Population and Distribution of Eurasian Beaver (Castor fiber)

DUNCAN HALLEY, FRANK ROSELL AND ALEXANDER SAVELJEV
1 Norwegian Institute for Nature Research, Tungasletta 2, N-7485 Trondheim, Norway, e-mail: duncan.halley@nina.no
2 Telemark University College, N-3800 Bodø Telemark, Norway
3 Russian Research Institute of Game Management and Fur Farming (VNHOZ) of RAAS, 610000 Kirov, Russia

Corresponding author: Duncan Halley


Abstract

After being reduced to about 1,200 animals in eight isolated populations by the beginning of the 20th century, Eurasian beavers (Castor fiber) have powerfully recovered in range and population, through widespread reintroductions, relaxation of persecution, and natural spread. Populations are now (2010) established in all countries within their former natural range in Europe except for Portugal, Italy, and the south Balkans (Greece, Albania, Bulgaria, Macedonia, Kosovo, Montenegro). In Asia, there are significant populations in West and Central Siberia; and small relict populations elsewhere in west and south Siberia, and in Xinjiang (China)/western Mongolia. The current minimum world population estimate for Eurasian beavers is 1.04 million, though this figure includes some populations of introduced North American beavers (C. canadensis) in the NW and Far Eastern Russian Federation, where the ranges of the two species occur in close proximity and to some extent overlap. Both populations and range are in rapid expansion, and in 2008 the species was reclassified by IUCN as Least Concern, though some subspecies remain threatened. We present maps summarizing current knowledge of the world distribution of Eurasian beaver and the Eurasian distribution of the introduced North American beaver, and tables of the most recent known population estimates for each country, broken down by region for the Russian Federation.

Keywords: beaver, Castor fiber, population, distribution, range, reintroduction

Introduction

Eurasian beavers (Castor fiber) have, since the late 19th century, staged a remarkable recovery both in population and distribution. From being a critically endangered species reduced to about 1,200 animals in scattered enclaves, the species is now conservationally secure and, aided by widespread reintroductions, rapidly recolonizing much of its range, including areas where it has not occurred for centuries or even millennia. The pattern of re-expansion is not only interesting in itself, but also offers valuable insights in the fields of population biology and conservation ecology. Until recently, this expansion has not been well documented, but since the latter part of the 20th century increasing amounts of information have become available, allowing the preparation of reviews summarizing the then current status of the species (Macdonald et al. 1995, Nolet and Rosell 1998, Halley and Rosell 2002, 2003). However, both population and distribution continue to expand rapidly, both through natural spread and new reintroductions, so that these reviews rapidly become overtaken by events. Periodic summaries and updates of the most recent population and distribution data are therefore of use, both to current researchers and managers seeking an overview of the many, widely scattered, papers on the subject, and for future biologists interested in following in detail a remarkable case study in conservation biology. In this paper, we present a summary of the information available on population and distribution up to the end of 2010, in a similar format to information presented in Halley and Rosell 2002, 2003 for ease of comparison.

Distribution and populations

Distribution in Europe is shown in Figure 1 and in Asia in Figure 2. The continuous population ranges from Germany through Poland, the Baltic States, Belarus, Ukraine, to central Siberia in the Russian Federation. There is a large disjunct population in Norway and Sweden, and smaller scattered disjunct populations through the rest of mainland Europe. Disjunct reintroduced populations are also found on the
Soviet Union, almost 17000 beavers were translocated between 1927 and 2004, of which 12000 were to sites in Russia and the remainder to Ukraine, Belarus, Latvia, Estonia, Lithuania and Kazakhstan in decreasing order of numbers (Saveljev 2003).

In 2009, beavers were reintroduced to Knapdale in western Scotland and near Copenhagen in Denmark. In 2010 the existence of a wild-living population on the Tay watershed in Scotland, probably resulting from escapes of captive animals, became public. Sightings of free-living animals on the Tay date from 2001 (H. Chalmers pers. comm.). Breeding has been confirmed in at least two locations and suspected in at least six others; but both the size and status of the population is unclear. This population was not established by the licensing process required in Scotland, and the authorities are currently (December 2010) attempting removal by live trapping at some of the known sites on the river.

Introduced populations of North American beaver are established in Finland and northwest Russia, and the Russian Far East (Savelev and Safanov 1999; Safonov and Saveljev 1999). In 2009 a small population was discovered in Luxembourg, apparently as a result of escapes from a wildlife park just across the border in Germany (Table 1).

Table 1. Location and estimated minimum population sizes of relict populations of Eurasian beaver (Castor fiber)

<table>
<thead>
<tr>
<th>Population</th>
<th>Minimum population size</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Rhône, France</td>
<td>30</td>
<td>Richard 1985</td>
</tr>
<tr>
<td>Telemark, Norway</td>
<td>60-120</td>
<td>Collet 1897</td>
</tr>
<tr>
<td>Elbe, Germany</td>
<td>200</td>
<td>Heideke and Hörg 1986</td>
</tr>
<tr>
<td>Priepet marshes, Belarus/Ukraine/Russia</td>
<td>&lt;300</td>
<td>Zharkov and Solokov 1967</td>
</tr>
<tr>
<td>Voronezh, Russia</td>
<td>70</td>
<td>Lavrov and Lavrov 1986</td>
</tr>
<tr>
<td>Konda-Sosva, Russia</td>
<td>300</td>
<td>Lavrov and Lavrov 1986</td>
</tr>
<tr>
<td>Upper Yenesei, Russia</td>
<td>30-40</td>
<td>Lavrov and Lavrov 1986</td>
</tr>
<tr>
<td>Urunug, Mongolia/China</td>
<td>&lt;100-150</td>
<td>Lavrov and Hao-Tsuan 1961</td>
</tr>
</tbody>
</table>

Of recent reintroductions, that to the Ebro/Aragon watershed of Spain, which is considered illegal by the regional authorities affected, is the most poorly documented. Current distribution and populations are unknown, though probably rather wider and larger than mapped and given in the table, given known patterns of dispersal and population growth (Halley and Rosell 2002; Discussion) and the large amount of high quality habitat available; breeding and the occupation of new territories is known to have occurred. Trapping and removal is apparently underway in one (possibly two) of the four Spanish regions affected, but neither systematically or widespread enough to have any realistic chance of substantially affecting the population. There are reports of beaver signs found recently (autumn 2010)

Figure 1. Distribution of both beaver species in Europe. Traditional subspecies designations: 1 – Castor fiber fiber; 2 – Castor fiber albicus; 3 – Castor fiber galliæ; 4 – Castor fiber belarusicus; 5 – Castor fiber osteuropæus. Dark grey shading represents the present range of Castor fiber (locations of relict populations are marked in black); light grey shading represents the range of Castor canadensis. Squares are reintroduction sites where range has not yet spread significantly.

Figure 2. Distribution of both beaver species in Russia, Kazakhstan, Mongolia, and China. Traditional subspecies designations: 1 – Castor fiber fiber; 6 – Castor fiber polheï; 7 – Castor fiber tuvinicus; 8 – Castor fiber birulai. Dark grey shading represents the present range of Castor fiber (relict populations are marked in black); light grey shading represents the range of Castor canadensis in the periphery of the main Russian range, in central Asia, and on the Amur of the Russian Far East. Although natural spread has contributed significantly to range and populations, most of the expansion is due to re-introductions, of which at least 205 have been recorded to distinct locations outside the former Soviet Union (FSU) (Halley and Rosell 2002). Within the former
downstream on the Ebro at Caspe, c.200 km SE of the
known range (I. Jimenez pers. comm.), but this may rep-
resent a wandering individual rather than establishment.

The status in Turkey remains uncertain. Reports of
an observation on the Yamurluk marshes (Adana
province) in the 1970s (Boessneck 1974, Kumerloev
1975, Veron 1995, discussed in Savelyev 2000) were
discounted by Turkish wildlife experts (Özgün Emre
Can, Turkish Society for the Protection of Nature, pers.
comm.; Halley and Rosell 2002). However, further sight-
ings have been alleged (Dr. Yüksel Coşkun, Univ of
Dulche, pers. comm.), but their reliability is unclear and
requires confirmation. If the species is still extant in
Turkey, clearly it would represent an additional sur-
viving subspecies (and ESU), a significant addition to
the genetic diversity of the species, and is probably
critically endangered. Establishing the status, and, if
extant, population and distribution, in the area should
clearly be priority.

Available information on relict population sizes is
given in Table 1, and data on date of extinction, legal
protection, reintroduction, and current population size is presented in Table 2.

Discussion

Populations of the eight refugia in which Eurasian
beavers survived the 19th century are currently each
described as separate subspecies. Recent mDNA stud-
ies (Ducroz et al. 2005) indicate that extant populations
of the species divides into at least two Evolutionary
Significant Units (ESUs). The western ESU comprises
the traditional subspecies C.f. fiber, albicus, and gal-
liae; the eastern C.f. belarusicus, osteuropaeus, poh-
lei, tuvicensis, and birulaei. While western ESU popu-
lations show very little differentiation and are clearly
a single ESU, eastern populations are more diverse and
may be considered to be several ESUs. These findings
should be taken into account by managers seeking
reintroduction stock in line with IUCN guidelines.

Eurasian beaver families consist of, on average,
about four individuals, of which only the adult pair
breeds. The minimum populations quoted should be in-
terpreted in this light; the Rhône remnant population,
for example, would seem to have been reduced to about
six breeding pairs at minimum, well below the 25 pairs
often quoted as a minimum viable population (MVP).
(That evidence on the ground indicates that this rule-
of-thumb is generally too pessimistic, is fortunate for
conservation; see Caughley and Sinclair (1994) for re-
view of this issue). The small size of remnant popula-
tions, and resultant inbreeding and loss of genetic di-
versity, does not seem to have led to serious breeding
problems in this species, but suggests that populations
descended solely from some of the smaller surviving
populations may be more susceptible as a population
to epidemic disease, due to lack of diversity in immune
systems (Ellegren et al. 1993). Recently other fuller and
interesting research of the major histocompatibility
complex, MHC, of the aboriginal beavers of Eurasia
(albiclus, galliace, fiber, tuvinicus, birulai, pohlei) has
been carried our (Babik et al., 2005), using the same
samples as used in Ducroz et al., 2005 and Durka et al.,
2005. In all the relict populations except pohlei, the
MHC on the DRB gene is specific and monomorphic,
one form only in each relict population and a different
one for each. Only West Siberian beavers C.f.pohlei
show any variation of the immune system (4 variants
of the DRB gene). The current minimum world popula-
tion estimate of 1036226 given here is conservative,
calculated by adding together the lowest estimates for
each country. Note, however, that the population fig-
ures for the North West Russian and Far East Federal
Districts of the Russian Federation are for Eurasian and
North American beavers combined (those for Finland
do not include C. canadensis).

All surviving European populations have grown
in numbers beyond the point where further loss of
genetic diversity through drift might be a conserva-
tion problem. The status of some of the Asian relict
populations is unclear and would merit investigation.

In most countries of the western and central Euro-
pean mainland, beavers occur at relatively low numbers
for the present, and there is much unused suitable habi-
tat. The range maps presented here are therefore prob-
ably conservative, as newly colonising beavers tend to
select prime habitat requiring little alteration, where
their presence may not immediately be noted by non-specialists. Very considerable expansion in both populations
and range can be expected in the coming decades, es-
pecially in Western Europe and the Danube watershed.
A typical pattern of population development on a wa-
tershed following natural or artificial reclamation has
become evident in recent years, the evidence for which
is reviewed in Halley and Rosell (2002); the most de-
tailed case study of range and population expansion is
found in Hartman (1995). At first, range expansion
through the watershed is rapid, but population expan-
sion is relatively slow. This seems to be because bea-
viers select the best habitat available, rather than set-
ting close to their natal territory. It is also difficult to
find a mate in the vast, unoccupied stretches of a large
watershed, and it appears that beaver will wander widely
while searching. The furthest known dispersal known,
500km, was registered in 1958 in the Irtysh watershed,
in the Omsk region of the USSR (Lavrov 1980 quoted in
Saveljev et al. 2002); and a dispersal of 200 km in-
volving crossing a watershed divide has also been re-

2012, Vol. 18, No. 1 [34] ISSN 2029-9230
Table 2. The history and present status of Eurasian beavers (*Castor fiber*)

<table>
<thead>
<tr>
<th>Country</th>
<th>Extirpation</th>
<th>Protection</th>
<th>Re-introduction and/or translocations</th>
<th>Present population size</th>
<th>References/comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>1869</td>
<td>-</td>
<td>1970-90</td>
<td>3 000</td>
<td>Sieber (1989), Kollar and Seiter (1990), Parz-Gollner and Vogl (2006); Parz-Gollner and Hübner (conf. pres. Dubingiai)</td>
</tr>
<tr>
<td>Belarus</td>
<td>remnant</td>
<td>1922</td>
<td>1948</td>
<td>65 400</td>
<td>Djoshkin and Safonov (1972), Belarus Ministry of Statistics (2008)</td>
</tr>
<tr>
<td>Belgium</td>
<td>1848</td>
<td>-</td>
<td>1998-99</td>
<td>800-1000</td>
<td>Rubbers and Van den Boegert (2006); Dewas pers comm</td>
</tr>
<tr>
<td>Bosnia and Herzegovina</td>
<td>?</td>
<td>2006</td>
<td></td>
<td>60</td>
<td>Kunovac (pers. comm. 2009)</td>
</tr>
<tr>
<td>Denmark</td>
<td>c.500 BC</td>
<td>-</td>
<td>1999</td>
<td>121</td>
<td>Skov- og Naturstyrelsen (1999); Klein (1999); Elmeros et al. (2007, 2009)</td>
</tr>
<tr>
<td>England</td>
<td>18th century?</td>
<td>-</td>
<td>Feasibility study completed</td>
<td>0^2</td>
<td>Coles 2006; Gow (pers. comm.)</td>
</tr>
<tr>
<td>Hungary</td>
<td>1865</td>
<td>-</td>
<td>1980-2006</td>
<td>492</td>
<td>Kollar and Seiter (1990), Bozsér (pers. comm.); Gruber (pers. comm.); EU^6</td>
</tr>
<tr>
<td>Italy</td>
<td>1541</td>
<td>-</td>
<td>proposed</td>
<td>0</td>
<td>Nolet (1996)</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>1915</td>
<td>-</td>
<td>1963-1986</td>
<td>5 500</td>
<td>Karagozhin (2000), Saveljev (2005), Berber (2008);</td>
</tr>
<tr>
<td>Lithuania</td>
<td>1938</td>
<td>-</td>
<td>1947-59</td>
<td>86 000-121 000</td>
<td>Palonen (1965); Mickus (1995); Balciuskas et al. (1999); Ulevicis (2000);</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>?</td>
<td>?</td>
<td></td>
<td>0^3</td>
<td>Ulevicis (pers. comm. 2009); Schley et al. (conf. pres. Dubingiai)</td>
</tr>
<tr>
<td>Moldova</td>
<td>?</td>
<td>?</td>
<td></td>
<td>?</td>
<td>Status uncertain</td>
</tr>
</tbody>
</table>

^1 Based on subfossil remains. Philological evidence from placenames suggests a remnant may have survived as late as the 11th century.

^2 Reintroductions to fenced enclosures at Ham Fen, Kent, 2001 (6); Cotswolda Water Park in 2005 (6) (2009 at population least 10, Rodell pers. obs.); and Martin Mere in 2007 (4). Enclosures are large enough that animals live an essentially wild existence, but dispersal is prevented.

^3 C. 15 C. canadensis established, probably escaped from zoo in Saarland (Schley et al pers. comm)

^4 Current population of the official trial reintroduction in Knaphal. A small feral population of beavers, of unknown size, is established in the wild on the Tay river system (see text).
<table>
<thead>
<tr>
<th>Country</th>
<th>Status</th>
<th>Year Range</th>
<th>Population Estimate</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portugal</td>
<td>c. 1450</td>
<td>-</td>
<td>0</td>
<td>Antunes 1989</td>
</tr>
<tr>
<td>Romania</td>
<td>1824?</td>
<td>1998-99</td>
<td>610-690</td>
<td>Troid and Ionescu (1997), Schwab (pers. comm.); Ionescu et al. (2006); G. Herlo (pers. comm. 2009); G. Ionescu et al. (pers. comm. 2009)</td>
</tr>
<tr>
<td>North-West Federal District</td>
<td></td>
<td></td>
<td>120 500⁶</td>
<td>Lomanova 2009</td>
</tr>
<tr>
<td>Central FD</td>
<td></td>
<td></td>
<td>126 000</td>
<td>Lomanova 2009</td>
</tr>
<tr>
<td>Privolzhsky FD</td>
<td></td>
<td></td>
<td>138 600</td>
<td>Lomanova 2009</td>
</tr>
<tr>
<td>South FD</td>
<td></td>
<td></td>
<td>7 500</td>
<td>Lomanova 2009</td>
</tr>
<tr>
<td>Ural FD</td>
<td></td>
<td></td>
<td>31 500</td>
<td>Lomanova 2009</td>
</tr>
<tr>
<td>Siberian FD</td>
<td></td>
<td></td>
<td>70 800</td>
<td>Lomanova 2009</td>
</tr>
<tr>
<td>Far Eastern FD</td>
<td></td>
<td></td>
<td>800⁷</td>
<td>Saveljev 2003; Lomanova 2009</td>
</tr>
<tr>
<td>Scotland</td>
<td>16th century</td>
<td>-</td>
<td>12⁴</td>
<td>Scottish Wildlife Trust (pers. comm. 2009)¹</td>
</tr>
<tr>
<td>Serbia</td>
<td>1903?</td>
<td>-</td>
<td>150</td>
<td>Cirovic 2006; Cirovic (pers. comm. 2008)</td>
</tr>
<tr>
<td>Slovenia</td>
<td>?</td>
<td>?</td>
<td>20²</td>
<td>Grubesic (pers. comm.); EU⁵</td>
</tr>
<tr>
<td>Slovakia</td>
<td>1851</td>
<td>-</td>
<td>520-700</td>
<td>Pachinger and Hulik (1999); Valachovic (1997), Dubba and Majlan (1997); EU⁵</td>
</tr>
<tr>
<td>Spain</td>
<td>17th century</td>
<td>1980s</td>
<td>&gt;40</td>
<td>Cena et al (2004); Cena (pers. comm.)</td>
</tr>
<tr>
<td>Sweden</td>
<td>1871</td>
<td>1873</td>
<td>&gt;100 000</td>
<td>Frey (1978), Hartman (1994, 1999)</td>
</tr>
<tr>
<td>Switzerland</td>
<td>1820</td>
<td>-</td>
<td>1600</td>
<td>Stocker (1985), Macdonald et al. (1995), Winter (1997), S. Capt, Centre Suisse de Cartographie de la Faune (pers. comm. 2007); Angst (conf. pres. Dubingiai)</td>
</tr>
<tr>
<td>Ukraine</td>
<td>remnant</td>
<td>1922</td>
<td>35 420</td>
<td>Safonov and Saveliev (1999)</td>
</tr>
<tr>
<td>Wales</td>
<td>16th century</td>
<td>-</td>
<td>0</td>
<td>Ukrgosstatistika (2008)</td>
</tr>
</tbody>
</table>

Minimum Population Estimate
- 1 044 000 (using lowest estimate from each country; final figure rounded to nearest thousand)

¹ Natural spread from Croatia.
² EU: European topic centre on biodiversity http://biodiversity.eionet.europa.eu/article17/
³ Both species (C. fiber and C. canadensis)
ported (Saveljev et al. 2002). Both were animals moving into uncolonised waters. However, the longest distance colonisation (i.e., settlement and breeding) has been reported is apparently Fustec et al.’s (2001) record of colonisation of an area about 80 km away from the nearest other occupied area, on the Loire in France.

Some time later, depending on the size and topography of the watershed but often after about 10-25 years, populations reach a critical density for encountering a mate, and the population then increases very rapidly. This is followed (on average 25-34 years after watershed colonisation in Hartman’s (1995) study) by a phase of population decline as marginal habitats become exhausted; and then by rough stability.

While in established populations average dispersal distance is usually much less than the extremes mentioned above, 3.9 km on the Azas river in south Siberia, individuals disperse much further, one subadult male being found 85 km upstream (Saveljev et al. 2002). This implies the potential for considerable gene flow within continuous populations.

Incidents of beaver conflicts with humans tend to intensify during the later stages of the rapid increase phase, in part because then beaver more often take into use more marginal sites requiring more beaver engineering, dams, canals, etc., which may conflict with human landuses. In many countries, this phase of population development has been accompanied by the introduction of hunting, aimed at least in part at addressing conflict issues (Halley and Rosell 2002).

Conversely, while beavers can and do cross land, and have been found up to 11.7 km away from the nearest water body (Saveljev et al. 2002) watershed divisions do show a clear barrier effect for beaver expansion, which can be strongly isolating where natural or artificial habitat barriers, such as high mountains or intensive farmland, intrude between watersheds. Depending on the management strategy, therefore, this suggests a policy of many reintroductions to many watersheds, or, conversely, the early removal of colonising individuals on watersheds where their presence is considered undesirable. Given the pattern of range expansion within watersheds, confining beaver populations to a particular stretch within a watershed will be impractical unless there are strong artificial barriers to expansion, such as man-made river barrages, or a heavy and directed hunting or trapping effort (Halley and Rosell 2002). Beaver populations should therefore be managed on a watershed scale.

Acknowledgements

Many beaver researchers throughout Europe kindly responded to requests for information. In particular, we would like to thank S. Ashbirk; O. Boszér; K. Bevanger; S. Capt; D. Cirovic; A. Czech; R. Dennis; J.-F. Ducroz; M. Grubesic; G. Hartman; V. Kostkan; P. Lahti; H. Lea; R. Liobis; P. Rouland; G. Schwab; J. Sieber; F. Tattersall; U. Timm; A. Ulevicius, A. Volokh, C. Winter and G. Yanuta.

Afterword

The authors would be grateful, on a continuing basis, for any corrections and/or updates to the information we have regarding the progress of reintroduction, range expansion, and population development of Eurasian beavers. All contributions will, of course, be acknowledged in any resulting publications.

References


Dewas, M. in press. The situation of native and introduced beavers (Castor spp.) in France and neighbouring countries. Mammal Review.


Baltic Forestry

Population and Distribution of Eurasian Beaver (Castor Fiber)  
H. Halley et al.


Erforschung biologischer ressourcen der Mongolischen Volksrepublik 2: 3-92.

Received 15 December 2010
Accepted 18 May 2012