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CAMARO-D

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Beaver management

Cluster 2 and 3

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1. Introduction

Background and aims of this best practice manual:

It is widely known that when beavers and humans come into contact, problems and conflicts can and do occur. Most of these conflicts are related to flooding caused by beaver building activity, destruction and damage from gnawing. Trees can fall over and pose a danger to people and property near residential areas. Crop damage can also occur in agriculture.

The aims of this brochure are

- providing information on damage compensation,
- beaver management and beaver monitoring and
- approaches to minimize conflicts by different interest groups.

Moreover, affected people (landowners etc.) will find information and effective solutions on what can be done and where to find help.

Figure 1: The Eurasian beaver, 2018, Alexander Maringer, National Park Gesäuse (Styria, Austria)

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The sharing of transnational best practice and a list of technical measures are listed.

The transnational manual for practitioners for beaver management is part of the Interreg Danube project “CAMARO-D” and therefore funded by the European Union. The manual contains best practices from Austria, Czech Republic, Germany, Hungary and Romania, and with a short overview relevant for all Danube countries. In specific CAMARO-D pilot areas the actual situation is described.

Figure 2: The Eurasian beaver, 2018, Alexander Maringer, National Park Gesäuse (Styria, Austria)

2. General facts about the European beaver (*Castor fiber*)

The Eurasian beaver almost got extinct in Europe in the sixteenth and seventeenth century due to the high demand for fat, fur and "castoreum", a secretion from the beavers' scent glands which was thought to have medical properties. However, the beaver is now being re-introduced throughout Europe.

The European beaver (*Castor fiber*) is the second largest rodent on earth as it can reach 75 – 100 cm body length and additional 35 cm tail length. Beavers continue to grow all their lives long. Adult male beavers over 25 kg are common. In contrast to most other mammal species, female beavers can be as large as or even larger than males of the same age.

Beavers live 10-17 years in in the open landscape and in a maximum of 35 years in keeping. The beaver is nocturnal and semi-aquatic. They are good swimmers and can stay under water for as long as 15 minutes. However, they are quite slow on land.

Figure 3: The Eurasian beaver, photograph by Alexander Schneider, Naturschutzbund, 2018

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Their broad stiff scaled tails are usually used like rudders to steer under water and for balance while sitting on land. They also use their tails to slap the water as a warning of danger. The beavers' front teeth never stop growing. Beavers prevent their teeth from getting too long by gnawing on wood. Moreover, they use their teeth to cut trees and other plants that they use both for building and for food. Beavers are herbivores and store sticks and logs in a pile as food for the winter since they do not hibernate. The months from May to October are referred to as "green vegetation period" which means that beavers consume mainly herbs in these months and often graze on agricultural crops (maize, sugar beets, corn, young rape etc.). From autumn to spring their preferable feed are woody plants. Nevertheless, they gnaw on woody plants throughout the whole year but to a lesser extent during the summer months. The beaver prefers certain woody plants to others – poplars and willows are the most important ones. Most of the trees that are cut down by beavers (95%) do not exceed 20 cm diameter. Moreover, the beaver prefers younger trees to older ones.

Beavers live in colonies, which consist of two adult beavers (male and female) and their offspring in their first and second year of life. Each year beavers have mostly 3-4 juveniles. A beaver family has its own territory, which is defended vehemently against fellow beavers. Therefore, it is not possible that more than one beaver colony lives in the same territory and thus the number of beavers will never increase to a disconcerting number.

In Austria, grown beavers do not have natural enemies, which is the reason why they can reach an old age. However, the death rate of young beavers is considerable.

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2.1. Building activities

Like no other animal, the beaver influences and shapes its habitat with enormous effects on the water balance. The most known natural trait of beavers is the building of **dams, lodges and canals** along rivers and streams. For those buildings they use branches and trunks (typically of smaller diameters).

They use leftovers from gnawed branches(without bark), but they often build from freshly cut down pieces which are not used for food as well. They use their favourite woody plants for gnawing and less favourite ones for building activities. When building a dam, they first place vertical poles where they put a crisscross of horizontally placed branches; gaps are filled with weeds and mud. Beavers build dams with the purpose of protection against predators as well as to provide easy access to food. The beaver works at night and is known for carrying mud and stones with its forepaws and timber between their teeth. Since beavers can rebuild dams overnight, it is quite difficult to destroy a dam without removing the beaver itself.

The small ponds, which are a subsequent outcome of well-maintained dams, help beavers to isolate their **lodges**. Beavers cover their lodges late each autumn with fresh mud, which freezes when frosts arrive and becomes as hard as stone and prevents predator from getting into the lodge. The underwater entrance of the lodge makes it for intruders almost impossible to get into the lodge.

Figure 4: Beaver dam, 2018, photograph by Claudiu PAŞCA, INCDS Braşov

Figure 5: Covasna County, 2018, photograph by Claudiu PAŞCA, INCDS Braşov

Canals can be up to 100 metres long and are built to link one pond to another or to link the lodge to a good source of food. The beaver builds the canal by pushing through soil and vegetation using its forepaws. At the bottom of ponds channels can be found, which have the function of a network between the lodge and other living areas, or food caches.

2.2. Beaver habitats

The spread of the beaver is currently being documented. As a species that can easily adapt to its environment, not only natural waters can function as a habitat for the beaver, but also waters surrounded by agricultural land and water running through villages can serve as such. Due to its ability of building dams and canals and cutting trees with a trunk perimeter of 50 centimetres, the beaver is considered as a key species of floodplain – ecosystems since it can shape its environment actively. However, this is the reason for a number of conflicts of interests (see Chapter 2.4.: Conflict Potentials).

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Figure 6: Beaver territory in Stein an der Enns, Verena Mayer, 2018

Threatening factors

1. Hunting (especially illegal)
2. Intensive land use, reduction of landscape connectivity
3. Water pollution (e.g. through fast-growing soft wood and aquatic vegetation which accumulate metals)
4. Defensive reaction of humans (protecting their security and economic interests against the influence of beavers on the landscape)
5. Traffic collisions; intensification of transport (shipping, road and rail)

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6. Habitat destruction (deforestation, regulation and maintenance of river beds and banks of already regulated streams and rivers, occupation of landscape for building, intensification of transport - shipping, road and rail transport, the intensification of the use of watercourses, construction of barriers on rivers, etc.)
7. Uncovered technical equipment in water and its proximity acting as traps

Positive effects on the environment

- **Locally increase of subterranean water**

  The dam building activity of the beaver leads to an increase of the subterranean water since the water floods areas that would not be flooded and infiltrates the ground. However, this is also considered as a major reason for conflicts between humans and beavers.
- **Weaker current and better distribution of water**
- **Cleaning of water**

  The water is much clearer after it has crossed a beaver dam since suspended matter are held behind by the construction.
- **Increase of biodiversity**
  - **Improvement of the habitats for fish**

    Due to weaker current, clearer water and more pebble stones on the ground, the biodiversity of fish can be increased
  - **Creation of new habitats for amphibians, dragon flies and birds**

    The dam building activity of the beaver leads to an increase of the subterranean water, which leads subsequently to newly flooded areas. Those areas provide new habitats for amphibians, dragonflies and birds.
  - **Deadwood (as a result of gnawing activities) as a habitat for numerous fungi and species of insects**

    Trees, which have their roots under water and die because of the beaver's gnawing activity, provide a new habitat for fungi and different species of insects.

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2.3. Conflict potentials

In relation to specially protected species of animals, the terms “conflict” and “conflict species” are quite clear. However, for this manual on beaver management, it is important to define the terms adequately. “Conflict species” are species that have a negative, direct or indirect impact on human activities which means certain consequences such as the loss of landscape function, property damage with a vast financial damage or the cause of situations for future damage (e.g.: dam building activity of the beaver).

The beavers’ habits of building dams and canals and the consequences of those, like for example flooding or fallen trees can lead to conflicts with agriculture, forestry, water economy or land owners. These conflicts occur mainly in those areas of the landscape, where the land is used by humans to the very edge of waters that are also colonised by beavers. Approximately 90 % of those conflicts occur within 10 metres between water and land and 95% within 20 metres between water and land. The numbers of conflicts in relation to the distance to water are represented in the bar chart below. This means that the beaver activity is limited to a small area along waters.

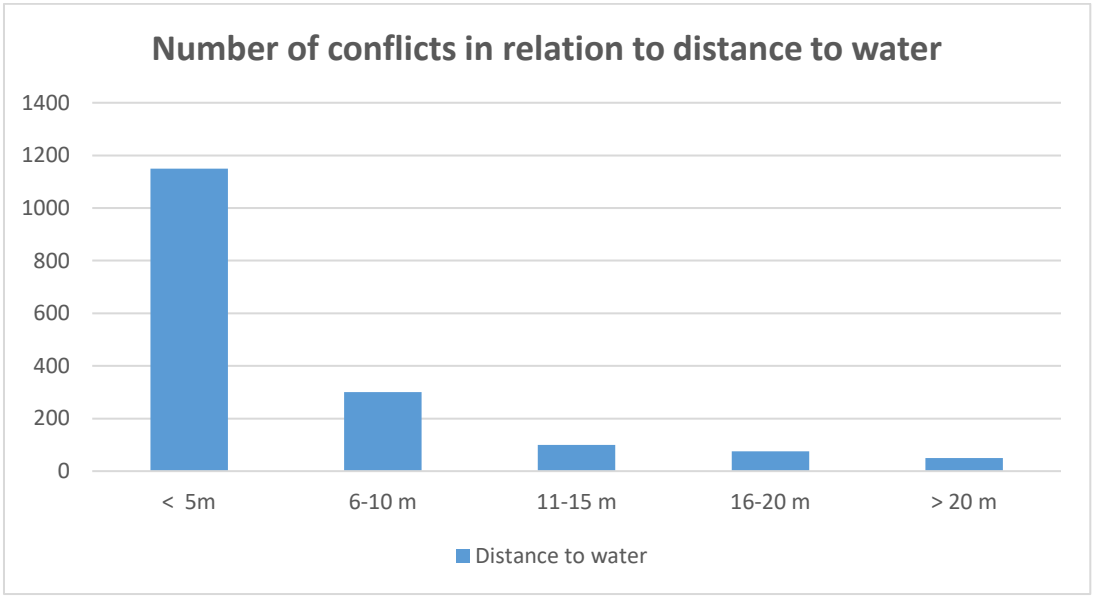

Figure 7: Number of conflicts in relation to distance to water, 2018, x-axis = distance to water, y-axis = numbers of occurring conflicts, Verena Mayer

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In addition to awareness raising measures, there is the idea to design an international beaver management plan as part of this project. In order to find effective solutions that have only a small impact on beaver populations, it is necessary to include and incorporate all stakeholders. Conflicts that occur between humans and beavers can be categorised into three main topics: Feeding and gnawing on crop, damages due to gnawing activities and damages and flooding due to building activities.

Figure 8: A beaver during swimming in Stein an der Enns, photograph by apodemus, 2018

1. Feeding and gnawing on crops

As herbivores, beavers feed on a broad range of plants and wood that grow next to waters. Moreover, they can adapt easily to new fodder plants like cultivated crops as corn, sugar beet, rapeseed and grain. In some areas, they also feed on carrots, celery and kale. However, the economic damage can be considered as insignificant, since on the one hand beavers only take crops, which they actually eat and on the other hand, the number of individuals living in the same area is limited due to the beaver's territorial systems.

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2. *Destruction of wood*

Wood is cut mainly during winter since beavers need bark and young branches to feed on. The beaver prefers softwood such as willows and poplars, which do not have a monetary worth.

Sometimes beavers also gnaw on forestry relevant trees and fruit trees when they can be found along waters. However, the economic damage is not seen as considerable. Problems are mainly caused by cut down trees that threaten the safety of humans since they can fall on roads, streets and walking paths.

Figure 9: Beaver tracks in Stein an der Enns, 2018, photograph by Verena Mayer

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Moreover, trees that fall on fields or hay meadows can complicate or hinder the cultivation of those. Another issue is that branches that fall into the water can have an impact on the functionality of embankment dams. In smaller waters, logjams can be a result of fallen trees and branches, which can lead subsequently to flooding. On top of that, the removal of fallen trees causes rising labour costs that need to be paid.

Figure 10: Beaver tracks in Stein an der Enns, 2018, photograph by Verena Mayer

3. Flooding and other damages due to digging and building activities

Beavers usually build their lodges and canals at the bank slope of waters. They dig canals into the ground, which can get many metres long. At the end of those canals, there living areas can be found. Those digging activities can cause immense damages. On the one hand, streets, roads, paths and fields can get excavated which can lead to a collapse of the soil that covers those canals and

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tunnels, on the other hand manmade dams with a protective function can become leaky or even be destroyed. The consequences are damages on vehicles and agricultural machines, flooded fields with complicated cultivation conditions, water damages on buildings, damages on purification plants or leaking fishing ponds. Additionally, damage to persons as a further consequence cannot fully be excluded.

Beavers build dams in order to impound water and to use the resulting pond. If dams are built near drainage channels, the water level will rise and adjoining fields will get flooded. The consequences are complications in the cultivation process and harvesting process and a decrease in profits. If dams are built near purification-plants of fishing ponds, the water supply and exhaust pipe might get affected which would interfere with the functionality of the whole system.

3. Legal Situation

3.1. EU level

The European beaver (*Castor fiber*) is internationally protected under the Bern Convention. The ***Bern Convention*** is a contract on the protection of European wildlife animals and plants and their natural habitats. Article III lists species that have to be protected in general but can be hunted under certain circumstances. Austria agreed to the convention in 1983.

Aim of the *Fauna-Flora Habitats Directive* (Council Directive 92/43/EEC of 21 May 1992) is the conservation and restoration of biological diversity. Annex II lists animal and plant species of community interest; their conservation requires the designation of special protection areas, so-called Natura 2000 sites (referred to as "European protected areas" in the Styrian Nature Conservation Act, see below). Annex IV lists animal and plant species of Community interest that are to be strictly protected. Article 12 of the Directive prohibits the capture and killing of these species. Any deliberate disturbance, in particular during breeding, rearing, hibernation and migration periods, is prohibited, as is any damage to or destruction of breeding sites or resting places. In addition, EU Member States shall prohibit the possession, transport, trade or exchange and offer for sale or exchange of specimens taken from nature.

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Aim of the ***Fauna-Flora- Habitats Directive*** (*Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora)* is to promote the maintenance of the biological biodiversity. Under article II zoological and botanical species of general interest are listed. There are certain protected areas for those species that are called „Natura 2000 sites" as part of the EU environmental protection efforts. Under article IV strictly protected species can be found which must not be killed or hunted. Every distraction, especially during reproduction, winter or migration, is strictly prohibited. Moreover, living areas and areas of reproduction must not be destroyed. In addition, EU-states do not allow ownership, transport or trade of those protected species.

Beaver occurrence mapping:

In order to analyse the Eurasian beaver's population dynamics, a beaver occurrence mapping takes place throughout Europe and is a binding obligation of EU member states. Therefore, regular surveys of beaver distribution should be done every 5-7 years with closer monitoring of sensitive areas and territories where changes are expected.

3.2. Contributing EU member states

In the following points, different laws for the protection of the beaver of all contributing EU member states are listed. However, since the availability of the legal situation of the member states was not equal, the amount of the provided information differs immensely.

Austria

Austria acceded to the Bern Convention in 1983 (Federal Law Gazette No. 372/1983). In Austria, nature conservation is regulated at provincial level (9 different laws). For the province of Styria the protection of the beaver is included into the **Styrian Nature Conservation Law** (Steiermärkisches Naturschutzgesetz; Stmk. NschG 2017 i.d.F.). The beaver is listed in the species protection regulation. According to the **Styrian Hunting Law** (Stmk. Jagdgesetz 1986 i.d.g.F.)in §2, the beaver is considered "wild" and thus protected all year long. The beaver is listed in Annex C (protected animals) of the **Styrian Species Protection Ordinance** (LGBl. Nr. 40/2007).

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In protected areas that have been designated on the basis of the Styrian Nature Conservation Act, some beavers enjoy special protection. A distinction must be made between several types of protected areas:

Union law requires special protection areas to be designated for the species listed in Appendix II of the Fauna-Flora Habitats Directive and thus also for beavers. Styria has designated 38 European protected areas in accordance with this directive, but in none of them is the beaver mentioned as a protected good.

European protected areas must also be established for the bird species listed in Annex I of the Birds Directive (Council Directive 79/409/EEC of 2 April 1979). If the presence of the beaver (through its ecosystem-forming activities) is of essential importance for the protected bird species of the area, the Eurasian beaver is also protected in these areas.

The Styrian Nature Conservation Act also defines different types of protected areas that are relevant under purely provincial law. On the one hand prescribed "landscape protection areas" (Stmk. NSchG §8) and the ex lege protected "lakes and ponds formed during the Ice Age, including their perimeter up to a 10 m wide strip of land measured " as well as all "naturally flowing waters including their old waters (old and dead arms, rivers and lakes)" (Stmk. NSchG §8) are relatively weakly protected, but on the other hand "nature reserves" (Stmk. NSchG §7), "natural monuments" (Stmk. NSchG §11) and "protected landscape parts" (Stmk. NSchG §12) are subject of a strict protection regime.

According to the **Red List of Mammals in Austria** (Spitzenberger 2005), beavers are considered safe (LC = Least Concern). This means that the probability of extinction in the next 100 years is less than 10 %. Both the population and the area development are classified as positive. According to the IUCN Red List of Threatened Species, the species is also considered safe (Batbold et al. 2008).

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Czech Republic

In the Czech Republic the Eurasian beaver (*Castor fiber*) is an autochthonous species, which is protected by

- The Convention on the Conservation of European Wildlife and Natural Habitats)
- European legislation (Directive 92/43/EEC), and
- Act no. 114/1992 Coll. on nature and landscape protection (ANLP).

Germany

The beaver is also strictly protected in Germany (International Law, EU Law, Federal Law, Federal State Laws).

- FFH Directive, Annex II: Designation of Special Areas of Conservation (FFH areas with beavers as conservation objective)
- FFH Directive, Annex IV: Species to be strictly protected
- Bundesnaturschutzgesetz §7 (2) No 13 (b), (aa) and §7 (2) No 14 (b) (reference to Annex IV FFH Directive): Beavers are specially and strictly protected

Access bans

- re-enact, catch, injure, kill
- disturb during the times of reproduction, rearing, moulting, wintering and migration

Significant disruption means

- the state of conservation of a local population deteriorates
- take reproduction or resting places from nature,
- damage or destroy them.

Bans on possession

- take into possession or custody, have into possession or custody, or process or treat
- sell, buy, offer for sale or purchase, stock for sale or transport, acquire for commercial purposes, display or otherwise use marketing bans

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Legal exceptions

These are exceptions to the prohibitions already provided for by law:

- Proper land use for agriculture, forestry and fisheries, provided that the conservation status of the local population is not impaired.
- Permissible intervention and certain construction projects or actions in preparation for statutory inspections.

Derogation from the marketing ban on beavers

- which have been lawfully acquired prior to the protection (beavers found dead may be taken along, but must be surrendered),
- sick, injured, helpless beavers may be taken into possession and cared for (report to the competent authority)

Exceptions in individual cases

- to prevent significant damage to land, forests, fisheries, water or any other significant economic activity
- for the protection of native flora and fauna
- for the purposes of research, teaching, education or reintroduction, or for the purpose of rearing or artificially propagating animals for such purposes
- in the interests of human health, public security, including national defence and the protection of the civilian population,
- or the significant beneficial effects on the environment
- for other imperative reasons of overriding public interest, including those of a social or economic nature.

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Further prerequisites for exceptions (the responsibilities in the Federal States are different).

- reasonable alternatives are not given
- conservation status of the population does not deteriorate
- further requirements according to Art. 16 para. 1 FFH Directive, compliance with Art. 16 para. 3 FFH Directive (documentation, reporting obligation)
- observance of further laws (animal protection, weapons law, §4 Abs. 1 BArtSchV (prohibition of access methods), ...)

Hungary

In Hungary, the Eurasian beaver occurs in many areas that are Natura 2000 sites. Therefore, the European law can be applied in those areas. However, there was no further data provided on a national basis.

Romania

In Romania, the legislative regulations in the field of conservation and environmental protection are unitary at national level. Since 1989, Romania has taken important steps in harmonizing national legislation with the European one.

Thus, in 1993 Romania joined the Berne Convention of 1979, which mentions *Castor fiber* in the list of protected species of fauna.

In the following year, two other important international documents for the ratification of the Convention on Biological Diversity, which was signed in Rio de Janeiro on 5th June 1992, were ratified by Law No. 58 of 13 July 1994 and Law No. 69 of 15th July 1994. Romania acceded to the Convention on International Trade of Endangered Species of Wild Fauna and Flora, adopted in Washington on 3 March 1973.

After the accession of Romania to the EU in 2007, the first protected areas were set up within the NATURA 2000 ecological network.

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Later, legislative efforts to harmonize national legislation with European legislation have accelerated. Therefore, a series of laws and government ordinances with a biodiversity application have been issued. Among those laws were: Law Nr. 49 of 7 April 2011 approving Government Ordinance no. 57 of 20 June 2007 on the regime of natural protected areas, conservation of natural habitats, wild flora and fauna, Law Nr. 203/14 of 5 March 2009 laying down the procedure for derogation from the protection measures of wild flora and fauna species, in cases where certain specimens need to be relocated or even eliminated in order to reduce the level of conflict.

In the field of hunting, the most important step was made in 2006 when the Law of Hunting and Hunting Ground Protection was updated by the law 407 of November 9. The beaver is mentioned in the list of species of hunting interest in which hunting is prohibited.

This was complemented by Romanian Government Decision no. 1679 of December 10, 2008 on the way of granting the damages provided by the Hunting and Game Protection Act no. 407/2006, as well as the obligations of the managers of the hunting funds and the owners of agricultural, forestry and domestic crops for the prevention of damages.

Among the European Legislative Documents that have been accepted, we recall:

- Council of Europe Directive 92/43 EEC on the Conservation of Natural Habitats and Wild Fauna and Flora adopted on May 21, 1992. The document mentions the species within the ANNEX no. 3: Species of plants and animals the conservation of which requires the designation of special areas of conservation and special protection areas for avifauna and Annex no. 4: Species of community interest. Species of animals and plants requiring strict protection.
- Commission Regulation (EC) No 865/2006 of 4 May 2006 laying down detailed rules for the implementation of Council Regulation (EC) 338/97 on the protection of wild fauna and flora and control of trade.

However, there is a lack of harmonization between environmental and water legislation that affects species management.

4. Swot Analysis

		Intern analysis	
		Strengths	Weaknesses
External analysis	Opportunities	Working on a transnational level means more corporations, more help and more knowledge. This might help to improve beaver management enormously since the beaver is a migrating species. Therefore, a transnational management plan will be a great way to increase the efficiency of beaver management in Europe.	Stakeholders and groups of interest as well as the legal situation are different in every country. Measures are not always helpful and sometimes even counterproductive, e.g.: destroying of beaver dams
	Threats	Transnational communication is of great importance and flexible individual solutions should be considered in certain cases since the situation in every country might be slightly different. Beaver coordinators are important for conflict management and for the implementation of measures.	

Figure 11: SWOT analysis on a transnational level, 2018

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5. Distribution and Beaver Management in EU

Wildlife management and thereby beaver management are quite young disciplines. In contrast to the classic protection of the environment, which takes only the well-being of animals and their habitat into consideration, wildlife management also focuses on the needs and interests of the local population. However, these different aspects and their expectations often collide. For example: While the conservationist is happy about the beaver, the farmer is annoyed by flooded plains and wants to get rid of the species or a house owner uses the press to put the blame for his wet cellar (which has been wet for decades), now finally on the beaver. This is the point, where beaver management is required to arrange a balance between human expectations and the necessities of beavers.

Beaver management is also necessary in order to encourage prevention of extensive damages caused by beaver activities. In Eastern and Northern Europe, beavers have repopulated large parts of their former range, while in the West the gaps are still very large (Map LfU to Duncan Halley, NINA, Trondheim, 2009). The Danube river basin is one of those areas with the highest beaver population density. Currently the distribution and expansion in the Danube river basin seems to be in the initial stage of extension in some areas (Hungary, Croatia, Serbia, Bulgaria, Romania, Slovakia), whereas in other areas there are beaver populations that have already stabilized in different stages (Germany, Austria, Slovakia partially).

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Figure 12: The distribution of the Eurasian beaver in Austria, Bayerisches Landesamt für Umwelt, source from Duncan Halley, NINA, Trondheim

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5.1. The Eurasian beaver in Austria

According to historical data on hunting, beavers already populated many Austrian rivers in 1700. In 1775 the beaver was considered extinct in Styria. The last autochthonous beaver population in Austria was extinct in 1869 (Anthering near Salzburg).

Reintroduction programmes

Starting points for resettlement in Austria were two intended naturalization actions and two unintended settlements of beavers that escaped from enclosures. In the years from 1970 and 1990 around 32 *Castor fibers* and also 12-15 *Castor canadensis* were repopulated in the area of the Danube basin, east from Vienna. Some reintroductions were not registered.

From 1972 until 1976, 15 beavers were reintroduced by the Bund Naturschutz Bayern in the island area of the Inn artificial lake in Ering-Frauenstein near Prienach. They had already penetrated the river mouth of the Salzach in the first year and were observed in the Ettenau/Salzach. The Austrian Federal Forests abandoned two European beavers originating from Sweden in the Ettenau in 1977. With a length of 225 km, the Salzach is the longest and richest in water tributary of the Inn. It flows in the province of Salzburg (Austria) and in Bavaria (Germany), is one of the major Alpine rivers and drains the Eastern Hohe Tauern to the North. It belongs to the river system of the Danube (discharge via the Inn-Danube-Black Sea).

In the course of flood events, beavers escaped from enclosures in research institutes and animal parks (between 1985-1986). Some beavers were run over by cars.

Immigration potential from neighbouring countries

The spread of *Castor fiber* from Croatia was expected, since settlement programmes of at least 90 beavers took place on the Drava and Save in the 1990s.

From 1996 to 1998 about 30 beavers were established in the Gemenc Nationalpark on the Hungarian Drava but they had no tendency to spread upstream on the Danube.

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The beaver was seen as a threat to agriculture and thus the extinction was also seen as a result of field damage compensation.

Moreover, individuals were reintroduced in the Province of Styria, near the rivers Enns and Salzach at almost the same time. As a result and due to immigration, the number of individuals has increased to 5.000 in Austria.

It is claimed that the beaver colonies in the Southern parts of Styria along the Rivers Raab and Mur descend from beavers from Hungary and/or Slovenia. The beaver colonies that live in the pilot area along the Enns descend from beavers in Upper Austria.

It is assumed that the beaver is further spreading and that gaps will be filled soon in Austria.

Beaver management and monitoring in the pilot area Styrian -Enns Valley

The beaver's spreading in recent years has shown that it can adapt to a variety of different habitats. The Enns River is an important connection between already populated areas in Upper Austria and Styria whereas an upstream migration is not uncommon. Since only young beavers search for new territories, it is quite common that they choose territories outside the distribution area.

Permanent beaver territories (fig. 13, red spots) in the Enns Valley are in Garsten, Altenmarkt, Landl, Hieflau and St. Martin am Grimming. Moreover, beaver tracks (yellowish spots) can be found in Ternberg, Großraming, Admont, Selzthal and Stein an der Enns. The upstream migration is a result of the beaver's ability to obtain information of areas through their scent, which tells them if a territory is already populated or not.

Even though the beaver is able to adapt through a variety of habitats, certain criteria have to be fulfilled: water depth, food availability and soil that allows building activities. Most parts of the Enns River are characterised by the occurrence of big rocks, which makes it impossible for beavers to build canals or lodges.

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Moreover, the current velocity of the Enns is quite strong which increases the beaver's energy rate. Therefore, as permanent territories, the beaver prefers contributing streams and ditches, like for example the water mouth of the Lohgraben leading into the Enns in St. Martin am Grimming or water storage areas near hydroelectric power station, like for example in Hieflau.

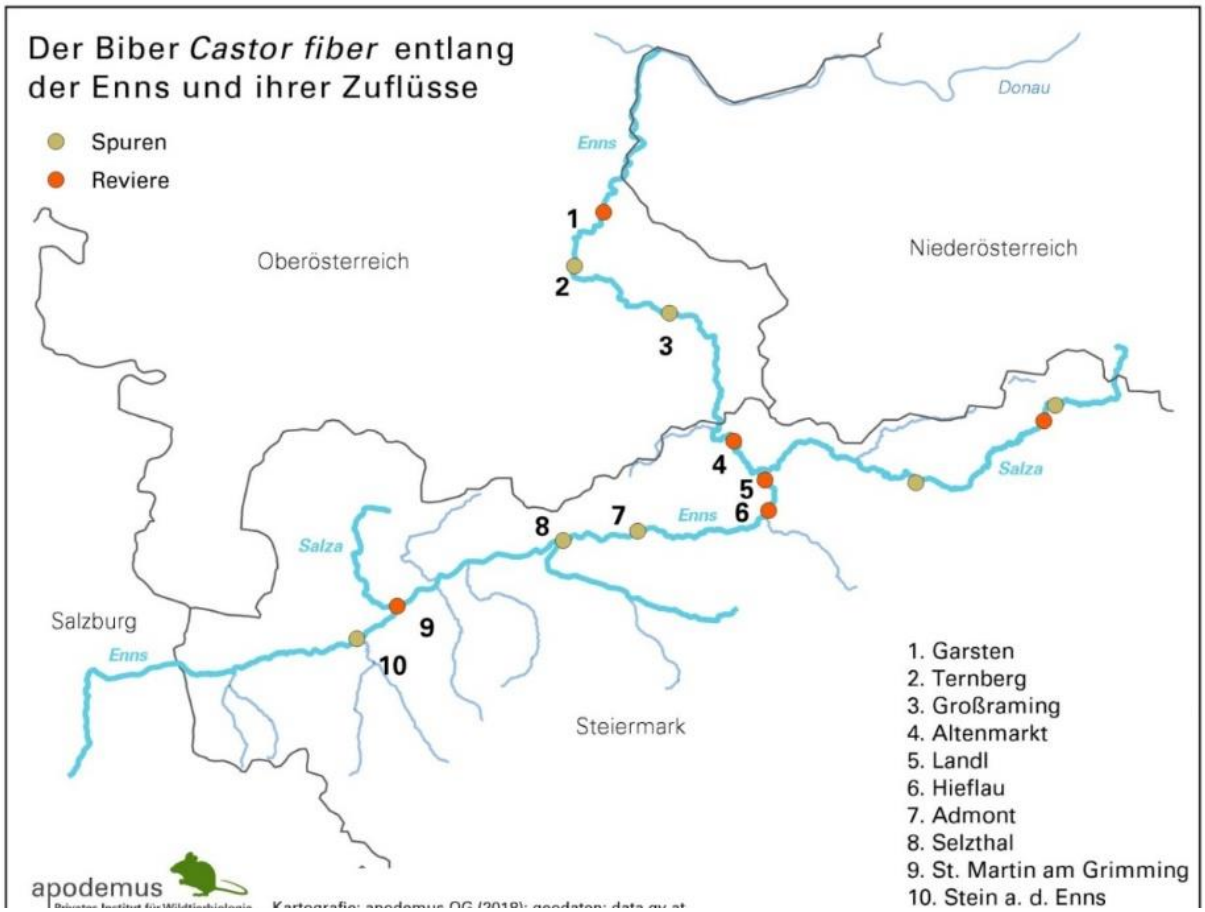

Figure 13: The distribution of the Eurasian beaver in the Styrian Enns Valley by Apodemus, 2018

Project co-funded by European Union funds (ERDF, IPA)

The Federal State Styria has a **Beaver Management Plan,** which focuses on the following three aims:

1. **Beaver monitoring:** The development of a beaver monitoring network of the Styrian Mountain and Nature Rescue Service (Steiermärkische Berg- und Naturwacht) in order to improve the knowledge of the current distribution of the beaver in Styria. Documentation of territorial expansion and inspection of already existing territories.
2. **Beaver counselling:** The establishment of a beaver advice centre where information about the beaver can be obtained and beaver observations reported. Moreover, conflicts and problems with the beaver and possible solutions should be discussed.
3. **The development of a Styrian beaver management strategy:** Based on the experiences of all federal states of Austria applying different management-strategies, a management strategy for Styria involving all stakeholders (conservation, water management, forestry, fishery etc.) is in progress. Since conflicts in Styria have not reached a worrying number yet, there is still a chance of finding optimal and sustainable solutions.

One part of the **"Beaver management strategy in Styria"** is the establishment of a **beaver observation network** to improve knowledge about the current distribution of beavers in Styria. This is a LE 14-20 funded project (Rural development programme) and has a duration from 2017to 2019. The expert and coordination team is ÖKOTEAM, which is an Institute for Animal Ecology and Land use planning. It is a co-operation between Styrian Mountain and Nature Rescue Service and the Federal State Styria.

Moreover, it is planned to document the area expansion and to inspect already known areas.

At the current range of distribution and expansion of beavers in the Danube river basin, it seems to be the best method to observe two different areas:

I. Areas where the beaver is in the initial stage of extension

II. Areas where beavers already stabilized in different stages

Monitoring is planned to be carried out mainly from the ground, eventually using camera sets or telemetry. In general, the following strategies, mostly methods of occurrence and detection, are used to monitor and map beaver activity. In order to collect useful data, standard conditions must

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be met and data cannot be collected in different seasons. Moreover, the knowledge of biology and ecology, as well as the experience of observers is crucial.

- Visual observation
- Video surveillance
- Direct observation (Observation of activity mainly on the water surface)
- Telemetry
- Cadaver records of incidental findings of dead individuals
- Questionnaire survey (Sending of special questionnaires at certain intervals to organizations operating within the territory with the potential beaver occurrence; e.g. stakeholders of hunting areas, conservation departments).
- Terrain mapping of areas – signs of presence (5 categories: Feeding activities – gnaw marks, droppings, feeding stools, teeth imprints, stocks; territorial activities - scent marks, motion activities – paths, tail or paws prints, slides; sheltering activities - resting haunts, burrows, lodges, semi-lodges; construction activities – dams, weirs, canals, water reservoirs, water ponds; droppings/faeces)

The beaver management of the Federal Province Styria has developed a **beaver monitoring plan**, which has its main focuses on the Natura 2000 sites and on known **"beaver districts",** which are further sorted into different categories of risk potential and need for action.

- high: Hartberg-Fürstenfeld, Südoststeiermark und Leibnitz
- moderate: Weiz, Deutschlandsberg, Graz-Umgebung
- small: Liezen, Bruck-Mürzzuschlag, Murtal, Graz-Stadt
- none: Murau, Leoben, Voitsberg

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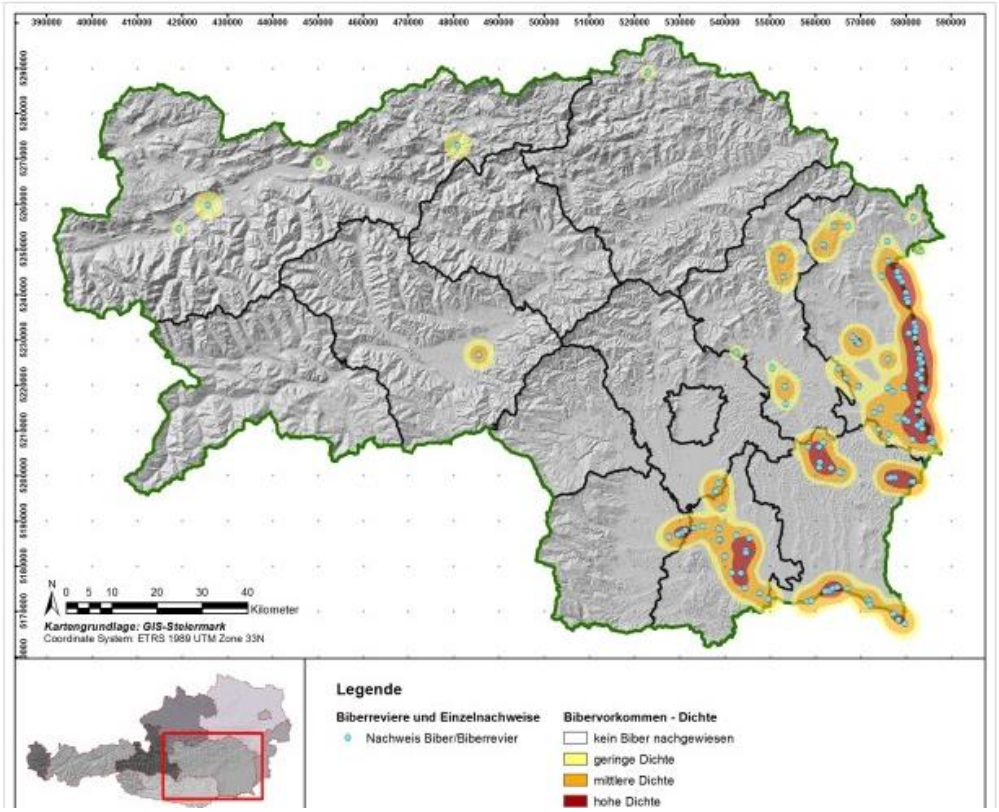


Figure 16 Distribution of the beaver, Zimmermann, 2018

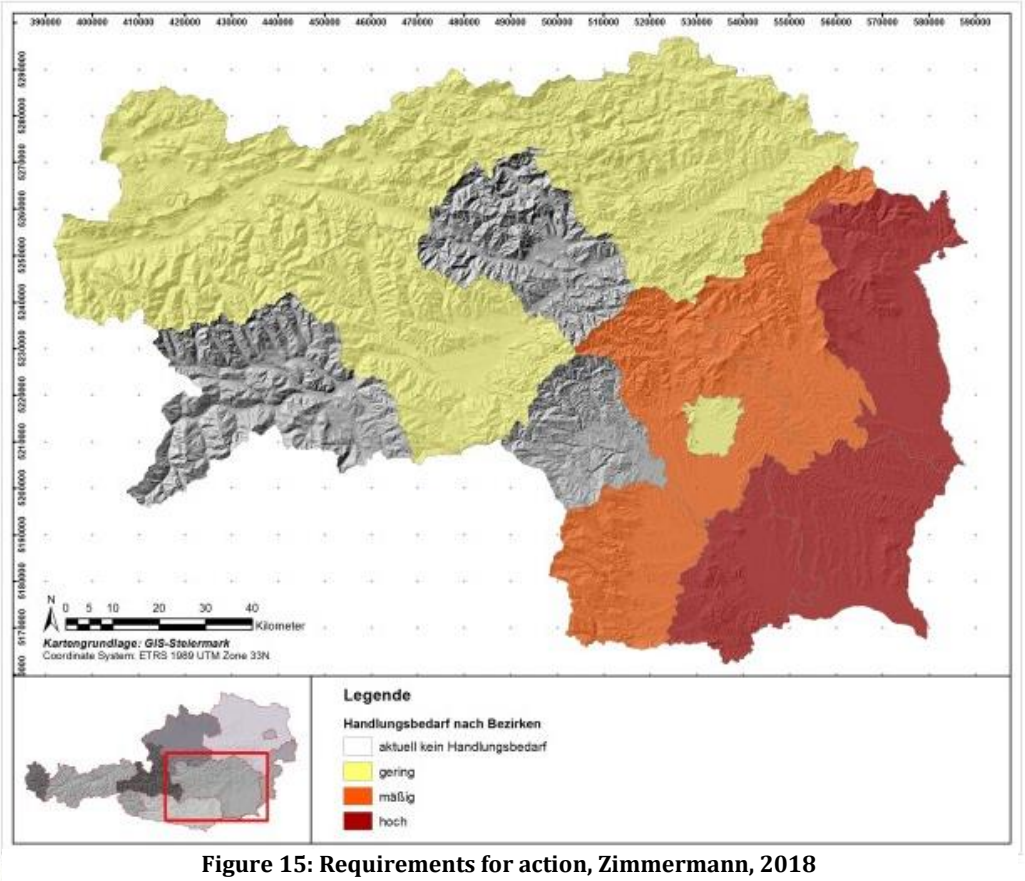


Figure 15: Requirements for action, Zimmermann, 2018

Beaver counselling: In addition to already existing consultative contacts, it is planned to establish a number of **beaver advice centres** where information about the beaver can be obtained and beaver observations can be reported. Moreover, conflicts and problems with the beaver and possible solutions can be discussed there.

Public relations: As a major part of beaver management, it is important to inform and enlighten the local society about the beaver, especially as a lot of knowledge has been lost over the last decades.

Investigation and acquisition of funds: Since beaver management is expensive (staff, necessary measures), financial sources are necessary. Therefore, it is important to investigate properly all possible sources of financial funding.

Mediator role: Another important task is to mediate locally in conflicts between all the different stakeholder groups. All in all, beaver management is supposed to bring the beaver into the hearts and minds of the human population.

Conciliation and advisory bodies in the Styrian Enns Valley: In case of conflicts, observations or findings, the beaver management centre of province government of Styria can be contacted. The beaver manager, Mag. Brigitte Komposch, MSc, who is part of the Ökoteam Styria and responsible for any kind of conciliation in Styria, will answer questions in relation to the beaver and help with conflict situations that will be examined in order to find sustainable solutions. Moreover, especially for the Styrian Enns Valley, the contact persons of the Mountain and Nature Rescue Service, Dr Christine Resch and Dr, Stefan Resch, who are responsible for educating and awareness raising activities, can be contacted. According to them, the reactions of people in relation to the return of the beaver to the municipality Niederöblarn were quite diverse. However, since it is only one individual of the species, which lives in the EU protection area, not many conflicts have occurred so far. In spring and autumn excursions to the beaver territory are offered to different target groups. The participants learn about beaver tracks, the beaver's way of living and its habitats. Moreover, this excursion provides people with the chance to obtain a lot of information about the beaver and to ask critical questions.

Since all federal states of Austria have slightly different management plans and the pilot area lies in the Styrian Enns Valley, the Austrian chapter of this manual focuses primarily on the Styrian

management plan. However, other interesting attempts can be found online (see following links). On top of that, some federal states, e.g.: Carinthia, have established funds for damages caused by wild life animals, like the beaver.

Beaver Management in Upper Austria:

Beaver Manager: DI Bernhard Schön

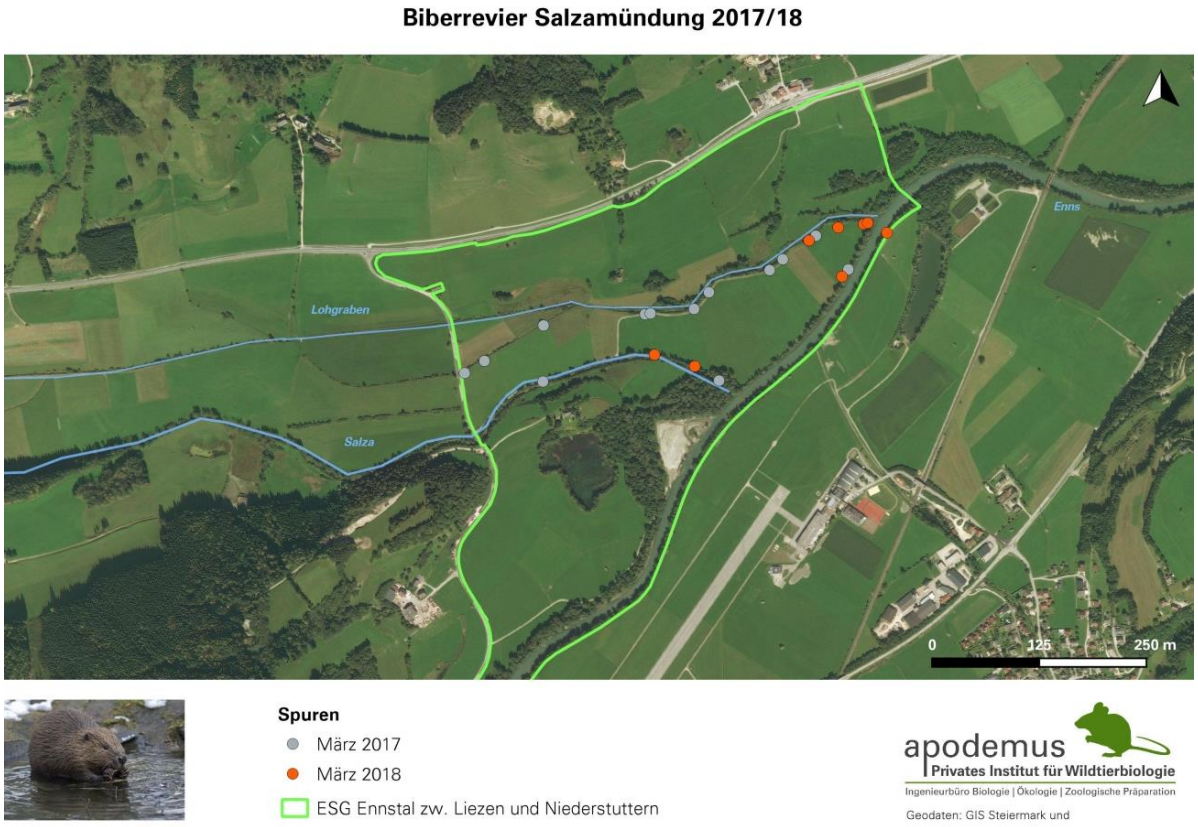
https://www.land-oberoesterreich.gv.at/129257.htm

Beaver Management in Burgenland:

https://www.burgenland.at/themen/natur/naturschutz/bibermanagement/

Figure 17: Local informative workshops and excursions on beaver management, photograph by Verena Mayer, 2018

Pilot actions to minimize conflicts: A permanent beaver territory is situated in St. Martin am Grimming and Niederöblarn in the Natura 2000 site "Ennstal zwischen Liezen und Niederstuttern". In this area, the remaining marsh areas after the regulation of the Enns (between 1863 and 1870) can be found. This is the reason why beavers can find suitable soil for



building activities. Moreover, the beavers can find enough food for the winter in the meadows.

Figure 18: The beaver territory in Stein an der Enns at the Salza in Styria by Apodemus, 2018

As already mentioned, most conflicts occur in a small strip along water and fields along the Enns are used for pasture and are reaped on a regular basis. Years ago those fields were drained and ditches were built in order to make the fields suitable for cultivation. Therefore, the beaver dam building activity is seen as a threat to these fields. A solution could be to remove parts of the beaver dam whereas entries must stay under water.

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In addition, many cycling and hiking paths can be found along the Enns. In case that those paths lead through a beaver territory, people might get harmed by falling trees or excavated paths. For security reasons, trees that show beaver damage need to be removed as soon as possible and trees can be protected by wire as already mentioned in another part of this manual.

Further important aspects are the busy roads along the Enns highways (B320 and B115) which can be considered as a source of danger. It can be assumed that especially young beavers, which are looking for a new territory, end up as roadkill when crossing those busy roads.

Moreover, the **hydroelectric power stations** from Gstatterboden to Upper Austria should be seen as a threat since beaver dams might get flooded or even destroyed. It is planned to document the area expansion and to inspect already known areas.

5.2. The Eurasian beaver in Czech Republic

The measures of the management plan for the beaver in particular aim to reduce the conflict rate and contribute to the solving of problematic situations by protecting the beaver as well as a system of compensations for damage and loss. Conflicts do not occur immediately after the first settlement of the beaver in a certain area. Noticeable damage that causes conflicts corresponds to a higher intensity of settlement. The beaver prefers a natural environment, away from technical elements in the landscape and with a distance to humans. The reasons for conflicts can be found in the increase of the beaver population. Therefore, the aim of the management plan is a controlled development of the population to ensure that the costs to eliminate conflicts are acceptable, even though it is clear that conflict situations cannot be avoided entirely.

From a biological point of view, the spreading and development of beaver populations is regulated by nature. Moreover, regulation during the population growth may lead to an increase of the fertility rate. Therefore, it is advised to introduce suitable management (regulatory catch) only when the population is stabilized (after 30-50 years of population growth). It is also suggested that milder solutions should be preferred to regulative measures. Moreover, before such measures take place, an understanding of the function of the beaver on the landscape is necessary – such as spontaneous renaturation of watercourses, restoring of wetlands etc.

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In order to ensure an acceptable development of beaver populations, the Czech Republic is divided up into three types of regions (A-, B-, C-zones – see picture). Each zone has a different emphasis on this development, depending on the degree of risk of serious conflict situations and thus a different level of interest in the protection and maintenance of the species.

Zones According to the Management Plan:

Defined zones meet the requirements on protection of the beaver considering the European legislation, which does not allow any reduction in the degree of legal protection. Three different spatial approaches allow land use and support social interests in the landscape, while avoiding conflicts with beaver protection.

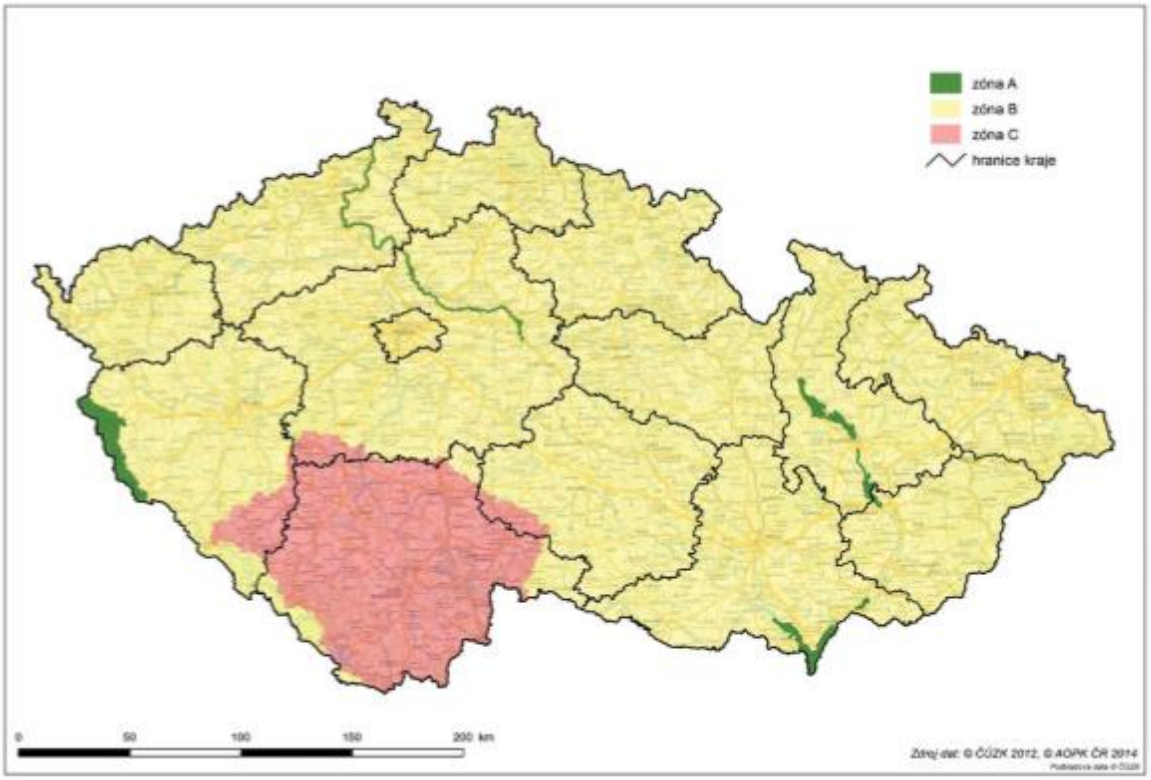

Figure 19: A Map of zones of differential protection of Eurasian beaver in the Czech Republic, source NCA CR

A-Zone: Highest level of beaver protection in Natura 2000 areas: It covers 1.2% of the Czech Republic and includes these SCIs: Labské údolí, Porta Bohemica, Kateřinský a Nivní potok, Niva Dyje, Soutok–Podluží, Strážnická Morava, Morava– Chropyňský luh and Litovelské Pomoraví. In this zone, the beaver is a subject of protection and therefore all activities need to take the demands

Project co-funded by European Union funds (ERDF, IPA)

and requirements of the beaver into consideration. The reason for the existence of this zone is to ensure that those are fulfilled. Conflict situations that occur in this area should primarily be solved by preventive measures. The number of individuals is estimated to more than 2000 individuals.

B-Zone: Species protection in this area is subordinated to the use and functions of the landscape. The purpose of zone B is to reduce negative impacts of beavers. Measures are the reduction of beaver dams and lodges and in justified cases local elimination of individuals or whole families. The development of beaver populations is allowed in places where no significant conflicts occur. Moreover, it should allow the flow and exchange of individuals between different parts of zone A.

C-Zone: The presence of the beaver in this zone in unwanted. The only appropriate measures in this zone are the elimination of any settlement of the beaver because of high risk of serious land use damage such as of vulnerable waterworks (e.g.: historic fishponds) and threats to security of the population.). The C-zone covers 13.3% of the territory of the Czech Republic and covers the entire river basins which are supplied by the South Bohemian fishpond basin, namely Otava, Blanice, Lužnice, Malše Rivers and the upper part of the Vltava River, which flow to the Orlík Dam. Šumava National Park (with regard to the conservation objectives of the area) is excluded from the C-zone and falls within the B-zone.

However, the activities of the beaver raise a number of conflicts with humans. In 2013 the Ministry of the Environment of the Czech Republic adopted a management plan for the beaver. This management plan represents a document that includes endangered and protected species, which also belong to conflict species. Management plans are created for species that get into direct conflict with the interests of man and have the purpose to contribute to sustainable populations, while mitigating the negative effects of those species.

5.3. The Eurasian beaver in Germany

According to the Federal Nature Conservation Act, the beaver is specially and strictly protected. If beavers cause serious damage, they may be caught by means of a special permit or regulation and, under special circumstances, also killed. In FFH areas, the state is obliged to preserve the beaver in a favourable state of conservation or, if necessary, to restore it.

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In Bavaria, the beaver has been exterminated since 1867 and reintroduced in small numbers since 1966. The animals came from Russia, Poland, France and Scandinavia. It was a funded project first by the Federal Ministry of Agriculture and later by the Federal Ministry of Environment from Bavaria. 2010, over 12,000 beavers and approx. 3,000 districts were counted (Bayerisches Landesamt für Umwelt, 2019). Migration took place to Austria and to the Federal State of Baden-Würtemberg and to the Czech Republic. In Germany there are about 20,000 beavers (BlU, 2009).

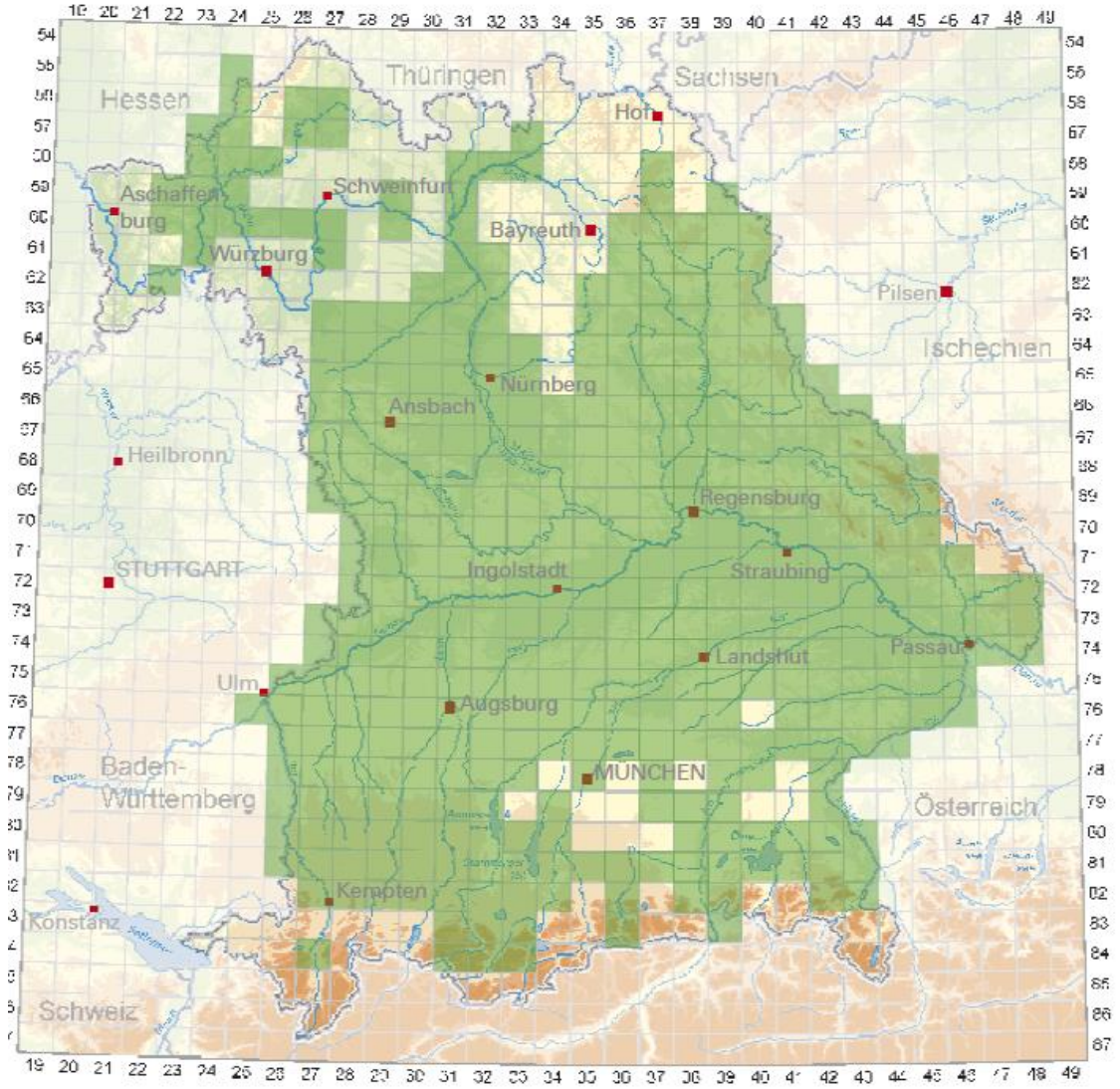

Figure 20: The Distribution of the beaver in Bavaria, Bavarian authority for Environment, 2009

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5.4. The Eurasian beaver Hungary

The reappearance of the beaver in Hungary was in the Szigetköz area of the country in 1985/1986. It was presumed that these animals came from Austria where successful reintroductions had already taken place. This is also the area, where the biggest beaver population of Hungary lives nowadays.

The first release at Tisza-lake was a so-called soft release: Artificial lodges were used,- a few hundred meters away of the natural lodge in the area. Moreover, food (apple, corn, etc) was provided in the following days for the released animals (Dudás 2002).

However, according to Gerhard Schwab (Germany, Bavaria), the beavers released at Tisza-lake were Canadians (*Castor canadensis*). Therefore, the last specimen from the Tisza-lake were trapped again.

The beaver reintroduction program of WWF Hungary in 1994 had the aim to find suitable habitats for beavers to be reintroduced to. Almost all chosen localities are protected by law, except 2-3 places. The following organisations and persons were informed: local councils, hunting and angling clubs and landowners.

According to the Hungarian beaver reintroduction feasibility study, the goal of the program was to reintroduce beavers to oxbow lakes close to the rivers that are suitable for this species. Márta Bera, who became the manager of the project, said that the program aimed to reach a self-supporting beaver population in Hungary. The feasibility study did not define the success of the program and did not determine quantitative and measurable goals. In the course of the program, the „ideal" population number was estimated according to the carrying capacity of the actual protected area and the reproduction of the animals. According to Sarrazin & Barbault (1996), Seddon et al. (2007) and Sutherland et al. (2010) reintroductions should be planned as ecological experiments.

Over 90% of the beavers reintroduced in Hungary originated in Bavaria. The rest of them are very likely to originate from Austria and Poland.

The beaver population in Hungary is growing.

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Beavers can be found almost everywhere along the Danube. They reach their highest number in Szigetköz. Even though there were no reintroductions in the first place, they have reached this area through migration from Austria. According to Varju (2008), during the 2008, monitoring about 104 territories were found and the calculated population is between 360 and 370, which might be, however, an underestimation. After 2008 the monitoring stopped but it is believed that the population has been growing further since because of the population in Szigetköz, of which specimen are migrating.

5.5. The Eurasian beaver in Romania

Like in most countries of Europe, the Eurasian beaver was extinct in the first decades of the 19th century in Romania. According to documents, the beaver was hunted in 1824. It is possible that the species survived for a few years in some isolated areas, but disappeared soon after from the fauna of Romania. The cause of extinction is excessive hunting, mainly for fur. Beaver fur was very valuable due to the extraordinary qualities of thermal insulation and was mainly worn by noblemen.

Between 1996 and 1997, preparatory actions for reintroduction were carried out, in particular habitat assessment and questionnaires to determine the degree of acceptance of the species by different interest groups.

It is worth noting that the greatest support for reintroduction came from hunters who wanted the species to re-establish its place in the national fauna. The reintroduction was carried out with the consent of the higher levels: the Romanian Academy, the Ministry of Waters and Forests, and the National Sanitary-Veterinary Agency.

The process of reintroduction was carried out in successive stages, between 1998 and 2003. A total number of 182 beavers was brought from Bavaria and released in the rivers Olt (91), Mureș (56) and Ialomița .

In the first five years after reintroduction, the population grew slowly, followed by an explosion characterised by population growth and the occupation of large river sectors of the historical species range. Several population surveys were done, the most important ones in 2007-2008 and 2014-2017.

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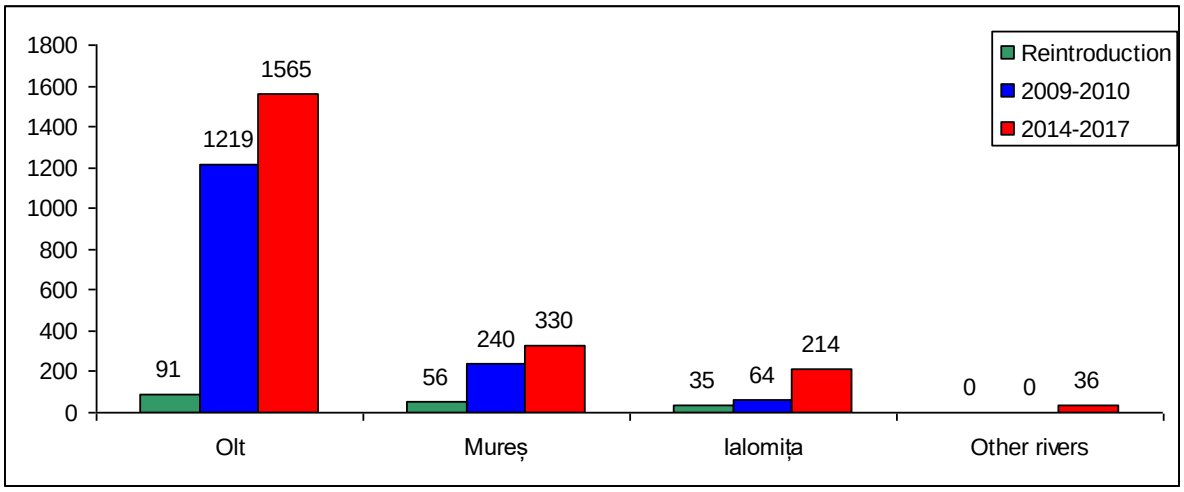

Figure 21: Beaver (*Castor fiber*) population dynamics after reintroduction

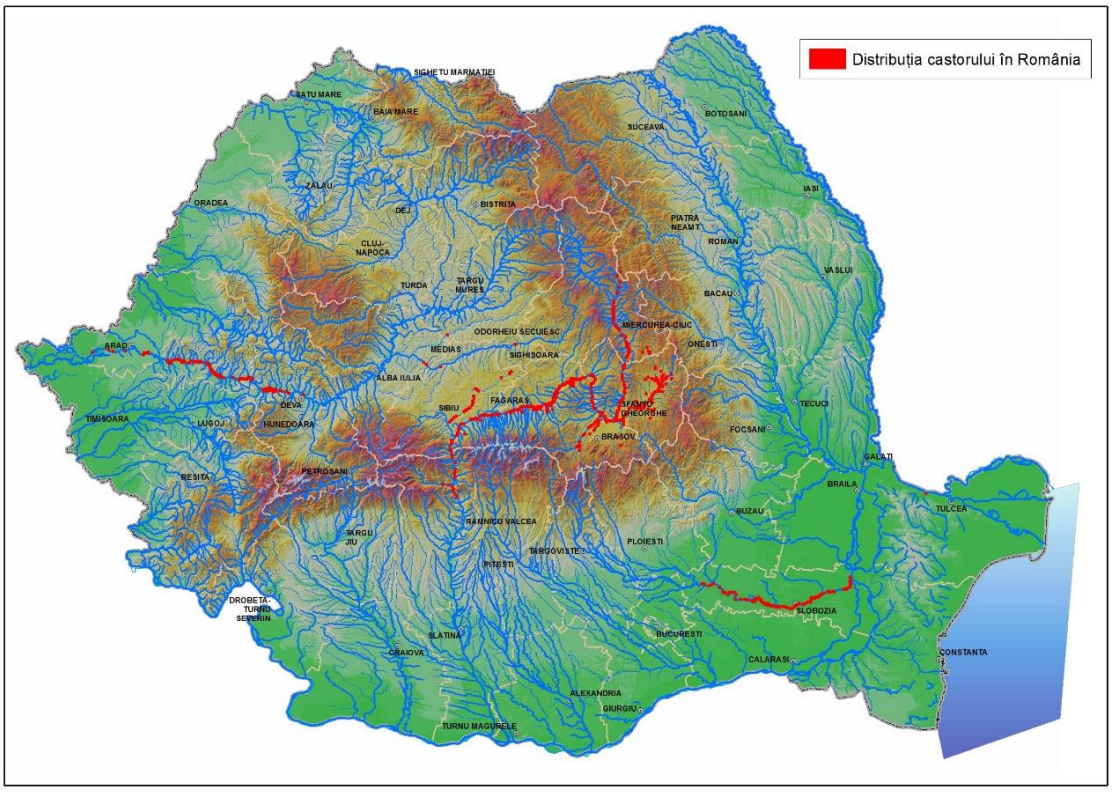

Figure 22: Beaver distribution in Romania, INCDS, 2010

Project co-funded by European Union funds (ERDF, IPA)

According to the most recent data achieved, the entire population was estimated at 2.145-2.250 beavers in 2017. Compared to the evolution of European beaver populations in other countries, the Romanian population has developed more slowly. It is possible that a cause of this phenomenon is the presence of many stray dogs beside the waters. They are the greatest natural enemies. High mortality can be caused by the torrential nature of most watercourses. Spring floods affect very young beavers; most families observed during the autumn period remain with 2, maximum 3 cubs.

In 2009, beaver specimen from Hungary and Ukraine were also reported in some rivers from NW of Transylvania (Someş, Criş, Iza, Mara, Vişeu). Beaver families were noticed outside of the repopulated watersheds, on the Uz, Buzău rivers.

For the Negru River, the average number of individuals estimated per family was 2.75, and on its tributaries 2.38 beavers per family, because of the potential of the biotope.

High densities of beavers (over nine specimens per quadrant) were observed in the upper basin of the Negru River, in the Reci - Breţcu sector, with a maximum recorded in Cătălina - Târgu Secuiesc - Ojdula area. Another high density nucleus is observed in the Ilieni-Chichiş-Ozun area.

The conservation status of the population is favourable. The next step in the beaver management of Romania will be to find the best solutions to mitigate the conflicts.

The Eurasian beaver in Covasna County

The beaver reintroduction started in 1998. First, eight beavers were reintroduced in Romania on Olt River, at the border between Brasov and Covasna County, at Lunca Calnicului and Podu Oltului.

In the following year (1999) the project continued with another 19 beavers, of which seven beavers were released in the Ilieni-Sfantu Gheorghe area.

In 2000, 13 beaver individuals were imported and set free in the Sfantu Gheorghe - Bixad area (Olt River) and 3 in the Black River Basin, Lemnia zone.

In 2001, the population of the Black River was completed with another four individuals released in the Târgu Secuiesc area.

Project co-funded by European Union funds (ERDF, IPA)

Later part of the beaver migrated upstream and downstream in search of the best habitats. In the first years of reintroduction, the population remained at a very low level, followed by an upward trend, reaching a population of about 455 in Covasna County (37% of the population on the OLT River) in 2010, of which 185 castors in the Negru river basin.

During the 2012-2013 assessment, around 300 beavers lived in the Negru River basin, and taking into account an annual population growth of 5%, we can estimate that the population in 2018 is about 420 beaver.

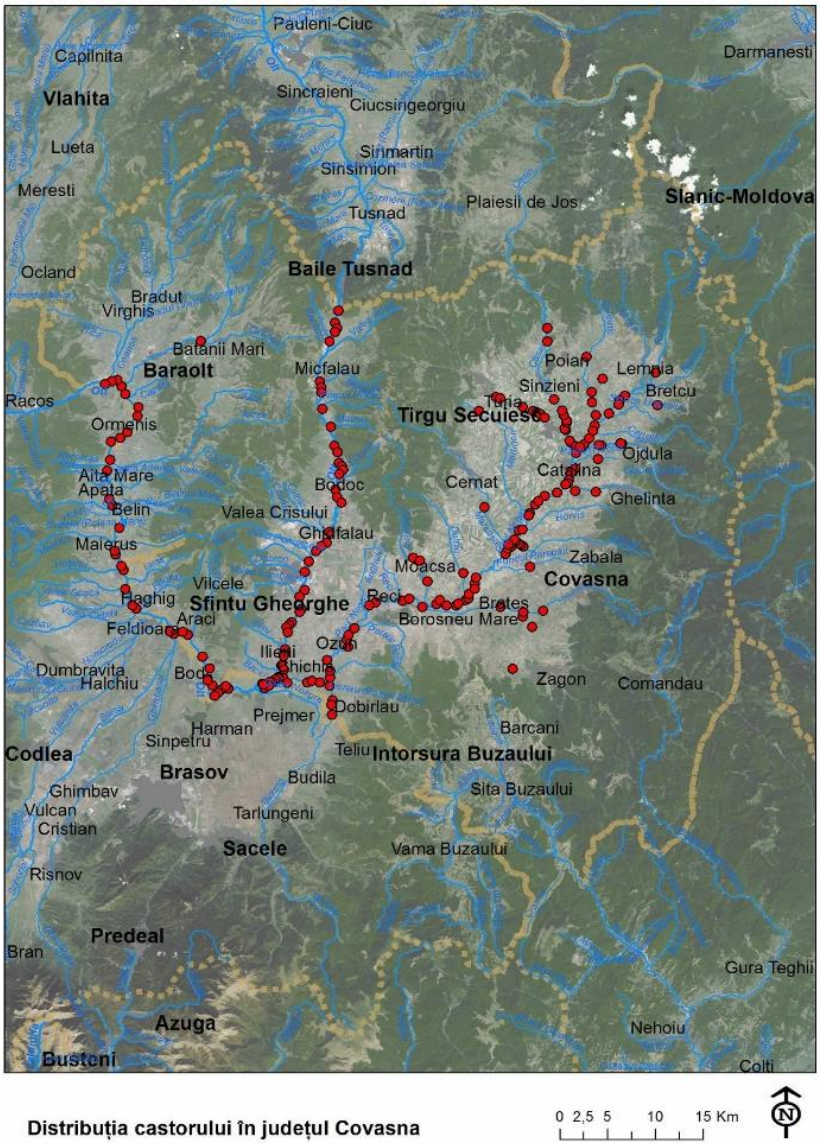

Figure 23: Beaver Distribution in Covasna County, INCDS, 2014

Project co-funded by European Union funds (ERDF, IPA)

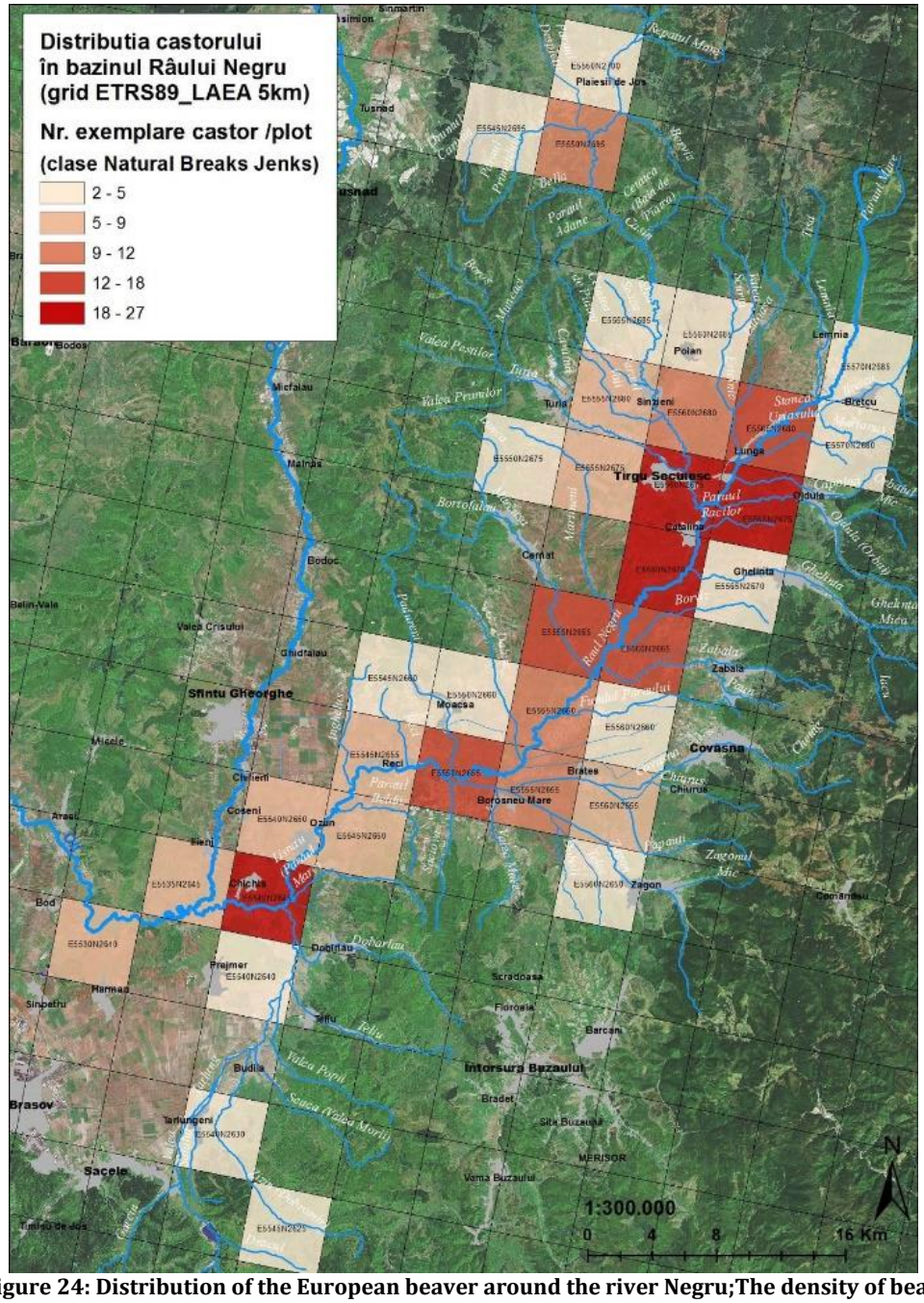

Figure 24: Distribution of the European beaver around the river Negru;The density of beaver occurence on 5x5km areas in different colors, INCDS, 2014

For the Negru River, the average number of individuals estimated per family was 2.75, and on its tributaries 2.38 beavers per family, in concordance with the potential of the biotope. High densities of beavers (over nine specimens per quadrant) were observed in the upper basin of the Negru River, in the Reci - Brețcu sector, with a maximum recorded in Cătălina - Târgu Secuiesc - Ojdula area. Another high density nucleus is observed in the Ilieni-Chichiș-Ozun area.

The conservation status of the population is favorable, next step in the management of the species will be to find the best solutions to mitigate the conflicts. The management of the species is regulated by the national and European legislation and it is made unitary at the level of the entire territory of Romania.

At present, the Eurasian beaver is present in all biogeographical regions of Romania: Pontic, Stepic, Panonic, and Continental and Alpine, except the Black Sea.

Species monitoring is based on the provisions of Article 17 of the Habitats Directive. The last report was made in 2015, following the data gathered through the project:

"Monitoring the Conservation Status of Species and Habitats in Romania under Article 17 of the Habitats Directive" Project financed by the Sectorial Operational Program "Environment"

There is a second report to be made in 2019,which is funded by the European Union. Apart from that, there are no subsidies that support species management and monitoring.

The beaver-human conflicts are mediated by the Environmental Protection Agencies (EPAs), which prepare damages files and send them to the Ministry of Environment for validation. The damage assessment commissions are made up of members of the mayoralty, hunting fund manager, EPA and the damaged owner. Until 2018 at national level, only a few cases were compensated.

5.6. Advice in conflicts and damage compensation

One major topic is to help and assist affected people in cases of beaver conflicts to find solutions and compromises. This can only work locally and in cooperation with all affected stakeholder groups and specialists.

When first problems occur, specialists or certain institutions should be contacted in order to receive preventive advice.

Moreover, in cases where severe conflicts occur, measures to compensate damage need to be conducted. Possible measures are listed in this chapter of the manual.

Preventive advice

Moreover, it is better to prevent conflicts than to find solutions for them. Therefore, communication is important. All potentially affected parties should be involved in preventive measures (e.g. property owners, residents close to the water, politicians, authorities and different federations).

Since re-mediation is often difficult, the only long-term solution is the prevention of problems. In countries with a longer experience of co-existence with beavers, complex measures are used. The consultancy of specialists who apply a wide range of technical, hydro-technical and biological methods to control water levels in beaver reservoirs is also well-proven.

Moreover, awareness and public education is necessary to protect the beaver. The co-existence of beaver and humans has to be learned again.

In order to ensure the beaver's survival as well as to support the interests of agriculture and forestry near waters, it is important to develop conflict-strategies.

Solutions and measures

As already mentioned, the majority of conflicts occur in a relatively narrow strip along the water bodies settled by beavers (90% within 10m, 95% within 20m distance). This result is the basis for solutions concerning conflicts with beavers.

Project co-funded by European Union funds (ERDF, IPA)

There are individual local measures which include a variety of measures t that are supposed to prevent and mitigate possible damages. Before measures can be started, legal requirements have to be taken into consideration.

Measures, which prevent damage caused by gnawing

- **Protection of individual trees**
  - **Fencing**

The measure is intended to protect individual plants or groups of plants from being reachable for beavers. The kind of technical implementation and the level of security can differ depending on the object that needs the protection. The aim of fencing individual trees is to prevent beavers from gnawing on those trees, their buttress roots and their low growing branches. The fence must be created in a way that it does not hinder the growth of the tree and also that beavers cannot overcome the fence in any way.

Figure 25: Fencing of trees, photograph by Claudiu PAŞCA, INCDS Braşov, 2018

The preferred food for beavers are woody plants , especially in distance of 20 meters from the water areas. For this reason, trees in this area where gnawing activities should be prevented, need to be protected by fences. Moreover, willows and poplars which represent the beaver's preferred food, need to be protected in a distance of up to 100 m.

Wire meshes that are at least one meter high, can protect valuable trees. Another possibility are bite-protection measures. Shred grids and 2-3 layers of 4-edge-meshes have proven as useful. However, thinner material such as chicken wire is often ripped and therefore not recommended

The protection with iron nets can be used for precious tree species where gnawing activities should be prevented.

- **Electric fences**

Electric fences can be used to prevent the beavers from accessing riverside parcels. Moreover, after removing or lowering a dam, an electric fence can stop beavers from rebuilding a new dam. Additional horses and cattle can be kept away, preventing them from breaking into beaver tunnels.

Electric fences can be used to prevent the beavers from accessing riverside parcels. Moreover, after removing or lowering a dam, an electric fence can stop beavers from rebuilding a new dam. Additional horses and cattle can be kept away, preventing them from breaking into beaver tunnels. For beavers the electric fence can be composed of 4 electrified wires disposed as close as possible to the ground. (maximum high~0,7m).

Project co-funded by European Union funds (ERDF, IPA)

Figure 26: Application of electric fences, photograph by Claudiu PAȘCA, INCDS Brașov, 2018

- **Protection of woody plants against beaver bites**

In urban areas, tree felling and the construction of dams, in particular, offer a certain potential for conflict and danger. In areas where man has reduced the shore shrubs to a narrow strip, or in park-like areas (Alte Donau, Donaukanal) and gardens, felling of trees by beavers is often undesired. This can be remedied by mechanically protecting individual trees with stronger wire mesh or by applying a protective coating to the tree trunks. This non-toxic coating containing quartz sand can be obtained from tree nurseries. It is also possible to reduce the pressure on individual trees by deflecting beavers (e.g. cutting material).

The City of Vienna investigates every tip from the population about beaver damage in order to take any necessary measures. Trees gnawed on massively by the beaver, which represent a safety risk, are felled immediately. If possible, the felled tree is left lying as a food resource for the beaver in order to reduce further felling.

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- **Buffer strips**

Part of the production area is provided for beavers; plants are planted that are attractive for the beaver (willows and poplars). This should be done along watercourses in width of at least 20 m. The presence of the buffer strip cannot completely prevent the occurrence of damage to agricultural areas behind it because beavers use for food a wider range of woody plants (than exclusively poplar and willow), but the strip can contribute to a significant reduction of gnawing. This measure has to be considered a long-term activity since the foundation and support of these strips is quite time consuming. This measure can be applied in a limited way and it will not be a short-term activity. However, the rate of reduction of damage depends on composition, age structure, density and width of the buffer strip. Moreover, the buffer stripe reduces the space for farming. The opposite of buffer strips is to reduce the attractiveness of the area by removing vegetation of woody plants in a strip along the banks. From a biological perspective, however, this measure is not appropriate. Due to the significant loss of biodiversity of this measure, it is only suitable for specific cases, e.g. around small hydropower plants (SHP), where the removal of vegetation in the vicinity reduces the risk of clogging of SHPs mechanisms by carried woody debris, which is in case of occurrence of beavers very frequent.

- **Selection of crops**

In order to reduce feeding damage or to reduce the financial significance, crops that are less attractive for beavers or of lower economical value can be cultivated, especially in river shore areas.

- **Supplemental feeding and planting of woody food**

In special cases, the beaver's chopping activity can be reduced by supplemental food. Moreover, in order to reduce damage on more valuable trees, shrubby willows can be planted near the water. When a new forest is planted, a 10 m wide strip along the water should consist of unused softwood.

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- **Leaving cut down trees**

Since chopped trees provide a source of food for beavers, they should be left until spring if it is possible because otherwise the loss of food has to be compensated by new trees. A solution for safety reasons would be to fix the tree with steel cables in order to prevent it from being washed away.

- **Protection of culverts and pipes**

Culverts and pipes often get blocked by beavers; they can be protected with wire grating which makes it more difficult for beavers to bloc.

Figure 27: Protection of pipes, photograph by Claudiu PAȘCA, INCDS Brașov, 2018

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- ***Flood Prevention***

It cannot be generalized under which parameters and limits beaver dams are built. However, there are certain patterns: Beaver dams occur, as mentioned in chapter 2.4. Conflict potentials, in small and medium sized watercourses. Moreover, the depth plays an important role: If it is too low, beavers try to increase its level. For beavers, the flow needs to be fluctuating or low. Therefore,

Picture 16: Damage caused by beavers because of surge of water level: a flooded forest (a); a flooded field (b); a flooded meadow (c); a beaver dam and castle in a flooded cover (d); a flooded road due to an expansion

Figure 28: Damages because of beaver activities, Czech University of Life Sciences Prague, 2016

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when the flow is too strong, they construct dams to achieve a reduction in the rate of water flow. To sum up, beavers build dams to reduce the water flow, or to increase the water level.

A measure is a drainage of the beaver dam. This measure aims to reduce the water level of the beaver basin. The principle is simple: The aim is to place a pipe with a protective cage to an inflow part, so that the final level is acceptable for humans and beavers. International experience shows that this measure is effective as long as the height of the water in the basin is not under 80 cm after the drainage. However, when the depth decreases to under 50-60 cm, it is quite likely that beavers will not accept this measure. Therefore, each particular situation needs to be assessed by experts because the aim is not draining the whole beaver basin, but only a reduction of the water level and subsequently a prevention for flooding.

For more detailed information, a beaver manager or other experts should be contacted.

Figure 29: Drainage of a beaver dam: into a dam inserted pipe with a knee in an inflow and with a protective cage (a); detailed inflow of the pipe and protective cage (b), Czech University of Life Sciences Prague, 2016

- ***Dislodgement of beavers***

Since the only measures to keep beavers out of larger zones would be to remove all trees and cover all river banks with stone, any trials do force beavers to leave a certain area failed. Under consideration of EU and national law, beavers might be dislodged if other solutions are impossible or too expensive. Legal requirements in the participating countries are normally based on derogative option in the FFH directive. Beavers are caught by traps that are placed ashore on beaver passages or by using a net. The further treatment is in most cases subject to the decision of local authorities.

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6. Relevant Stakeholders and cooperation partners

As already mentioned, in order to find effective solutions in relation to conflict management, prevention and damage compensation, it is necessary to include and incorporate all stakeholders: The European beavers crosses borders and is a species that migrates to uninhabited areas. Therefore, it is of immense importance that the issue is not only dealt with on a national level but also on a transnational level; thus it requires the cooperation of all relevant stakeholders and cooperation partners.

- Land owners
  - Fishery
  - Forestry
  - Agriculture
- Decision-makers and Administration
  - European Union
  - Federal State Authorities
  - Districts and Provinces Authorities
  - NGOs
  - Cooperations under public law (legal according to regional, national and European law; eg.: Styrian Mountain Nature and Rescue Service)
- Camaro-D participating countries: Austria, Germany, Hungary, Czech Republic, Romania
- European Union (Laws: Bern Convention, Flora and Fauna Council Directive 92/43/EEC, FFH Directive)
- Danube River Basin

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7. Summary and Conclusion

In conclusion, it can be said that the attempts of beaver management in the participating EU countries are quite different. Therefore, as already mentioned in point 4. SWOT Analysis, it is important that transnational communication takes place.

A transnational beaver management plan is a way to find common solution, considering the EU and national legal situations. In addition, the beaver is a species that is spreading throughout Europe and crosses borders. Therefore, it is suggested to stick to certain guidelines in the case of conflict occurrence:

Local beaver advisory body and beaver monitoring

Firstly, it is suggested that advisory bodies should be implemented on a district level.

Secondly, if a person notices beaver activities or even is affected by beaver activities or damages, a local beaver advice center should be contacted. In some (federal) states, there are beaver managers for this purpose. However, sometimes other advisory bodies need to be contacted.

Transnational advice

Moreover, it is suggested that conflict situations are evaluated on a transnational level - if necessary. Therefore, a transnational advisory body, a group of people who exchange their knowledge and experience would lead to more consistent management strategies.

Application of measures

The beaver is a legally protected species in the Danube River Basin and EU(FFH directive). Since most conflicts occur in relation to agriculture or land use, landowners and other stakeholders need to be incorporated into management concepts and measures. After the evaluation of a conflict situation by an expert, measures that do not cause harm to the beaver should be preferred to the elimination or removing of the beaver, which should only take place when no other solution is possible.

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8. Figures and Tables

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