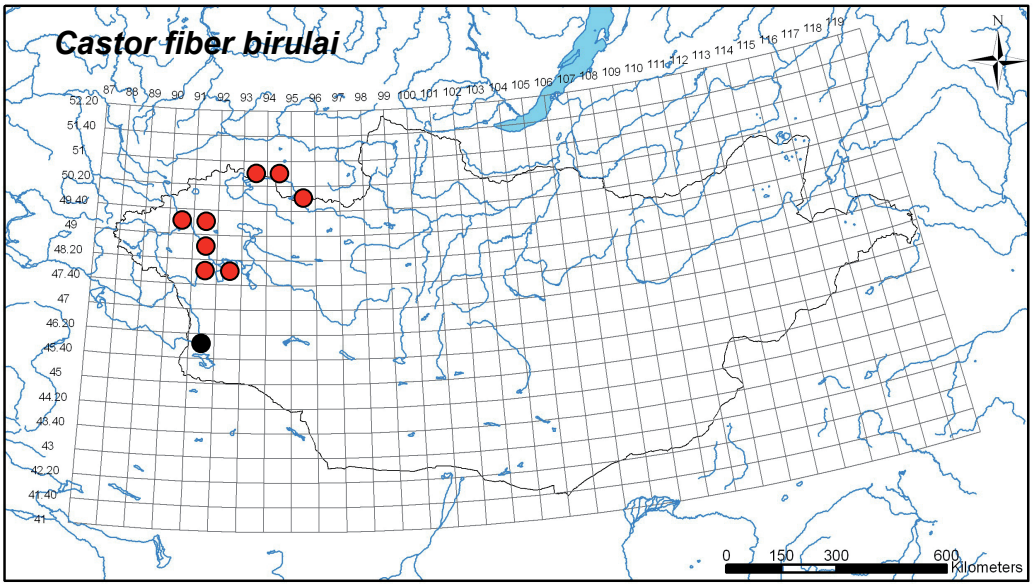


Fig. 13: Location of autochthonous population (black point) and distribution of translocated Centralasiatic beavers (*Castor fiber birulai*).

As mentioned above, we initiated a project in cooperation with our Mongolian colleagues in order to map the breeding regions of all raptors. Therewith, by using the example of a systematic group, we want to emphasise the necessity for grid based mapping approaches to underline a severe lack of data for several regions, as well as for a large number of species. This mapping approach has been made publicly accessible in order to record all plant and further animal species.

Both quantification and a temporal resolution will gain greater importance within later phases of the project. Quantitative ornithology has a huge backlog demand in Mongolia, which may currently not be solved considering the sheer size of the country and the low number of trained scientists; sound spatial information may be only gained with a focus on certain regions. This publication may be a first step towards this goal.

We kindly address all insiders and hobby researches of the Mongolian Avifauna to contribute their breeding bird observation of raptors to us; this may allow for a most up to date assessment.

Fig 14: Lower course of Bulgan-gol – the area of the autochthonous Centralasiatic beaver *Castor fiber birulai* (photos: A. & M. STUBBE, 2002).

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