



Fig. 1: Beaver (*Castor fiber*)

Beaver

Our largest and most impressive rodent is worth learning about because the traces it leaves are easy to see. It is found in the whole of the country and therefore in many parts of Bavaria as well. Because of its comical appearance it has a positive image among students, but very few of them have ever seen a live beaver.

You can see the connection between the beaver's activity and the condition of the landscape like with no other animal. The reasons for conflict and possible solutions come to light when there are great changes in the waters.

Basic aims of the activity

- To discover a beaver's tracks and its habitat
- To experience the way the beaver changes the landscape
- To describe the reasons for conflict with beavers and to discuss solutions, to evaluate options to take action and to communicate appropriate with the person you are speaking to

1. Factual information about the beaver

The beaver was extinct in Bavaria for nearly one hundred years. The superiority of those who were hunting the beaver was too great. The main reasons for being hunted were for beaver fur for hats and coats, for castoreum, a glandular secretion against all kinds of bodily illnesses, and for beaver meat, which was considered to be a Lenten food by resourceful men of the church. The last Bavarian beaver was caught in 1867. Ignorance, prejudice, and its all-round usefulness characterised the management of the beaver:

"It is a danger to fish and crabs". (Conrad Gesner, 1669)

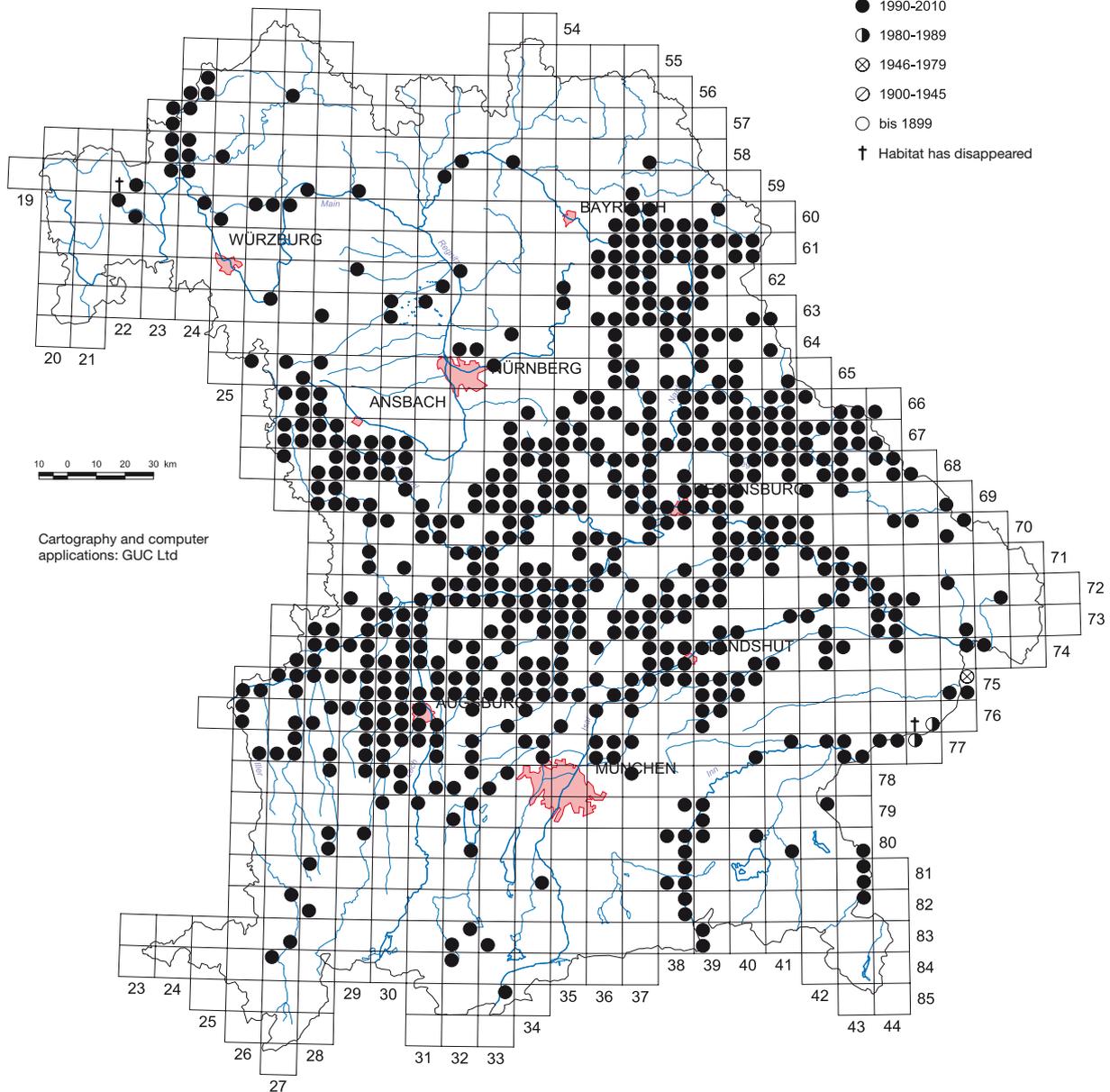
"With respect to its tail it is completely a fish, and it has been declared to be such by the faculty of medicine in Paris, and as a result of this declaration, the faculty of theology in Paris has decided that the meat may be eaten during fasts". (Jesuit priest Charlevoix, 1754)

Mapping of Conservation in Bavaria

As at 30.06.2010

Year of collection of data:

- 1990-2010
- ◐ 1980-1989
- ⊗ 1946-1979
- 1900-1945
- bis 1899
- † Habitat has disappeared



Publisher: Bavarian State Office for the Environment

Source: Reports of volunteer workers, own mapping and evaluations of literature wertungen

Fig. 2: Distribution of the beaver in Bavaria (Bavarian State Office for the Environment; Mapping of Conservation in Bavaria; as at 30.06.2010)

Since 1966, a successful reintroduction programme has brought the beaver back to Bavaria. Today there are about 12,000 animals living in approximately 3,000 beaver territories. (See fig. 2)

Beaver, nutria or muskrat?

The beaver is often mistaken for the muskrat or the nutria. The beaver is much bigger than the muskrat and the nutria and is easy to recognise by its wide, flat tail (see fig. 3). The tail is held underwater when the beaver is swimming, so you have to compare other details, too.



The beaver glides smoothly through the water, its back legs propelling it from under the surface. The nose, eyes and ears form a line over the surface of the water and the rest of the body stays under the water.

The much smaller muskrat has its back above the water and you can usually see the tail moving from side to side while it is swimming. The side to side movement also helps you recognise the difference between a muskrat and a young beaver. They are of similar size but the beaver glides smoothly through the water.

You can recognise the nutria by its bright white whiskers and square-shaped head. Its nose stretches high out of the water so that the head points upwards at an angle. You can see its back and part of the tail through the water.

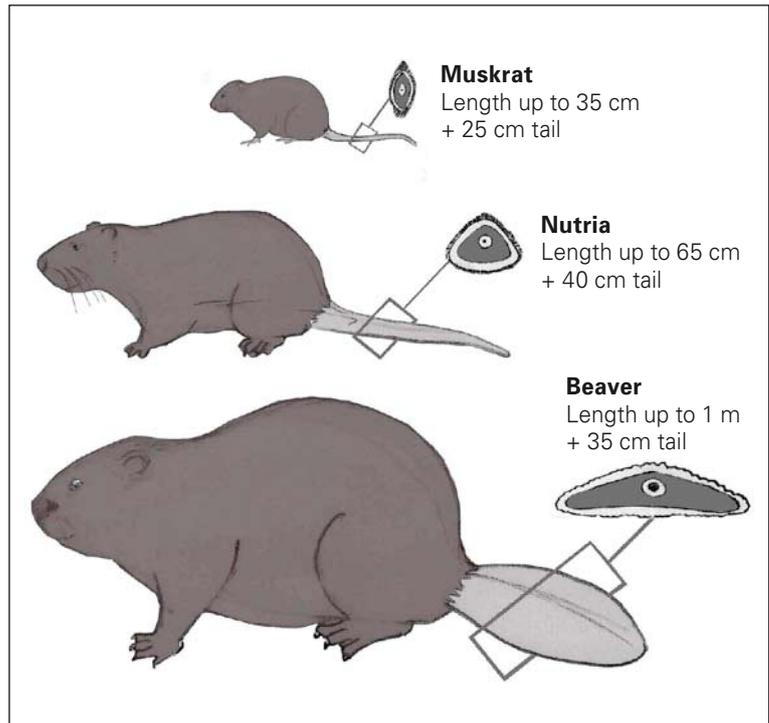


Fig. 3: Diagram of a beaver, a nutria and muskrat.

Teeth

Because of its special teeth, the beaver cannot only peel bark from branches but also fell large trees. (See fig. 6). The front of the incisors is covered with an extremely hard, orange-coloured layer of enamel (see fig. 5). The enamel on the back of the teeth is somewhat softer and gets worn down more quickly. Because of this, the teeth are constantly sharpened. Using this “beaver principle”, self-sharpening knives and saws have been developed, which are constantly sharpened during use.



Fig. 4: A beaver’s tail with its characteristic scales



Fig. 5: Teeth showing the special front teeth



Fig. 6: A tree which has been felled by beavers, showing gnaw marks and wood shavings



The wearing down of the teeth during gnawing is balanced by constant regrowth. The beaver uses its back teeth to grind its food.



Fig. 7: A beaver swimming



Fig. 8: Hind paw showing webbing

Adapting to life in the water

The nose and the ears are closed while diving and the eyes are covered with a protective eyelid. The beaver uses its sensitive whiskers to find its way under the water. It can sense the smallest currents and differences in pressure. The spindle-shaped body allows the beaver to swim in an energy-efficient way (see fig. 7). The large back feet are webbed to paddle well and propel the beaver (see fig. 8). The short front legs are held close to the body during swimming.

The beaver's fur is perfectly adapted to life in the water. It is very thick. There are up to 23,000 hairs per square centimetre on the belly. Two types of hair, the guard hairs and the undercoat, lie over one another so that a layer of air prevents the penetration of water during diving. Because of the special structure of the undercoat, the layer of air is trapped in the crimped hairs. But this only works when the hair is well looked after. Because of this, the beaver must spend a lot of time on grooming. It washes and combs its fur with special cleaning claws on its back feet. The anal glands produce an oily secretion which the beaver spreads over the fur with its paws. This waterproofing ensures that water runs straight off the fur.

The beaver can swim around under the water for five minutes. When it dives under the water and keeps still, for example when it senses danger, the beaver can stay underwater for 20 minutes. The beaver's tail is used as a steering rudder and for extra propulsion when swimming, and in the winter it is used to store fat. The tail also functions as an alarm signal for other beavers: in dangerous situations the beaver slaps its tail hard on the surface of the water; which makes a loud clapping sound. The tail is also used as an insulation mat for the young beavers and as a support when sitting.

The beaver lodge

In Bavaria, most beavers live in so-called bank lodges. To build a bank lodge, the beaver first digs a gently rising tunnel into the bank. At the end of the tunnel it will build the living space. This can have a diameter of 120 cm and a height of 60 cm. The beaver reinforces the thin roof of the tunnel and the living space with sticks and twigs. The entrance is always under the water.

If the banks are high and stable enough, for example under the roots of trees, then the beaver does not need to reinforce the lodge. These types of lodges are difficult to find. Large lodges which are completely surrounded by water are only built by beavers when the banks are very flat or when the banks have been flooded by beaver dams (see fig. 9).



In the beaver's territory there are usually two to four lodges of different types, sometimes more. As well as building lodges, the beaver digs simple tunnels which it can hide inside when it senses danger.

Beaver dams

Beavers are born with the ability to build dams, but they only do this when necessary. The main purpose of a dam is to keep the water at least 80 cm deep. This water depth enables the beaver to dive safely and stops the water from freezing completely during the winter. Dams are also built to flood nearby areas and enable the beavers to reach their food by swimming, or to transport building wood and food more easily.

The beaver is very flexible in its choice of building material for the dam. A dam is usually made of a main framework of branches and sticks, which is sealed with mud. Rapeseed, corn or stones are also used to build a dam.

Way of life

The beaver is mainly nocturnal and leaves its lodge at twilight. It lives in family groups. These consist of parent animals, which stay together their whole lives, and their young from the last two years. The family occupies a territory which can include 1-5 km of flowing waters depending on the quality of the habitat. The territory is marked with so-called castoreum (= an oily secretion from glands in the anal area) to warn away intruders.

After mating, which takes place between January and March, the female gives birth to 2-3 young. She nurses the young for up to two months and they are usually sexually mature at the age of three years. When they are two years old, the young are driven out of the territory by their parents, and they travel up to 100 km to occupy their own territory and begin their own families.

No other animal is in the habit of felling trees in winter. This is because of the beaver's completely vegetarian diet. In the summer, it eats grasses, herbs and water plants, and it also uses field crops such as corn, sugar beets or grain which grow near the waters where it lives. Beavers like a varied diet and eat almost any kind of edible plant. When plant foods become scarce in winter, it closes this "gap" with the help of its strong incisors. It gnaws at a tree trunk for so long until the tree falls to the ground. Exact grooves made by the incisors can be seen on the trunk, and you can also find wood shavings. Then the branches up to a thickness of a person's arm are removed and transported to a safe place at the water and peeled. Beavers only eat the inner bark; the rough bark and the wood are left. The beaver transports bulky or heavy branches in the water. Wood is not only food for beavers but is also used as a building material for lodges and dams.

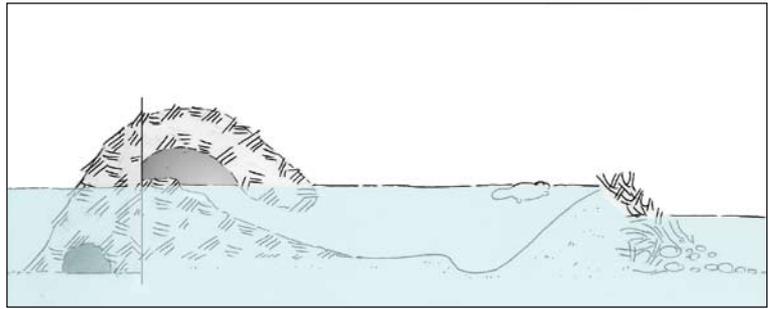


Fig. 9: Cross section of a beaver lodge



Habitats

Beavers are very adaptable in their choice of habitat. They prefer slowly flowing waters and large areas of still water which are at least 80 cm deep. A good habitat contains steep banks for digging living areas and tunnels to hide in as well as other good places to hide. Beavers can establish themselves here without having to build big dams or complicated lodges. Areas near the banks with fields containing edible plants and other soft woods as well as water plants provide the best food.

Like no other animal the beaver is able to actively change its habitat, to improve the habitat for itself and for other species. Beaver dams in flowing waters create ponds and wetlands, raise the water table and they also moisten hollows which are further away from the waters. This moistening leads to a change in the vegetation of the affected areas. Plants that like damp conditions and plants that tolerate them benefit from this moisture, plants that are not tolerant to damp conditions disappear. The felling of trees in autumn and winter thins out the forest on the banks and sunlight can reach the ground. The microclimate changes and creates succession areas of various sizes. The tree trunks and the gnawed trees which have not fallen over become deadwood. The trees lying in the water increase the variety of structures. Digging tunnels and living spaces into the banks allows water to get into the ground. Tunnels which are flooded or collapsed increase the variety of structures in the bank.

As a whole, the activity of the beaver creates richly structured habitats which are always changing. Countless other creatures, often rare or endangered animal and plant species, can find a home there. More fish live in waters that have been altered by beavers, and these provide food for otters and kingfishers. Otters also use abandoned beaver lodges as hiding places and for raising their young. Kingfishers can make their breeding burrows in banks which have collapsed or in the roots of trees which have fallen over. Countless beetle species use the deadwood and also become food for various bird species.

Beavers in the cultural landscape

River wetlands where beavers can live permanently and without any problems are mostly in a nearly natural state and have enough wide banks. The beaver therefore is an indicator species for intact waters. Because of today's highly modified water systems (straightening, technical development etc.), the beaver

does not find it easy to spread out its territories. The beaver itself can manage quite well with these changes, but conflicts can arise in the case of waters near areas that are intensively used by humans. If there is less than 10 metres between the farmland and the open waters, there is a danger that agricultural machines might cause beaver tunnels to collapse. Where there is no buffer zone, crops like corn, wheat or sugar beets become favoured foods that are easily obtained. The felling of trees in winter in particular is a source of conflict in the forests. This mostly affects softwoods near the water. As well as the softwoods, hardwood species like ash, maple and even fir trees are gnawed on.



Fig. 10: Beaver dam in a drainage ditch



Management of beavers – living next to each other without conflict is possible!

In the early 1990s, ideas were developed to solve problems with beavers. This was focused on northern Bavaria. The solutions are being implemented as part of the Bavarian beaver management programme. The best solution is, of course, to create unused space near waters. Beavers are not the only ones who can benefit from this space. The areas stop fertiliser and pesticides from reaching the water. They also serve as retention areas for flood waters and provide habitats for many animals and plant species. But because such spaces cannot be created everywhere, a whole range of individual measures have been developed to prevent conflicts or to compensate for them. These include draining or removing beaver dams, electric fences to prevent beavers eating crops and installation of wire mesh in the banks to prevent undermining. Since 1st August 2008, money has been available from the Bavarian State Ministry for the Environment and Health as compensation. This is handled by the relevant Lower Conservation Authority. If great damage is expected and no other remedy is possible then the beaver will be removed, most probably with traps. The captured animals used to be given to other countries, especially those on the Danube, to be reintroduced. Today most beavers which have been caught are killed.

The first contact for questions about beavers is the relevant Lower Conservation Authority in the District Office, which can give advice, funding and practical help.

The work of the beaver management program is supported by volunteer "beaver advisors" (Biber-Berater). These are people from all fields (for example, farmers, hunters, foresters, fishermen, conservationists) who have been trained by the Bavarian Academy for Nature Conservation and Landscape Management.

As well as the beaver advisors, who have been employed by the countries, there are also two full-time beaver managers from the Registered Society for Conservation who provide advice and do publicity work.

Literature

Reference books

Volker Zahner, Markus Schmidbauer, Gerhard Schwab (2009):
The Beaver – The Return of the Lords of the Lodge, 2nd edition (Der Biber – die Rueckkehr der Burgherren, 2. Aufl.) Buch- und Kunstverlag Oberpfalz, Amberg. ISBN 978-5-935719-52-0

This book with beautiful pictures has information about all aspects of the beaver, from biology to management. Suitable for primary and secondary school.

Hubert Weinzierl (2003):

The Beaver: Master Builder of the Wilderness (Biber: Baumeister der Wildnis). Bund Naturschutz-Service GmbH, Lauf a.d. Pegnitz. ISBN 3-9808986-0-1
The adventure-filled story of the reintroduction of the beaver in Bavaria

Messlinger, Ulrich (2006):

Monitoring of beaver territories in western Middle Franconia (Monitoring von Biberrevieren in Westmittelfranken). Registered Society for Conservation in Bavaria County Trade Office Nuremberg

This work documents the effects of beavers on species diversity in the habitat which they shape.



Teaching materials

Andreas Steinig (2006):

With the Beavers (Bei den Bibern). Patmos Verlag, Düsseldorf. ISBN 3-491-42055-5.

Excellently illustrated picture book with descriptions of the beavers' life as well as short factual texts and background information for primary school students.

Brochures

Bavarian State Office for the Environment. Editor (2009):

Beavers in Bavaria (Biber in Bayern). Free brochure from the Bavarian State Office for the Environment, Augsburg. Order from www.bestellen.bayern.de

Bavarian State Office for the Environment and Society for Conservation in Bavaria. Editors (2009):

Species Diversity in the Beavers' Territory (Artenvielfalt im Biberrevier). Free brochure from the Bavarian State Office for the Environment, Augsburg. Order from www.bestellen.bayern.de, download from www.bibermanagement.de/Artenvielfalt_im_Biberrevier.pdf

Bavarian State Office for the Environment (2009):

Bavarian Beaver Management – Avoiding Conflicts – Solving Conflicts (Das Bayerische Biber-Management – Konflikte vermeiden – Konflikte lösen)
Order from www.bestellen.bayern.de, download from www.bibermanagement.de/Artenvielfalt_im_Biberrevier.pdf

Beaver backpacks

At several Lower Conservation Authority Offices as well as the offices of the local groups of the Society for Conservation and also the State Society for the Protection of Birds you can borrow “**Beaver Backpacks**”. These contain materials for talks on beavers and for trips (fur, skull, footprints, films, teaching materials, examples of lessons etc).

Internet addresses

www.biber.info

Website with information about beavers and links.

www.biber-rlp.de

You can download a beaver folder. The educational part of the folder gives ideas on how to introduce this topic into your lessons for various ages. Its aim is for students to get to know the beaver and to see it as part of our own habitat.

Contacts

Zoos with beavers

A visit to a zoo is a good addition to the activities. The following zoos have beavers:

Augsburg Zoological Garden, Brehmplatz 1, 86161 Augsburg

Tel. 0821/567149-0, www.zoo-augsburg.de

Hellabrunn Animal Park, Tierparkstr. 30, 81543 Munich

Tel. 089/625080, www.zoo-munich.de

Nuremberg Zoological Garden, Am Tiergarten 30, 90480 Nuremberg

Tel. 0911/54546, www.tiergarten.nuernberg.de

Lohberg Zoological Garden, Schwarzenbacher Str. 1A, 93470 Lohberg

Tel. 09943/941313, www.bayerwald-tierpark.de

Open-air Zoo in the Bayerischer Wald National Park, Ludwigsthal

Tel. 08552/9600-0, www.nationalpark-bayerischer-wald.de

Wilhelma Stuttgart, Postfach 50 12 27, 70342 Stuttgart

Tel. 0711/5402-0, www.wilhelma.de

Alpenzoo Innsbruck, Weiherburggasse 37, A-6020 Innsbruck

Tel. +43-512/292323, www.alpenzoo.at

Zoo Hellbrunn Salzburg, Anifer Landesstr. 1, A-5081 Anif

Telefon: +43-662/820176-0, www.salzburg-zoo.at



Contacts for information about beavers

Contact the Lower Conservation Authority Offices at the city district offices (see Appendix D at the end of the whole document). In most parts of Bavaria they can help you contact the trained "beaver advisors". Beaver advisors can help you find beavers as well as helping you before your trip.

Gerhard Schwab, Southern Bavarian Beaver Manager of the Registered Society for Conservation in Bavaria. Tel. 01 72 / 6 82 66 53; Email Gerhard.Schwab@biber.info

Horst Schwemmer, Northern Bavarian Beaver Manager of the Registered Society for Conservation in Bavaria.

Tel. 01 71 / 2 43 22 69; Email horst.schwemmer@bund-naturschutz.de

2. Legal information

The beaver is a strictly protected species (Flora-Fauna-Habitat Guidelines of the EU Appendix IV, Federal Law for Nature (BNatSchG), Article 10, Section 44 ff.) Please take note that according to the Federal Law for Nature, places of reproduction or resting places may not be disturbed, damaged or destroyed (Article 44 Part 1 Number 3 BNatSchG). If you discover dwellings during the activities, these must be left **untouched**.



3. Activities

Fundamental aims of the activities

- To discover beaver tracks and habitats
- To experience how the beaver shapes the landscape
- To describe the reasons for conflict with beavers and to discuss solutions, to evaluate methods of action and to communicate so your listener can understand you

Activities

- A 1 **On the trail of the beaver**
Looking for tracks, discovering the beaver's habitat
- A 2 **Role play "My Dear Beaver"**
Portraying various interests, developing solutions to conflicts
- A 3 **The beaver as a conflict-prone species**
Ideas for scientific topics for senior high school pupils: ecology, acquiring knowledge and experiences with beavers

Additional material

- Material A 1_1 **Identification handout 'Gnawing Marks on Wood'**
- Material A 1_2 **Identification handout 'Beaver Tracks and Beaver Lodges'**
- Material A 1_3 **Overhead projector transparency 'Beaver'**
- Material A 1_4 **Overhead projector transparency 'Beaver Habitats'**



On the trail of the beaver

Factual background to the activity

Because the beaver is nocturnal, you cannot expect to see him in the wild. But looking for tracks and finding the lodge is fun for pupils because they are curious and like being detectives. The winter time is very good for looking for beaver tracks when the ground is frozen (gnaw marks are fresh and easy to see, mud on the riverbanks is frozen). The time at the beginning of spring before the trees get their leaves can also be used. Gnaw marks and impressive nibbling activity on trees is easiest to find at this time of year. Later in the year it is usually more difficult to get to the edges of waters (large bushes are sprouting and there are nettles) and the activities are not to be recommended because the birds must be protected (breeding time).

On flowing waters with a good amount of food, a beaver territory extends from 0.5 to 1 kilometre along the stretch of flowing water. Waters which do not provide a good amount of food can reach a length of 6 kilometres along the stretch of flowing water. The gnaw marks increase as you get closer to the lodge. Because the beaver uses the current to transport gnawed wood, most trees are felled upstream from the lodge rather than downstream.

It is important for the beaver to have quick-growing softwoods in its habitat in the winter. They especially like to gnaw willows and poplars. In wetland forests which are close to their natural state, these are found right next to the edge of the water. The beaver only eats the bark, not the wood. The beaver is mainly active up to 10 metres from the edge of the water, sometimes up to 20 metres from the water. Parts of trees which the beaver transports mostly have a diameter of less than 10 cm. The beaver takes the wood that it has cut to a protected part of the bank and gnaws it there. You can recognise where the beaver eats because of there are many white peeled parts of trees on the bank there.

Implementation

- Ask the local beaver advisor about current numbers of beavers (contact through the the Lower Conservation Authority Office at your local district office. The beaver advisor might even be able to take part in your activity.
- Take a trip to the beaver habitat to prepare yourselves; this is best done with the beaver advisor. You can find out what the area is like and also where the beaver lodge is.
- Talk about beaver tracks in the lessons beforehand. (See Additional Materials A 1_1 to A 1_4).
- Pupils can look for and collect evidence of beaver activity (branches, twigs, wood shaving etc.).

Season:



Grade level:



Development:



Aims of the activity

- To discover the beavers' habitat by their tracks
- To get to know and understand beaver activity as an active shaping of the edges of waters
- To understand that beavers are a part of our landscape
- To recognise that these dynamics are an important part of the development of the landscape

Materials

- Digital camera to photograph the lodge, exits from the water and felled trees
- Additional material A 1_1 Identification handout '**Gnawing Marks on Wood**'
- Additional material A 1_2 Identification handout '**Beaver Tracks and Beaver Lodges**'
- Additional material A 1_3 Overhead projector transparency '**Beaver**'
- Additional material A 1_4 Overhead projector transparency '**Beaver Habitats**'



- The following evidence is very easy to find:
 - Trees which have been gnawed into the shape of an hourglass or felled completely; wood shavings lying on the ground
 - Gnawed twigs and branches with clear marks from the incisors
 - Twigs which have been completely gnawed off; these are fresh and almost white in colour, with the end gnawed on a slant (“beaver spaghetti”)
 - Wide places where beavers exit the water, sometimes with footprints or marks where the tail has been dragging on the ground (“beaver slides”)
 - Places where beavers eat
 - Rafts made of gnawed off branches and twigs, which is the beavers’ winter food store
 - Beaver lodges, mostly in the banks, with a cover made from a pile of gnawed wood; the living area can only be reached by diving under the water; freshly piled-up mud is a sign that the lodge is being used
 - Much more gnawing activity near the lodge than further away from it
- Evaluate the quality of the habitat you found with the pupils. Use the ‘Beaver Habitats’ additional material to help you. Is the habitat suitable for beavers?
- Follow-up work: organise a beaver exhibition



Role play “My Dear Beaver”

Factual background to the activity

Intact wetland areas are important in many ways. They collect water during floods, they protect drinking water and they provide a habitat for many animal and plant species. Problems with beavers are mostly small in these areas. There is a much higher chance of conflict with waters that are not in their natural state and which have been technically changed by humans, such as with wastewater treatment plants, retention reservoirs, fish ponds, mill canals or ditches created for agricultural use. There is a rule: the closer the edges of the water are to their natural state, the less conflict there will be with beavers.

That means the beaver is a good indicator of whether the edges of waters are in a natural state or not. If there is no protection zone for collecting floodwaters and keeping the water clean (softwood wetland area) then the beavers will feed on economically important forestry plantations and crops. There is also the problem of contamination by fertilisers and pesticides and there is the danger of tractors causing beaver tunnels up to a distance of 10 metres from the water to collapse. Beaver tunnels and other structures made by animals (such as nutria, muskrat, badger, fox, rabbit) can make the compromise the safety of artificial dams (for example, river dams, fish ponds, wastewater treatment plants).

Implementation of the role play “My Dear Beaver”

- To get started, a current newspaper article on the topic of beavers – if available – is helpful. A role play should help pupils imagine the beavers’ situation. The students pretend to hold a meeting of citizens to discuss the various points. After the points have been stated, possible solutions should be suggested.
- The teacher may need to repeat the rules for the discussion. He/She assigns the roles described below among groups of students. The groups should be about the same size.
- Each group discusses the opinions of the role they have been assigned and collects further points if possible. Each group nominates a speaker.
- The speakers of each group briefly present their points in front of the whole class. The teacher pretends to be the mayor.
- Then all the pupils except the speakers are asked to develop possible solutions or suggestions for intervention for the various interest groups.
- After that, there is a discussion moderated by the teacher (mayor), in which all the pupils present their possible solutions.
- At the end of the role play, you can review the main points of the discussion and the strength of the arguments. The pupils can also give their opinion about the roles they played.

Season:



Grade level:



Development:



Aims of the activity

- To recognise the role of the beaver in cultural landscapes which have been technically changed by humans
- To describe the reasons for conflict with beavers and to draw conclusions
- To discuss solutions, to evaluate methods of action and to communicate so your listener can understand you



Representatives of the different interests:

Opinion of Agriculturalist Frank Farmer:

"A beaver? Not in my area! I have to produce crops and I need every metre of land. The beaver would eat all my corn and sugar beets from my fields. Or he would build a dam and my fields would be flooded. And if I drive my tractor over a beaver tunnel and the ground collapses, I could break my neck!"

Opinion of Forest Owner Fred Forrest:

"A beaver would be a catastrophe! It would fell all my trees which I've waited for years to grow! My grandfather planted these trees. And who will pay for the damage?"

Pupil Petra Miller:

"I think beavers are nice. They are interesting animals that belong in my area and they are protected. And anyway, they wouldn't bother anybody in an intact wetland forest."

Wastewater Treatment Plant Manager Annette Clear:

"Beavers don't belong anywhere near a wastewater treatment plant. If there was even one beaver tunnel dug through our dam, all the wastewater would drain out and there would be terrible pollution of the water."

Representative of the Water Management Authority Peter Waterman:

"We're happy about the beaver. It creates natural water habitats which we all want. Of course we have to protect flood embankments, but not only against beavers, but also against other animals like the muskrat."

Representative of a Conservation Society Anna Smith:

"I'm happy that the beaver has come back to us after more than 100 years and I would like to keep it as part of the fauna in our area. To do this, we have developed a beaver reintroduction programme."

Possible solutions that can be discussed:

Agriculturalist: Gets compensation payments for leaving a strip of land for the beavers which he can't use any more → no economic loss. This helps the beaver, the wetlands and protects the water and the soil. Install drainage pipes in the beaver dam → A water level can be reached which is acceptable to the farmer. The farmer does not have to constantly remove new beaver dams.

Wastewater Treatment Plant Manager: Catch and remove the beavers (risk is too high, as the water could leak out from the treatment reservoir) and use wire mesh at the outlet of the wastewater treatment plant (prevents beavers from entering) → danger is removed, beavers are permanently prevented from entering the area.

Forest Owner: Compensation payment for parts of the forest that are not used → no economic loss; useful for the wetlands and for species diversity.

Representative of the Water Management Authority: Can buy pieces of land for the waters and can protect embankments, for example with mesh or stone blocks.



The beaver as a conflict-prone species

Ideas for scientific topics for senior high school pupils

Beaver – biology, determining population and potential for conflict

Explanation and aims:

The beaver is our largest native rodent, which actively shapes its habitat like no other animal. Its successful return poses many questions.

Suggestions for topics

- 1) Find out about the number of beavers in a defined water system as well as the potential for conflict (especially with agricultural and forestry use, fish pond dams and flood embankments)
- 2) Beaver management in Bavaria and the possibilities for implementing solutions in the area being studied
- 3) Form an opinion about the topic of beavers in the area being studied and which groups in society are more or less affected
- 4) Make a summary analysis of the local situation and consider the chance of beavers permanently establishing themselves in the area being studied
- 5) Research the topic of beaver management in other countries in the European Union and North America; analyse the differences to beaver management in Bavaria
- 6) The beaver in cultural history
- 7) Examine the relationship between beavers and people from the middle ages until its extermination and reintroduction in Bavaria

Season:



Grade level:



Development:



Aims of the activity

- To recognise the role of the beaver in cultural landscapes which have been technically changed by humans
- To describe the reasons for conflict with beavers and to draw conclusions
- To discuss solutions, to evaluate methods of action and to communicate so your listener can understand you



Identification handout: Gnawing Marks on wood



Fig. 11: A tree with splints felled by the beaver's gnaw



Fig. 12: The strong incisors imprints in the wood



Fig. 13: Gnawing marks on a bark



Fig. 14: Only beavers gnaw off branches slant-ingly and completely before transporting them



Fig. 15: Pieces of debarked branches on a feedlot



Fig. 16: Old and new feeding traces on soft wood. Preferred food are the new grown sprouts which are „harvested“ again and again.



Beaver Tracks on the ground



Fig. 17: A beaver slide



Fig. 18: Wide beaver path where it falls trees



Fig. 19: Imprint of a back leg in the mud bank (rarely seen)



Beaver lodges



Fig. 20: Beaver lodge. The raised mud shows a beaver is living in there.



Fig. 21: An inconspicuous beaver lodge close to the settlement. The grey, raised mud is easy to see.



Fig. 22: Beaver dam



Fig. 23: The "emergency exit" in the centre is only visible during low water level. Furthermore two more beaver exits can be seen.



Fig. 24: Food raft as a winter food supply. During winter the stock is being fetched from the ground.



Beaver



Fig. 25: Beaver



Fig. 26: Swimming beaver with bent front legs



Fig. 27: Beaver babies are born with fur



Fig. 28: Chisel-like incisors



Fig. 29: Beaver tail



Fig. 30: Hind paw showing webbing



Fig. 31: Fore paw webbing



Beaver habitats

Three stages of water bodies: At which one the lowest conflicts between beaver appearance and land use can be expected?



Fig. 32: Body of flowing water with broad riparian buffer strips



Fig. 33: Body of flowing water with narrow buffer strips



Fig. 34: Straight human made river



Beaver habitats



**Fig. 32: Body of flowing water with broad buffer strips:
Less conflicts**

Perfect for people and nature. Floods and soil retention. Water purification. Buffer zone against influx of fertilizers and pesticides. No risk to break in beaver tubes with tractors, low risk of feeding on crops.



**Fig. 33: Body of flowing water with narrow buffer strips:
Risky in conflicts**

Suboptimal for people and nature. Low retention of floods, low impact to soil conservation. Low buffering against fertilizers and pesticides. Risk to break in beaver tubes with tractors.

Suboptimal for beavers: They must eat crops during summer.



**Fig. 34: Human made river:
High conflict potential**

Bad for people and nature. No retention of floods and no soil conservation. High risk to break in beaver tubes with tractors. High damage on crops are possible. Risk of damming at a low water level caused by beaver dams.

High conflict potential if beavers appear: Less food for them in water bodies. Beavers only can eat crops. Nearly no food in winter (woods).