PROGRAMME & BOOK OF ABSTRACTS

8TH INTERNATIONAL BEAVER SYMPOSIUM

SEPTEMBER, 18TH – 20TH 2018
NØRRE VOSBORG, DENMARK
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DEAR COLLEAGUES

The Organizing and Scientific Committee is happy to welcome you all to the 8th International Beaver Symposium, 18 September – 20 September 2018, Nr. Vosborg, Denmark within the topic: **Beavers, Science and Society – Understanding and Managing an Ecosystem Engineer.**

The 8th International Beaver Symposium is facilitated as follows:

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**WEBPAGE AND REGISTRATION:**
Christian Peter Stolt, Henning Fjord Aaser, Hanne Fensbæk and Caroline Vestergaard Mikkelsen

**PARTNERS:**
The Danish Environmental Protection Agency
The Danish Nature Agency
Department of Bioscience, Aarhus University

**SPONSORS:**
Lemvig Municipality
Holstebro Municipality
THE VENUE AND THE SURROUNDINGS

The conference take place at the old manor Nørre Vosborg (Northern Vosborg) in the western part of Jutland, Denmark. The manor is beautifully situated in a protected cultural landscape with 700 year long history. The castle complex with surrounding ridges consists of four grouped buildings, which enclose a paved courtyard. The Gyldenstjerne residence is built in 1552, the Ide Lange residence in 1642, the De Linde residence in 1770 and the Tang residence in 1839. “The castle” alone represents therefore four different architectural styles. The Barn Complex is built in 1788. The Gate Tower elegantly frames the entrance of the manor complex.

In 2004 the Realdania Byg foundation took over Northern Vosborg. Four years later a thorough re-establishment, restoration and refurbishment of Northern Vosborg was completed. With respect for the historical setting a new hotel wing with 37 rooms has been built, so that Northern Vosborg has 56 rooms in total. Today the Bühlmann Family runs the place.

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The manor is situated at the banks of Storå – a river famous for its very strong stock of Atlantic Salmon. The river enters Nissum Fjord only a few kilometers to the west – with salty meadows and a large number of migrating water birds.

In the Holstebro Municipality, you will find a rich and unique nature all year round. From the white sandy beaches of the North Sea only 15 km to the west off Northern Vosborg and to the north and east the soft hills of Limfjorden, nature is open to you. The beautiful and varied landscape spans many different nature types, such as sea and fjord, wood and moor, and the more special ones, such as salt marshes and swamps, fresh meadows and pastures. The region is aspiring Geopark and the area around Nissum Fjord is designated as Nature Park.

To the east the area is a mixture of agriculture, open heathland and plantations. Red deer is abundant and mid September is the peak of the roaring season. Furthermore, you will find flowering heath and lingonberries – and the only breeding wolf pair is having its den in the large state owned plantations close by. Beavers are present in many of the small streams in the area – but most of you have probably seen both beavers, dams and other signs of beavers.
## 17 SEPTEMBER, MONDAY

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>18:00-19:00</td>
<td>Registration</td>
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## 18 SEPTEMBER, TUESDAY – OPENING SESSION

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>8:00-9:00</td>
<td>Registration</td>
</tr>
<tr>
<td>9:00</td>
<td>Thomas Borup Svendsen</td>
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<tr>
<td></td>
<td>Opening remarks</td>
</tr>
<tr>
<td>9:00-9:10</td>
<td>Signe Nepper Larsen, Vice Director, Danish Nature Agency</td>
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<tr>
<td></td>
<td>Welcome to the 8th IBS</td>
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<tr>
<td>9:10-9:20</td>
<td>H.C. Østerby, Mayor of Holstebro Municipality</td>
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<tr>
<td></td>
<td>Welcome to Holstebro</td>
</tr>
<tr>
<td>9:20-9:30</td>
<td>Professor Peter Busher, Boston University</td>
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<tr>
<td></td>
<td>From Russia to Denmark with love: A Scientific Committee review of beaver research since the 7IBS</td>
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</tbody>
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### SESSION 1 - BEAVER MANAGEMENT POLICY ANALYSIS

(Session Chairs: Alexander Saveljev and Gerhard Schwab)

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>9:30-10:00</td>
<td>KEYNOTE: Ales Vorel &amp; Jitka Uhliková</td>
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<tr>
<td></td>
<td>Beaver management in Europe – where to go next</td>
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<tr>
<td>10:00-10:15</td>
<td>Kristijan Tomljanovic</td>
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<tr>
<td></td>
<td>Beaver in Croatia – 20 years after</td>
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<tr>
<td>10:15-10:30</td>
<td>Bernhard Schön</td>
</tr>
<tr>
<td></td>
<td>Wanted: Landscape engineer, experienced in rewilding rivers and adjacent land, is in search of a quiet working place. Preferred country: Upper Austria</td>
</tr>
<tr>
<td>10:30-10:45</td>
<td>Thomas Borup Svendsen</td>
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<tr>
<td></td>
<td>Reintroducing beavers in a lowland agricultural dominated landscape – The Danish Experience</td>
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<tr>
<td>10:45-11:15</td>
<td>Coffee Break</td>
</tr>
<tr>
<td>11:15-11:30</td>
<td>Richard Brazier and Hugh Graham</td>
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<tr>
<td></td>
<td>Dam conflicts and opportunities: Modelling where beavers build dams and applying this to Beaver Management Strategies</td>
</tr>
<tr>
<td>11:30-11:45</td>
<td>Silvan Minnig</td>
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<td></td>
<td>Reintroduction success of Eurasian beaver in Switzerland? Insights from the restoration of the species' ecological and evolutionary potential</td>
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<tr>
<td>11:45-12:00</td>
<td>Anke Simon</td>
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<td>Environmental education and beaver management</td>
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<tr>
<td>12:00-12:15</td>
<td>Jean M. Johnson-Bice</td>
</tr>
<tr>
<td></td>
<td>The influence of density dependence, weather, wolf presence, and harvest on beaver population dynamics</td>
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<tr>
<td>12:30-13:30</td>
<td>Lunch Break</td>
</tr>
</tbody>
</table>
SESSION 2 – BEAVERS AND SOCIETY
(Session chairs: Cherie Westbrook and Volker Zahner)

13:30-14:00 KEYNOTE: Linnéa Jägrud
Beavers in their landscape – viewpoint from a forester and limnologist

14:00-14:15 Bent Graversen
Reintroducing beavers – from a local point of view!

14:15-14:30 Volker Zahner
Beaver dams – their distribution and impact on water storage in Bavaria

14:30-14:45 Cherie J. Westbrook
Dynamic beaver pond levels in mountain peatlands provide transient floodwater storage

14:45-15:00 Joshua Larsen
Beavers and their influence on the structure and function of river systems (hydrology, geomorphology, water quality, ecosystems)

15:00-15:30 Coffee Break

15:30-15:45 Ivan V. Bashinsky
Some hydrological and hydrochemical features of beaver ponds in Russian forest-steppe

15:45-16:00 Lina Polvi
Where can beaver create multi-thread channels? A hydro-geomorphic framework

16:00-16:15 Stella Thompson
Ecosystem services provided by beavers (Castor spp.)

16:30-18:00 POSTER SESSION

18:30 Dinner
Guided tour at the castle

19 SEPTEMBER, WEDNESDAY

SESSION 3 – BEAVER BIOLOGY
(Session Chairs: Peter Busher and Patricia Graf)

9:00-9:30 KEYNOTE: Göran Hartman
What do we know and what do we need to know about beavers?

9:30-9:45 Boris Romashov
Peculiarities of adaptation of Stichorchis subtriquetus (Trematoda, Cladorchiidae) in beaver populations

9:45-10:00 Claudia Pasca
Distribution and dynamics of beaver (Castor fiber) population in Romania

10:00-10:15 Steve K. Windels
Wolf-Beaver Interactions: New Insights and Future Directions

10:15-10:45 Coffee Break

10:45-11:00 Rasmus Mohr Mortensen
Dead reckoning fine-scale behaviour and movement trajectories of Eurasian beavers

11:00-11:15 Steve K. Windels
Why walk when you can swim? Long distance dispersal in North American beavers
<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:15-11:30</td>
<td>Martin Meyer</td>
<td>Density-dependent effects on territorial movement patterns in Eurasian beavers</td>
</tr>
<tr>
<td>11:30-11:45</td>
<td>Glynnis A. Hood</td>
<td>Moving on? Beaver lodge occupancy and abandonment in a heterogeneous landscape</td>
</tr>
<tr>
<td>11:45-12:00</td>
<td>Peter E. Busher</td>
<td>Site occupation patterns by a beaver population in Massachusetts, USA</td>
</tr>
<tr>
<td>12:00-12:15</td>
<td>Olgirda Belova</td>
<td>Effects of beaver (Castor fiber L.) dams on nutrient content in sediments in North-Western Lithuania</td>
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<tr>
<td>12:30-13:30</td>
<td>Lunch Break</td>
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</tbody>
</table>

**SESSION 4 - BEAVERS AND BIODIVERSITY**
(Session chairs: Aksel Bo Madsen and Glynnis Hood)

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>13:30-14:00</td>
<td>Glynnis A. Hood</td>
<td>Beavers and biodiversity – A review of present knowledge</td>
</tr>
<tr>
<td>14:00-14:15</td>
<td>Mia Vehkoaja</td>
<td>Beavers promote calicioid diversity in boreal forest landscapes</td>
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<tr>
<td>14:15-14:30</td>
<td>Mark Elliot and Alan Puttock</td>
<td>Nature's Water Engineers – impacts of beaver dams on flows, water quality and wetland species</td>
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<tr>
<td>14:30-14:45</td>
<td>Sara Schloemer</td>
<td>New insights into the invertebrate fauna of beaver dams – a comparative study conducted with a vacuum sampler</td>
</tr>
<tr>
<td>14:45-15:00</td>
<td>Ulrich Meßlinger</td>
<td>Beaver created structures as a larval habitat for the golden-ringed dragonfly (Cordulegaster boltonii) in Bavaria</td>
</tr>
<tr>
<td>15:00-15:30</td>
<td>Coffee Break</td>
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</tr>
<tr>
<td>15:30-15:45</td>
<td>Pil Birkefeldt Møller Pedersen</td>
<td>How much deadwood do beavers provide?</td>
</tr>
<tr>
<td>15:45-16:00</td>
<td>Aleksandr Mishin</td>
<td>Beaver scent mounds – attractive objects for other mammals</td>
</tr>
<tr>
<td>16:00-16:15</td>
<td>Irina Chalova</td>
<td>On the issue of specific communities of a zooplankton forming under the influence of Castor fiber L activity: quantitative changes of two different size Cladocera species in beaver ponds (in situ experiment)</td>
</tr>
<tr>
<td>16:30-17:00</td>
<td>Closing Session – The Future</td>
<td>9IBS – Announcement and Invitation from the Organizing Committee</td>
</tr>
<tr>
<td>17:00-18:30</td>
<td>Posters</td>
<td>Conference Photograph</td>
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<tr>
<td>19:00</td>
<td>Conference dinner</td>
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</tbody>
</table>

**20 SEPTEMBER, THURSDAY**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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</thead>
<tbody>
<tr>
<td>8:30-16:00</td>
<td>Excursion in Western Jutland with emphasis on nature, culture and volunteers (Nature Park Nissum Fjord, Geopark Western Jutland, Heathlands and Plantations)</td>
</tr>
</tbody>
</table>
ABSTRACTS

SESSION I
BEAVER MANAGEMENT POLICY ANALYSIS
Beavers have returned as a component of the European landscape and the rapidity and range of their recolonization has impressed scientists, conservationists, governmental authorities, and the general public. Ecologists and conservationists value the positive effects beavers can have on the landscape and wetland communities. However, the return of beavers to human-altered landscapes often creates conflicts with human interests. Currently, beavers are viewed positively by a large segment of the general public and many stakeholders, but as beaver numbers increase and conflicts result this may change. Landscape modification by beavers and negative interactions with human infrastructure necessitates thoughtful and efficient management approaches. In most European Union (EU) countries the beaver is a protected species. However, in some countries hunting/trapping is allowed based on beaver population size. There is no unified European management plan and most countries have established their own management programmes to solve beaver-human conflicts. Additionally, programs have not always been established in an effective manner. For example, in the Czech Republic (Czechia), as early as the year 2000 beavers were included in the legislative damage compensation system, yet a management plan was not established until 2013. In Czechia we are currently facing numerous requests for legal regulation including a call to set annual hunting/trapping quotas and stakeholders affected by beaver activity are also requesting an extension of the damage compensation system. We view the components of successful beaver management to include, 1) a knowledgeable consultant service, 2) the support of preventive measures, 3) compensation for damage, 4) the elimination of nuisance beavers when necessary, and 5) effective public relations. Going forward we consider there to be three major questions regarding beaver management in Europe: 1) Is it possible to develop a unified approach for beaver management throughout Europe? 2) How will the protection status of beavers in the EU change in the future and 3) What role will beaver specialists play in management decisions?

**Keywords:** recolonization, management, beaver-human conflicts, Czechia.
Beaver ([Castor fiber L.]) was reintroduced into Croatia in the period from 1996 to 1998. A total of 85 individuals were transported and released from Bavaria. After ten years in Croatia, some areas have been colonized by beavers to that extent that problems began to arise. Fifteen years after the inhabitation of beaver, the first claims for beaver made damages are reported. Over the past twenty years, the beaver population in Croatia has grown to approximately 10,000 individuals. At present there is a problem of increasing population density, resulting in an ever greater impact on the habitat, or more frequent problem with damages from beavers. In addition to damages to agricultural areas and orchards, problems are arising with swamp creation and flooding of agricultural areas due to the construction of dams. Roads are affected by water closures and there has been some collapse of agricultural land and roads. Since 2013, beaver is on the wild game list and is also a strictly protected animal species. This dual status puts it under the jurisdiction of the two Ministries. According to the valid regulations it is necessary to create a Management Plan for beaver, which would be implemented throughout Croatia, and whose creation is in process.

**Keywords:** beaver, reintroduction, habitat potential, damages.
The beaver is back – back in an Anthropogenic cultivated landscape with high pressure on suitable area for different economic use and a high density of different infrastructure. Area along the rivers is limited. From the viewpoint of nature protection we promote beaver as an ecosystem engineer. But where is the animal able to “produce” biodiversity? Swimming is allowed for the beaver, gnawing prohibited in many cases by different prevention techniques, digging and dam-building activities are a major source of conflicts. In order to alleviate conflicts we discuss how many beavers can be trapped or killed according to the existing legal framework. We discuss population data of beaver in order to find an argument that we reached Favourable Conservation Status (FCS) and the strict protection regime could be changed. We ignore that beaver needs permanent management, either there are “enough” beavers or not. It’s hard to convince stakeholders that even if the FCS, however we are defining it, will be reached, we need a beaver management, and therefore need money and personal skills of people working for beaver management. The related experiences with beaver management in Upper Austria are discussed and possible ways for the future are presented.

**Keywords:** beavers as ecosystem engineer, beaver management, Upper Austria, legal framework.
ABSTRACTS

The Danish Nature Agency (DNA) reintroduced Beavers in Denmark in 1999, after an intense debate. 18 beavers from the upper Elbe population were released in Flynder Å – in the western part of Jutland. In 2008-2010 additional 23 beavers where released in Lake Arresø on Zealand. Monitoring results has shown that species richness and abundance has increased for almost all groups monitored – especially for dead wood, insects, amphibians and bats. The public interest in the project has been huge. In the period from 1999 to 2014 DNA staff have arranged 930 guided tours with app 30.000 participants. The beaver population in Denmark in 2017 is estimated to approx. 200 individuals and the spreading has been both continuous downstream from the release sites and more unpredictable long distance dispersals. Beaver damages have increased concurrently with the beaver population. According to the present management plan DNA is obliged to solve problems for private land owners – eq. by fencing trees and regulate beaver dams. Compensations for beaver damages are not part of the management plan. In 2017, DNA staff use approx. 1600 hours handling local landowners having problems with beavers – mainly flooding. Review of Beaver Management Plan is under preparation. The new plan is going to address a number of issues including target of population level, geographic dispersal, compensation/subsidies, culling/removal of animals, water regulation of streams, public information, level of monitoring and when the beaver population can be considered viable.

Keywords: reintroduction, monitoring ecological effects, dispersal patterns, beaver management.

REINTRODUCING BEAVERS IN A LOWLAND AGRICULTURAL DOMINATED LANDSCAPE – THE DANISH EXPERIENCE

T.B. Svendsen
Ministry of the Environment, Nature Agency, Denmark

Presenter: Thomas Borup Svendsen, tbs@nst.dk

The Danish Nature Agency (DNA) reintroduced Beavers in Denmark in 1999, after an intense debate. 18 beavers from the upper Elbe population were released in Flynder Å – in the western part of Jutland. In 2008-2010 additional 23 beavers where released in Lake Arresø on Zealand. Monitoring results has shown that species richness and abundance has increased for almost all groups monitored – especially for dead wood, insects, amphibians and bats. The public interest in the project has been huge. In the period from 1999 to 2014 DNA staff have arranged 930 guided tours with app 30.000 participants. The beaver population in Denmark in 2017 is estimated to approx. 200 individuals and the spreading has been both continuous downstream from the release sites and more unpredictable long distance dispersals. Beaver damages have increased concurrently with the beaver population. According to the present management plan DNA is obliged to solve problems for private land owners – eq. by fencing trees and regulate beaver dams. Compensations for beaver damages are not part of the management plan. In 2017, DNA staff use approx. 1600 hours handling local landowners having problems with beavers – mainly flooding. Review of Beaver Management Plan is under preparation. The new plan is going to address a number of issues including target of population level, geographic dispersal, compensation/subsidies, culling/removal of animals, water regulation of streams, public information, level of monitoring and when the beaver population can be considered viable.

Keywords: reintroduction, monitoring ecological effects, dispersal patterns, beaver management.
The River Otter Beaver Trial in Devon is the first licensed release of beavers into the wild in England. It covers the entire catchment and runs from 2015 to 2020 when a decision about the future of the beavers will be made by the English government. A suite of models have been developed to understand where watercourses have the capacity to support dam building and where this might lead to conflicts with existing land use and infrastructure. A model has been developed for the Otter catchment and run on the Tay/Earn catchments to increase the reliability of the model validation. Model performance has been found to be very reliable in locations where dams have, so far, been constructed. The model is now being extended to determine the carrying capacity of the catchment for beavers. Using dam capacity and vegetation suitability along with empirical findings on beaver population dynamics it is possible to simulate the maximum number of territories that can be supported. The mapping of catchment colonisation and potential conflicts will help inform a Beaver Management Strategy Framework being developed for the River Otter catchment should the beavers be permitted to remain beyond 2020.

**Keywords:** dam capacity, management, population dynamics, modelling, Great Britain.
ABSTRACTS

The Eurasian beaver (*Castor fiber*) was reintroduced in Switzerland between 1956 and 1977 and some 3000 beavers are currently colonizing the Rhine, Rhone and Inn catchments in four discrete populations. Four national surveys conducted between 1978 and 2008 confirmed the expansion of the species in range and numbers. Heavy modification and disturbance of lakes and river systems during the last century may have hampered individual movements but did not prevent Eurasian beaver from recolonising large parts of its former range. Genetic monitoring was first conducted in 2016, to evaluate the reintroduction program and exclude the occurrence of the North American beaver (*C. canadensis*). Using a mitochondrial DNA fragment, we assigned most of the 294 hair and tissue samples analysed to individuals from the refugium populations *C. f. galliae* and *C. f. fiber*, and a single individual to the refugium population *C. f. albicus*. We did not find evidence of North American beaver. Microsatellite markers revealed a general pattern of isolation by distance and a high level of inbreeding. Individual assignment confirmed records on founding events that two beaver populations situated along the Aar River and its tributaries were founded from individuals of different origins, *C. f. galliae* and *C. f. fiber*, respectively. We detected the genetic signature of a translocation event between these two populations in 1984. Evidence for a high level of inbreeding within the Swiss beaver population led us to initiate an adaptive management project following IUCN Reintroduction Specialist Group guidelines, to restore the evolutionary potential of the species. The project relied on the results of genetic evaluation of the reintroduction program of beaver in Switzerland, designed further management actions to favour population connectivity within Switzerland and considers the central role of Switzerland in promoting gene flow among beaver population in Western and Central Europe.

**Keywords:** adaptive management, *Castor fiber*, genetic structure, inbreeding.

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SESSION I: BEAVER MANAGEMENT POLICY ANALYSIS

**REINTRODUCTION SUCCESS OF EURASIAN BEAVER IN SWITZERLAND? INSIGHTS FROM THE RESTORATION OF THE SPECIES’ ECOCOLOGICAL AND EVOLUTIONARY POTENTIAL**

S. Minnig¹, C. Angst² & G. Jacob³

¹Genossenschaft Umweltbildner.ch, Bern, Switzerland, ²Biberfachstelle, Centre Suisse de Cartographie de la Faune, Neuchâtel, Switzerland, ³Department of Biology, University of Fribourg, Fribourg, Switzerland

Presenter: Silvan Minnig, silvan.minnig@umweltbildner.ch
In the south of Germany, where beavers have successfully returned, public relations are an important part for effective beaver management. Knowledge about beaver biology, their lifestyle and their role in the ecosystem helps to mitigate potential conflicts. With beaver excursions based on nature experiences as a means of environmental education, it is possible to impart knowledge to all ages, from pre-school children to Golden Agers. Beavers are fascinating animals for using games as a method of teaching — not only the interesting biology of the species, but also their habitat creation capabilities and their importance for biodiversity and wise water management. Playing is one of the most effective ways of learning. Personal interaction and immediate nature experiences are important for long-term learning. Following the principle: “I only value the things I know and I only protect the things I value” it is not enough to give only information to the participants. They should learn with their head, heart, hand and all their senses. Then they can develop empathy and solidarity with the beaver, and learn important values and competences through education for sustainable development (BNE) competences through education for sustainable development.

Keywords: beaver management, nature experience games, environmental education, public relations.
**THE INFLUENCE OF DENSITY DEPENDENCE, WEATHER, WOLF PRESENCE, AND HARVEST ON BEAVER POPULATION DYNAMICS**

S.M. Johnson-Bice¹, J.M. Ferguson², S.K. Windels³, J.D. Erb⁴ & R. Moen⁵

¹ Natural Resources Research Institute, University of Minnesota Duluth, USA
² Department of Fisheries, Wildlife and Conservation Biology, University of Minnesota Twin Cities, USA
³ Voyageurs National Park, MN, USA
⁴ Forest Wildlife Populations and Research Group, Minnesota Department of Natural Resources, USA
⁵ Natural Resources Research Institute, University of Minnesota Duluth, USA

**Presenter:** Sean M. Johnson-Bice, s.johnsonbice@gmail.com

Beaver (Castor canadensis) populations often exhibit density-dependent regulation through the interaction of habitat quality and territoriality among neighbouring colonies. Extrinsic variables such as weather and wolf predation can also influence population dynamics, and human exploitation has been shown to suppress beaver populations below carrying capacities. The cumulative effects from these factors likely influence short-term beaver population fluctuations; however, the relative influence that they have remains poorly understood. Using nearly 30 years of colony survey data (1975–2002), we evaluated the relative influence that density dependence and extrinsic covariates had on inter-annual beaver colony fluctuations across 15 survey routes in Minnesota, USA. We combined a density-dependent population growth model with weather, wolf presence, and harvest data within a Bayesian state-space model framework. Preliminary results suggest that density dependence influenced inter-annual fluctuations to a greater extent than weather, wolf presence, or harvest, even after accounting for observer bias within the colony surveys. We posit that higher colony growth rates at lower densities are likely a function of increased dispersal rates due to the combined effects of population density and habitat quality.

**Keywords:** population dynamics, habitat quality, human exploitation, wolf predation, climate.
ABSTRACTS

SESSION II
BEAVERS AND SOCIETY
ABSTRACTS

In the footsteps of the reintroduction and recolonization of the Eurasian beaver, *Castor fiber*, throughout its former range conflicts with humans are increasing. The activities of beavers affect the shared landscape in a diverse range of ways. Highly productive forests can be flooded, infrastructure damaged, agricultural land flooded and beaver dams and ponds can cause leakage of methylated mercury into the environment. Organizations responsible for drinking water might consider beavers as having both positive and negative effects on water quality. The return of the beaver has allowed hunters to view beavers as a “new” game species regulated by legislation in many countries. A cascade of beaver dams can have a positive impact on the aquatic ecosystem increasing biodiversity. If beavers flood a nutrient-rich drained peat land it can decrease the emissions of greenhouse gases. The public often view beavers with curiosity and interest, mainly in a positive way. Thus, beavers and their activities are viewed both positively and negatively depending on the human perspective. All these views should be met with justice and respect. The governmental authorities need objective science to make sound and appropriate decisions on beaver-human conflicts. The research community has the responsibility to provide objective science. However, scientific information has little impact if it is not communicated with decision makers, the public and other researchers. In an attempt to respond to this the WAMBAF project (Water Management in Baltic Forests) was initiated. WAMBAF is an EU Interreg project dealing with some of these conflicts and working to find realistic solutions to beaver-human issues.

**Keywords:** beaver-human conflicts, objective science, decision makers, WAMBAF.
ABSTRACTS

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The reintroduction of beavers has led to several changes in our local environment, which has helped increase species richness in the municipality, but has also changed the nature of farming in the areas where beavers are abundant, and has caused problems for the farmers. This conflict has, to some extent, been counteracted by Danish Nature Agency staff handling the landowners problems with beavers according to the management plan for the introduction period. Danish legislation has not been adequate in meeting the new problems following the reintroduction of beavers, and it is of critical importance that the questions of responsibility for beaver caused flooding, culling/removal and compensation are addressed in the coming management plan and the following legislation.

Keywords: beaver impact on nature and farming, beaver management, legislation.

REINTRODUCING BEAVERS - FROM A LOCAL POINT OF VIEW!

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SESSION II: BEAVERS AND SOCIETY
Dam-building is a unique feature of beavers. In this study we tried to find out where and how beavers build dams and created a prediction model out of this. We studied dams in 8 different landscapes and surveyed 51 dams and their surrounding water stretches by photogrammetric and manual techniques. Subsequently dam profiles were generated, and the permeability of a beaver dam was studied using an Acoustic-Doppler-Current-Profiler. In addition to the 51 dams, we used information from another 91 dams from similar research. The study has determined what impact these dams might have for water storage and which parameters reduce the effects of floods. Dams were built in small streams smaller than 70 cm depth, and less than 6 to 10 m width and with an inclination less than 7 %. Three to six dams in a cascade was common but up to 21 occurred. The average beaver pond had a volume of 5500 m$^3$ and a surface area of 8200 m$^2$. The strongest flood event beaver dams survived in our study was a 10-years flood. Important for continued water impoundment and the mitigation of a flood event was the bank height which could reach up to 49 cm.

**Keywords:** dam-building model, water storage, flood mitigation.
There is growing interest in using beaver to help restore ecosystem resilience to floods and droughts. The problem with the concept of relying on beaver ponds to attenuate floods is that they, when full, should offer little storage of floodwaters. In late June 2013 the Alberta 2013 flood happened, which was the most expensive natural disaster in Canadian history. Over a 4-day period 200 to 350 mm of rain fell on the partially snow-covered eastern slopes of the Canadian Rocky Mountains near Calgary. The flood provides a natural experiment that permits a test of the hypothesis that beaver ponds have limited flood attenuation capacity. Intensively studied was a foothills peatland containing multiple beaver ponds, which was hydrometrically instrumented at the time of the flood. Also studied was beaver dam persistence across 5826 km². In the valley-bottom peatland we found that even though the soils were mostly frozen at the time of the event, floodwaters were transiently detained. The four largest beaver ponds in the peatland collectively stored $1.9 \times 10^4 \text{ m}^3$ of water when full. However, water levels in the ponds were dynamic during the event, owing to high pond bed permeability and vertical drainage. The water storage offered by some of the beaver ponds, even ones experiencing breaches, delayed floodwater transmission. High-resolution imagery obtained in the weeks following the flood was analyzed for beaver dam condition at 74 sites. Of these sites, 32 % experienced full breach of all dams, 26 % had some breach of dams, and 42 % had fully maintained dams. The amount of rain received poorly explained dam persistence. Instead, landscape setting might be a better predictor; dams built in valley-bottom wetlands were most often structurally intact after the flood. Results indicate that beaver dams can offer enhanced hydrological resilience to floods, but that the conditions under which this happens requires further study.

**Keywords:** beaver ponds, flooding, dam persistence.
Beavers (Castor fiber, Castor canadensis) are the most influential mammalian ecosystem engineer, heavily modifying rivers and floodplains and influencing the hydrology, geomorphology, carbon and nutrient cycling, and ecology. They do this by constructing dams, digging canals and burrows, felling trees and introducing wood into streams, which in turn impounds water, raises shallow water tables, and alters the partitioning of the water balance, sediment transport and channel patterns, biogeochemical cycling, and aquatic and terrestrial habitats. We first synthesize the overall impacts on hydrology, geomorphology, biogeochemistry, and aquatic and terrestrial ecosystems. We then present the summarized results from the investigation of four sites in Switzerland and Germany in terms of hydrology, water biogeochemistry (nutrients, pH, dissolved oxygen and water temperature), geomorphology, and dissolved and particulate organic matter concentration and composition (absorbance and fluorescence measurements coupled with parallel factor analysis (PARAFAC), and RockEval-pyrolysis), during a complete hydrological cycle including all seasons. The key feedbacks and overlaps between these changes induced by beavers hints towards that modifications to the longitudinal connectivity drive many key process feedbacks. However, the magnitude of these feedbacks is also heavily dependent on the landscape and climatic context, with the ability to promote lateral connectivity determining the extent of beaver impacts as stream order increases.

Keywords: ecosystem engineering, beaver cascades, structure from motion, flood attenuation, sediment transport.
Forest-steppe natural zone lack standing water-bodies and lakes due to climate reasons. Beavers create a lot of ponds on small rivers, and thus they significantly increase amount of lentic aquatic habitats in the region. This leads to some consequences for ecosystem processes (abiotic and biotic). Our work aims to study some hydrological and hydrochemical features of beaver ponds in compare with natural water-bodies (oxbows). Our results show that sedimentation rates of suspended matter in ponds varied from 7.33 to 71.81 g/m$^2$ per day, in oxbows – from 7.83 to 10.69 g/m$^2$ per day. Share of organic matter in beaver ponds was 39.93–56.12 %, in oxbows 77.11–81.29 %. We measured concentrations of biogenic elements (nitrites, nitrates, ammonium, phosphates, and chlorides) in water, and their concentration and accumulation rates were generally higher in oxbows. We did not find correlations between presence of beaver and chemical characteristics of water which were mainly influenced by agricultural activities. Also we studied temperature regimes of different water-bodies. Beaver ponds were colder than oxbows, with a mean differences of 3.3°C. In cold months temperature was approximately equal but in summer warming of oxbows was higher.

**Keywords:** beaver ponds, suspended matter, hydrochemistry, forest-steppe.
WHERE CAN BEAVER CREATE MULTI-THREAD CHANNELS? A HYDRO-GEOMORPHIC FRAMEWORK

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Beaver dams create biogeomorphic feedbacks by increasing geomorphic complexity through avulsions and the formation of multi-thread channel systems. Compared to single-thread meandering channels, multi-thread channels with semi-permeable beaver dams can provide many ecosystem services including attenuating high flows, extending riparian zones, and storing carbon. However, since beaver were extirpated in most of Europe and North America, multi-thread channel systems have become rare and the true range of where beaver can create multi-thread channel systems is unknown. Here we provide a conceptual model of geomorphic factors that steer potential locations where beaver dams can create biogeomorphic feedbacks and thus multi-thread channel systems. Although beaver can colonize a wide range of stream types, the hydro-geomorphic setting determines the potential range where beaver build dams and create biogeomorphic feedbacks and thus multi-thread channel systems. We propose that the range for where beaver dams cause biogeomorphic feedbacks is a function of four factors: 1) valley and channel geometry, 2) bank stability, 3) sediment regime, and 4) flow regime. Here we contrast potential ranges for beaver dam-induced multi-thread channels in two regions: the Colorado Front Range, USA and northern Sweden.

Keywords: beaver dams, geomorphology, complexity, multi-thread channels, Colorado, Sweden.
Beavers (Castor spp.) are ecosystem engineers that modify the hydrological and biogeochemical conditions of their habitats. Beaver activity concurrently produces both positive ecosystem services and negative disservices to societies. Beavers help purify water resources, mitigate floods and droughts, and play a role in greenhouse gas sequestration. On the other hand, beavers cause flood damage to forests, agriculture, and human infrastructure. The value of beaver-produced positive services has not been previously quantified. Therefore, societies have focused on the more visible disservices, and positive aspects have mainly been ignored. We estimate the value of beaver-produced ecosystem services and disservices for the entire Northern Hemisphere. Each quantified service is estimated to be worth billions to hundreds of billions of US dollars annually.

Water purification along with drought and flood mitigation are particularly valuable services offered by beavers. These are also expected to increase in importance and value in upcoming decades, as they can help mitigate damages caused by progressing climate change. However, services and disservices are scale-dependent. New tools, such as Payment for Ecosystem Services (PES) mechanisms, should be implemented to allow nations to benefit from beaver activity, while ensuring that landowners accruing disservices are compensated for and incentivised to tolerate beaver activity.

**Keywords:** beaver, ecosystem services, ecosystem disservices, monetary valuation, payments for ecosystem services.
The ecology of beavers of different ages influences the abundance dynamics (abundance index) of hemipopulations of marita Stichorchis subtriquetrus. We detected that the young beavers (4-12 months old) and yearlings (1 to 2 years old) of beavers have the highest rate of increase in the number of marit. On the other hand, static and stable functioning parasite-host system of Stichorchis subtriquetrus + C. fiber of adult beavers was noted. S. subtriquetrus regulate the number of young and yearlings of beavers to a greater extent. The most active phase of stichhorchis invasion was noted in summer and in autumn. The registered peak of the hemipopulation number of marit is autumn. At this time, the highest indices of the abundance index of S. subtriquetrus were found in young beavers. The highest productivity age of maritas is 2-6 months. Marit’s life expectancy is 30 months (2.5 years) and includes three periods: pre-production (2 months), reproductive (28 months) and post-production (less than 1 month). Pubescent marita of S. subtriquetrus produces an average of 60 eggs per day. The individual productivity of marita varies depending on the age of beavers. The maximum number of eggs is produced in young beavers and yearlings. The minimum marit productivity is typical in two-year old beavers. We investigated the productivity of local hemipopulations of marit. Young beavers and yearlings of beavers are of primary importance in the accumulation of metacercariae in the external environment.

Keywords: Stichorchis subtriquetrus, marita, hemipopulation, productivity.
The reintroduction of the Eurasian beaver in Romania was a real success. The process was carried out in successive stages, between 1998 and 2003. A total number of 182 beavers were released in the rivers Olt (91), Mures (56) and Ialomita (35) (Ionescu et al., 2010). After more than 150 years post-extirpation, the population has developed following a logistic growth curve. During the first 5 years after reintroduction, the population grew slowly, followed by an explosion that was expressed by exponential numerical growth and the occupation of some important sectors of the historical range. On the main water courses, the population reached the plateau stage, so the species migrated rapidly to the tributaries, occupying the optimal or satisfactory habitat sectors. According to the most recent data accumulated from 2014 to 2017 the population at national level was estimated at 2145-2250 beavers. The process consisted of evaluating/re-evaluating beaver lodges and signs of presence (on more than 2500 km of watercourse) to which has been added 5% representing undiscovered beaver sites. The species has extended its range size distribution considerably from 71 to 690 km. Specimens from Hungary and Ukraine were also reported on the Someș, Cris, Iza and Vișeu rivers.

**Keywords:** beaver distribution, _Castor fiber_, Eurasian beaver in Romania, beaver population dynamics.
Gray wolves can be significant predators of beavers and conversely, beavers can be important prey for wolves, but wolf-beaver interactions in North America, Europe, and Asia are poorly understood. Since 2015, we have been doing intensive research in the Greater Voyageurs Ecosystem in northern Minnesota, USA, to better understand the relationship between wolves and beavers. The Greater Voyageurs Ecosystem is an ideal area to study wolf-beaver interactions as the area has a dense wolf and beaver population, and beavers constitute up to 42% of the summer (April to October) diets of wolves in the area. To understand wolf predation on beavers, we have searched clusters of locations from GPS-collared wolves to locate where wolves are hunting and killing beavers. In addition, we have collected wolf scats to estimate wolf pack diets during the summer. All of this has provided new insight into how wolves hunt beavers, the role of beavers in the diets of wolves, and the impact of wolf predation on beaver populations. As we have learned more about wolf-beaver interactions, it has spurred other interesting questions about the role of predation in the terrestrial behaviour of beavers, how wolf-beaver interactions affect sympatric ungulate populations, and the hunting strategies and predatory abilities of wolves. We will discuss these questions, how we aim to address them, and the future directions for our research on this important but poorly understood predator-prey relationship.

**Keywords:** wolf, predation, predator-prey, hunting behaviour, foraging.
Technological advancements have improved the resolution of recorded animal locations. Yet, animal locations tell little about what the animal was actually doing during the monitoring, requiring behavioural context to be otherwise inferred. Behaviours can be deduced from animal-attached accelerometers, which provide information on body posture, movement and movement-based energy, excluding observer bias, impaired visibility and constraints of topography. Previously, Graf et al. (2015) demonstrated the potential of using accelerometers to elucidate behaviours in free-ranging Eurasian beavers, enabling classification of seven behavioural types with high precision. However, not all behaviours are well described by accelerometers alone, as interpretation of movement-based acceleration can be confounded by forces not generated by the animals themselves. We show how acquisition of useful movement-related metrics can be used to quantify fine-scale behaviour in free-ranging beavers, including rapid and transient behaviours that previously could not be deduced from acceleration alone. Incorporating acceleration and magnetic heading, we show how dead-reckoning can accurately predict and reconstruct three dimensional movement paths in time and space, improving knowledge on the territorial movements and time budgets of free-ranging beavers.

**Keywords:** acceleration, magnetometry, daily diaries, spatial behaviour, time budgets.
The distance juvenile mammals must disperse is related to availability of limiting resources, population density, and mating system/social structure. American beavers typically disperse from natal areas between 2–3 years of age to reduce competition for resources or to limit inbreeding. Mean distances previously reported are generally <10 km in northern systems, due to predation risk from wolves. A total of 695 beavers were tagged from 2006–2013 in Voyageurs National Park (VNP), USA, where harvest is not allowed and densities are >1.0 lodges/km². For 46 natal dispersal events, mean (±SE) straightline distance was 16.66 km (±2.7) and mean distance by water was 33.1 km (±4.4). Maximum dispersal distance by water was 140 km, with 10 others exceeding 50 km. Dispersal was female-biased (64% of events), and females also dispersed farther than males (35.0 ± 5.0 km versus 24.2 ± 5.0 km). Females tended to disperse in the spring (73% of events) and males in the fall (60% of events). Beavers tended to disperse upstream (71% of events). Estimated dispersal routes crossed predominantly lake (61% of total distance) and stream habitats (35%), followed by wetlands (4%) and uplands (<1%), suggesting that long-distance dispersal by beavers is facilitated in hydrologically-connected systems.

**Keywords:** long-distance, dispersal, lakes, Voyageurs National Park.
ABSTRACTS

**DENSITY-DEPENDENT EFFECTS ON TERRITORIAL MOVEMENT PATTERNS IN EURASIAN BEAVERS**

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Territory defence is crucial for beavers to increase the duration of territory occupancy and consequently, reproductive success. However, little is known about the factors affecting spatial movement patterns in response to territorial intrusions. We simulated an intruder in several territories using experimental scent mounds (ESM) and investigated the detection probability of ESMs and the spatial response by territory-holders while controlling for demographic factors. Our results indicate that beavers remember the spatial location of ESMs, and subsequently spent more time investigating and overmarking them. However, the presence of a simulated intruder did not change patrolling patterns, measured as both the time spent at territory borders and in water. Instead, beavers spent less time at territory borders and in water when population density was comparatively high, leading to a reduced detection probability of ESMs. A previous study found that beavers are more likely to disperse when population density is lower, indicating an increased intruder pressure at lower population density. Moreover, we found that aggressive encounters between conspecifics were more likely at lower population density. We conclude that territory-holders adjust their patrolling effort with changing population density, which appears to be a predictor for intruder pressure.

**Keywords:** chemical communication, density-dependence, scent experiment, territoriality.
As with many species, the distribution of North American beavers (Castor canadensis) is spatially structured within a heterogeneous landscape. To assess these distributions, various studies note that recolonization within classic metapopulation models is very similar to dispersal characteristics of territorial species. However, gathering data on dispersal of individuals over time can be difficult and costly, especially if the fate of the disperser is unknown. Using an 11-year data set to quantify annual occupancy status of all beaver lodges in Miquelon Lake Provincial Park in Alberta, Canada, I was able to determine, mean occupation time, mean time to recolonization, mean time to abandonment, and proportion of time a lodge was occupied over the study period. Combined with data on dominant vegetation communities, adjacency to human structures, pond area, adjacency to nearest lodge (occupied or unoccupied), slope, and distance to adjacent wetlands, I developed predictive models to ascertain which variables best explained lodge occupancy/abandonment within a boreal landscape at three spatial scales. This study provides insight into the distribution and habitat requirements of a long-lived territorial species and its ecological sustainability over time.

**Keywords:** abandonment, beavers, habitat, occupancy.
The two beaver species, *Castor canadensis* and *Castor fiber*, while differing genetically, are anatomically, ecologically and behaviorally similar. An understanding of one species can support our understanding of the other species. This talk reports on the inception, growth and current status of a beaver population in western Massachusetts, USA. The population consists of shore colonies and interior colonies and at the peak there were 54 family groups (39 interior and 15 shore). The shore groups, subjected to fluctuating water levels, have remained low since 1985 (range 0–5, mean = 1.9). Since 1988, the interior colonies have fluctuated between 7 and 21 family groups (mean = 14.8). There are thirty-nine potential interior occupation regions (ponds, partial and complete drainages) that are surveyed annually and 31/39 (79.5%) have been occupied at least once. Mean number of years a site was occupied is 23 (range 2–46 years). Only 10% of the potential sites have been occupied for longer than 40 years. Management planning must account for long-term population dynamics and a clear understanding local site occupation patterns.

**Keywords**: site occupation, population dynamics, long-term patterns.
Beaver habitats across Eurasia and North America are often associated with increased biodiversity and more productive and resilient ecosystems. These positive impacts on species diversity and associated ecosystem services are often the driving force behind beaver reintroductions into their formerly occupied habitats. Although much research has focused on biodiversity of more visible species, beaver activities can have positive impacts from the micro- to macroscopic scale. This talk explores the role of beavers in enhancing biodiversity and provides a spatiotemporal perspective on past, current, and emerging research. As a long-lived, circumpolar species, beavers facilitate diverse ecological communities throughout their natural distributions. In understanding their influence within their current distribution, we gain insights for how beavers might affect new habitats as distributions expand northward in response to a warming climate.

**Keywords:** beavers, biodiversity, future directions.
Beavers are ecosystem engineers that modify and maintain a range of special habitat types in boreal forests. They also produce large quantities of deadwood that provide substrate for many lignicolous organisms such as calicioid fungi (Ascomycota). We studied how calicioid diversity differed between boreal riparian forests with and without beaver activity. The results show that calicioid diversity were significantly higher at beaver sites compared to the other two forest site types studied. The large quantity and diverse forms of deadwood produced by beavers clearly promotes calicioid diversity in the boreal landscape. The specific lighting and humidity conditions within beaver wetlands could be the reason why they promote the success of certain calicioid species.

Keywords: deadwood, flood, pin lichen, riparian forest, snag.
Beavers are known as ecosystem engineers and profoundly alter ecosystem structure and hydrological function through the creation of canals, dams and associated ponds. Results from the Enclosed Beaver Project in Devon will be presented, where a family of beavers were introduced into a 3-ha fenced enclosure in 2011. A first order tributary draining intensively managed grassland passes through the site, and the beavers have constructed a sequence of 13 dams along 183 m of this stream. Annual topographic surveys have generated high resolution maps of the changes to the watercourse, and ecological surveys shown significant increases in certain aquatic species. Upstream and downstream monitoring of flows and water quality have demonstrated increased water storage, attenuated flow regimes and reduced flood flows, as well as mitigating diffuse pollution from upstream agriculture, with reduced sediment, nitrogen and phosphate leaving the site. However, there remains a need to quantify the impacts of beavers across spatial scales different landscapes. The experimental design and preliminary results from a suite of new UK based beaver monitoring projects will be presented. Together these projects aim to form an evidence base for understanding the potential role that beavers could play in multually beneficial, natural-process-based catchment management.

Keywords: beavers, flow attenuation, water quality, biodiversity, ecosystem services.
Beaver dams are influential structures in streams, since they are able to create a multi-habitat-pattern which many other animals benefit from. These beaver-generated landscapes are described and explored by many scholars. Nevertheless, we still lack data on the faunal composition of beaver dams themselves, because common aquatic ecological sampling methods do not allow for encompassing investigations. Thus, it is hardly surprising that the present data regarding this topic is comprised of two studies worldwide (Clifford et al. 1993; Rolauffs et al. 2001). For a new approach in surveying this well-hidden species community within beaver dams I constructed a vacuum sampler. This sampler was initially tested under field conditions in 2017, resulting in the documentation of 18 species out of 11 orders, including the first and unexpected discovery of *Dianous coerulescens* (Coleoptera) in a beaver dam. In my presentation I will describe the results of a comparative study on the invertebrate fauna of active and abandoned beaver dams. I will highlight which portion of the invertebrate community is recorded through this sampling method and explore the dependence of probability of detection from the duration of suction, species-specific habitat preferences as well as behavioural patterns.

**Keywords:** beaver (*Castor fiber, C. canadensis*), beaver dams, vacuum sampling, invertebrate community.
BEAVER CREATED STRUCTURES AS A LARVAL HABITAT FOR THE GOLDEN-RINGED DRAGONFLY (CORDULEGASTER BOLTONII) IN BAVARIA

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Studies following recolonisation of Central Europe by Eurasian beaver identified that landscapes, activities and structures beavers create result in significant increases in diversity of damsel and dragonflies. Therefore, we designed a study into how stenotopic – running-water taxa – react to beaver dams and their backwaters. We studied stream systems where beavers and golden-ringed dragonflies (Cordulegaster boltonii) occurred together in various regions of Bavaria. Larvae of C. boltonii were in many of the sandy sediments of beaver-made structures. These ranged from modifications to beds and banks of their pools, as well as the bottom of abandoned ponds. We examined edges and outer faces of dams, cascade-like structures, hidden water bodies and the lateral outflows of their ponds. In a systematically sampled stream in the lower ranges of the Spessart Mountains, the density of captured larvae was more than six times higher in a sector with beaver dams than in a free-flowing sector lacking beavers. In fast flowing creeks with few sandy sediments, beaver-generated structures strongly increased population density of C. boltonii. Damming by beavers enabled a natural density of C. boltonii. This finding was particularly evident for anthropogenically-modified streams with reduced accumulations of fine sediment. Larvae of C. boltonii were in beaver-generated structures in slowly flowing, sandy streams in very small numbers compared to more rapid flows. Here, beaver dams reduced accessible habitat area. Additionally, diverse larval habitats formed in and around beaver dams and their ponds as well as in their channels. Overall, regional impact of beaver activities on C. boltonii was positive.

Keywords: beaver impact, dragonflies, Golden-ringed Dragonfly, Cordulegaster boltonii.
Beavers are recognized as ecosystem engineers (an organism which provide resources to other species by causing physical state changes in biotic or abiotic material) and as a keystone species (a species whose activities exert a disproportionate influence on species communities). Many studies have investigated the role of the beaver as an ecosystem engineer and keystone species by studying the effects on species richness and diversity of plant and animal species. To our knowledge, only limited studies have hitherto attempted to evaluate beavers’ ability to create habitat heterogeneity by estimating extent of habitat they provide for other species. Here we present data from fieldwork conducted in Scotland and in Denmark on the ecological effects of beavers’ logging and dam-building activity on deadwood and living wood volume and sapling regeneration. Estimating deadwood and living wood volumes and sapling regeneration at beaver dam sites and control sites enable us to answer questions such as: 1) Does the proportion of deadwood compared to living wood differ between a beaver site and a non-beaver site? 2) What proportion of the available trees do beavers coppice? 3) Does sapling regeneration differ between beaver sites and non-beaver sites?

Keywords: deadwood and living wood volume, Sapling regeneration, Scotland, Denmark, rewilding.
Beavers create scent marks on mounds of mud and plant material, or on uneven ground. There are two sources of scent – castoreum and anal gland secret. Lures from castoreum attract six species of mustelidae and a fox. Otters can use beaver lodges as marking places. The purpose of our research was to study whether beaver scent mounds attract other animals. We used Bushnell camera traps to observe scent mounds in the Voronezhsky Reserve (Central Russia). A total of 234 trap-nights were recorded at five locations in spring 2017. We received 384 videos with animal activity. Camera traps detected eight species of mammals: otter (Lutra lutra), probably American mink (Neovison vison), European badger (Meles meles), red fox (Vulpes vulpes), wolf (Canis lupus), European roe deer (Capreolus capreolus), moose (Alces alces), and red deer (Cervus elaphus). Also a lizard (Lacerta sp.), passerines (Passeriformes), ducks (Anatidae) and waders (Charadriiformes) were recorded. Only mammals reacted to beaver scent mounds. Ungulates, wolf and badger only sniffed them. Foxes and otters also sniffed the mounds and left scent marks (urine and excrement) on one of them. Carnivores may use beaver scent mounds as attractive objects for mediated communication by scent mark.

**Keywords:** beaver scent mound, camera trap, mammals, communication.
Experiments are conducted in microcosms, with different initial ratio of two differ in size Cladocera species, on background and regulated by beavers sites of the small rive. It is revealed that Castor fiber L. activity promotes the increase in the content of the total phosphorus and the decrease in N/P ratio in water, the increase of chlorophyll “a” concentration, abundance and a biomass of bacterial plankton. Under these conditions, as compared with background amounts, the abundance and the biomass of a large – *Daphnia* (Ctenodaphnia) *magna* Straus increases in grate ratio both at separate, and at joint with *Ceriodaphnia dubia* Richard dwelling. In addition, in microcosms from beaver’s pond in which two species of Crustacea co-exist, the quantity of young small *Ceri- odaphnia dubia* was lower, while an abundance of young large *Daphnia magna* is larger. A seven-day test with *Ceriodaphnia dubia* also demonstrates the reduction of it fruitfulness in the water from microcosms where *Daphnia magna* has the greatest abundance. The conclusion decision is – forming of zooplankton with specific parameters in beaver’s pond due to large Cladocera is promoted by changes of quantitative and qualitative characteristics of the food supply. This is favoured to mass development of large specie – *D. magna* and its successful competition with small – *Ceriodaphnia dubia*. The results of biotesting show that the effect of oppression of *C. dubia* fruitfulness also can be caused by chemical communications with *Daphnia magna* vital activity products.

**Keywords:** beaver activity, *Daphnia* (Ctenodaphnia) *magna* Straus, *Ceriodaphnia dubia* Richard, biomass, phosphorus, chlorophyll “a”.

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From a management perspective, beavers are defined as “ecosystem engineers” and “keystone species” because they physically alter habitats by cutting trees, digging canals, building dams and lodges. The management of beaver damage is still reflected insufficiently in the context of water protection. The question is whether a) beaver dams affect water quality by acting as trickle barriers that accumulate nutrients and hazardous substances; and b) accumulated bottom sediment behind the dams degrade downstream water quality in watercourses. The study was conducted in forest watercourses of North Lithuania. We collected sediment samples in upstream sites, the beaver pond, at the beaver dam construction area and downstream of beaver dams from the end of spring to October 2017. The total quantity of carbon (C), nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), mercury (Hg) and methyl mercury (MeHg) were analysed in sediment samples. The differences in concentrations of these nutrients and hazardous compounds were determined and analyzed. N, P, K, Ca, and Mg tended to accumulate upstream of the pond. However, there was not clear tendency of changes in C and Hg concentrations. At several sites, sediments from the upstream site, beaver pond and beaver dam construction site retained the highest C, Hg and MeHg concentrations.

**Keywords:** beaver, damming, nutrients, sediments, forest watercourses.
Following the successful reintroduction of beavers to Western Jutland, Denmark in 1999, human-beaver conflicts have increased, with the flooding of farmland and private lands being most problematic. Repeated removal of beaver dams is the most common mitigation for these conflicts. The goal of our study is to determine how beaver management can be more efficient by identifying and characterizing 15 dams and determining which site characteristics best predict the rebuilding of dams by beavers.

Our models indicate that water depth at the den site is the best predictor of the rebuilding of dams by beavers, once the dams had been altered by management activities. We also found that dams used in winter are rebuilt more often than those used only in autumn. Our finding can help inform management as to the effectiveness of dam removal as a mitigation for human-beaver conflicts.

**Keywords:** beaver dam, wildlife management.
The Eurasian beaver (Castor fiber) is an obligate monogamous mammal that lives in family groups. However, little is known about the cohesiveness between the members of a pair and the underlying spatial movement patterns. To gain insight into topics such as territoriality and foraging strategies, it is important to investigate spatial movement patterns of the breeding pair within their territory. To determine to what extent their territory use overlaps, we will simultaneously track the dominant male and female using GPS and calculate the percentage overlap of the 95% (territory) and 50% (core use) MCP between them. In addition, we will calculate the distance between the male and female throughout their active periods to determine whether they are moving together or separately, and identify foraging sites based on clusters of terrestrial positions to assess whether they are foraging in the same areas. Because beavers have been observed in the field patrolling separately from each other, but within similar boundaries, we predict a high level of territory overlap but that they will be found no closer to each other than random within this territory. This may allow them to more efficiently defend their territory.

**Keywords:** GPS, monogamy, pair movement, territoriality.
Mapping field signs is a well-established method to detect beaver settlements and results can be used to estimate the number of resident individuals. Recently, intensive mapping of activity signs along selected river sections in the province Lower Austria was carried out to investigate the ongoing expansion of the population. Furthermore, effects of management-induced derogation activities were observed. In accordance with the European Habitats Directive, exceptional permissions issued by the Nature Conservation Administration allows the temporarily restricted killing of beavers at conflict locations in Lower Austria. Since winter 2006/07 in total more than 1000 beavers were trapped and killed at various sites all over the province. The position of trapping localities and data about body weight, size and sex are available for the majority of killed individuals. To test, if the number of locally killed beavers can also be used as an appropriate measure to reflect the presence of beavers expected according to beaver signs mapping, both data sets covering same areas are combined. As an example, the results for two different regions will be presented.

**Keywords:** beaver signs mapping, beaver trapping, beaver management, Lower Austria.
Proper age determination is a key aspect in animal life history studies, but also crucial for wildlife management based on population age structure, growth and mortality rates. In mammals, tooth sectioning is widely used for age determination. In this study, we aged 123 Eurasian beavers (Castor fiber) from seven regions in Lower Austria based on tooth development and mandibular measurements (see Frahnert 2000), to examine whether regional or sex differences in body size and weight exist. Preliminary results show no support for differences in body measurements between regions or sexes. All mandible measurements were good predictors for age derived by tooth development and showed curvilinear relationships, with mandible length showing the highest $R^2$ value. A linear relationship with age was only found for the variable “tooth-index” (crown width × length/tooth length). We suggest that mandible measurements and inspection of basal tooth openings may be used for ageing younger beavers (up to 5 yrs), while cementum annuli and the tooth-index should be inspected in older beavers. Differences in weight and body size may not be resolvable in our study due to low sample sizes for some regions, or the fact that such differences may rather be related to small-scale habitat features.

**Keywords:** age determination, Eurasian beaver, mandible measurements, tooth development, tooth index.
Eurasian Beaver (*Castor fiber* L.) was reintroduced in Lithuania in 1947. Population growth was quite rapid and today beaver’s population in Lithuania is more than 40,000. Beaver actively modifies environments (by building dams, lodges, making borrows systems, changing water level etc.); therefore, beaver activity has a huge indirect environmental impact, not just by damaging forest and agricultural lands, but also by creating a specific environment. The aim of this research is to find out how various game species use beaver dams to cross water streams and what factors impact their movements. According to our findings, game species more often use beaver dams to cross the water stream in forest-edge habitats. Animals use beaver dams more frequently if weather temperature is between 0°C and 10°C and most crossings were captured at night. During spring and fall, game species crossed the beaver dams more often than during summer and winter time.

**Keywords:** beaver dam, migration, game species.
The Eurasian beaver (*Castor fiber*) is an obligate monogamous mammal, with semiaquatic and primarily nocturnal habits. Little is known about the time budget of the adult pair, and the social interaction between males and females outside the reproductive period. Most of the published data on the behavior of Eurasian beaver are derived from free-living animals through radio-tracking and accelerometers. These methods present some disadvantages due to logistic problems (e.g. no observations inside the lodge). Since 1958, there has been a farmed group of Eurasian beaver at the IAR&FR PAS research station in Popielno (Poland); the animals are grouped as couples living in separate stalls. With CCD cameras located in lodges, on pools and on yards, 2 adult pairs were recorded during 24h periods for 7 consecutive days in August 2002. Using the focal subgroup technique, we noted the behaviors (e.g. swimming, foraging, resting, self-grooming, allogrooming, and other) of both the males and females, and the locations where they performed the behaviour. The analysis of the data allowed us to show the 24h time budget of farmed Eurasian beavers in summer, the differences between male and female behaviours, and the sharing of space between the individuals of the pair. This contribution was supported by the grant of KNOW Consortium “Healthy Animal - Safe Food”, MS&HE Decision No. 05-1/KNOW2/2015.

**Keywords:** Eurasian beaver, camera recordings, behaviour, space share.
Monogamous mating is rare in mammals, occurring in fewer than 3% of all species. Both beaver species exhibit social (biparental) and in most cases genetic (exclusive) monogamy. Monogamous pair bonds last for multiple years and the pair stays together throughout the year. At least five hypotheses have been suggested to account for monogamy in beavers, but few tests of these hypotheses have been conducted. We examined the female aggression hypothesis, which suggests that female dominance in the family group, female territorial behavior and female agonistic behavior towards non-family members act as proximal mechanisms for maintaining the pair bond. Livetrapping data from different density periods of a population in Massachusetts, USA were examined with attention paid to the amount and degree of tail damage. No significant difference in tail damage was found between adult males and females in any population phase, although the percent of tail notches in both sexes during the exponential phase was significantly different from the low and carrying capacity phases. The percent of tail notches observed during the peak phase was significantly different from the carrying capacity phase. These data suggest that the female aggression hypothesis may not represent a significant explanation for monogamy in beavers.

**Keywords:** monogamy, females, agonistic behavior.
The development of drone flight technology brings new opportunities for assessing the impacts/changes made by castors on riparian vegetation. Successive flights make it possible to compare covered areas with different types of vegetation. The study was conducted on a 9-ha pilot site located in a protected area near Brasov, Romania.

**Keywords:** Castor fiber, beaver impact assessment, unmanned aerial vehicle.
Since the 20th century, beavers have been recolonizing territories due to protective laws in Europe and reintroduction operations in several countries. On some rivers, series of beaver dams are observed, producing potential significant hydrological impacts at the catchment scale. Quantifying the specific impacts of these dams is particularly challenging. Therefore, it follows to separate the changes specifically related to the presence of dams from the changes due to climate variability and to the evolution of other catchment characteristics. In this context, hydrological modelling can be used as a way to detect and quantify relative changes (e.g. deforestation, urbanization) in the hydrological behavior of catchments. Here, we applied the same type of modelling methodology on several catchments where beaver dams have been observed. We collected meteorological and streamflow time series on the studied catchments, and calibrated a hydrological model on the time period before beaver dam construction. Then, the model was used to simulate flows for the time period after dam construction. These simulated flows were finally compared with the observed ones, in order to quantify the impact of the beaver dams on several flow catchment characteristics.

Keywords: beaver dams, hydrology, modelling, floods, baseflow.
Beavers (*Castor fiber*, *C. canadensis*) are ecosystem engineers, which means they modify their habitat so that it benefits their needs. Beavers modify the hydro-geomorphology of the rivers and floodplain they occupy in three ways: they build dams and ponds, construct burrows and canals, and add wood to streams. This then leads to a larger heterogeneity in flow, and larger water storage, especially in low-order streams, which alters biogeochemical characteristics and diversifies river-floodplain habitat thus resulting in the observed increase in biodiversity. Hence, the key of better understanding the influence of beavers on river-floodplain systems is the hydro-geomorphology.

In this study, we model the hydraulic influence of beaver dams in two low-order streams, one of which is a beaver dam complex, the other a beaver dam cascade. In order to account for the high-spatial variability in beaver streams, we model three scenarios, which were reconstructed on the base of old aerial photography, interviews, SfM drone surveys, high resolution lidar data, dGPS, and ADCP-derived beaver pond bathymetry. We then relate the outcome to measured discharge and sediment transport, and argue that beaver dam complexes and cascades can have a significant effect on flood attenuation, and can, therefore, play a large role in river and flood management.

**Keywords:** ecosystem engineering, beaver cascades, structure from motion, flood attenuation, sediment transport.
In North America, active beaver sites have been investigated using aircraft and aerial photographs at various heights and survey methods. Long beaver dams and big lodges in lakes and ponds made detection possible and relatively easy (see references with this poster). We used a camera drone to record winter territories and activities of beavers in two Nature Protection Areas in the former opencast-mining landscape. The surface area of both investigation areas is 124.26 ha. Inaccessibility and a ban on entering many parts of the area made the use of a drone the only way to determine beaver activity. The beaver population in the study area is estimated at a maximum of 15 to 20 animals. Due to limited winter food resources the beaver population will remain small. However, for many reasons it was difficult to operate the camera drone and the interpretation of aerial photos was also difficult.

Free-standing lodges in open water were not present and burrow sites along the bank are only visible when covered by wood. Only when icefree waters with gnawed wood-stems on the bank can be seen, can an inhabited beaver burrow be assumed. We found numerous disadvantages for the application of a camera drone, including the limited capacity of batteries, low flight distances (max. 300 m) and short flight times, and weather (calm, no minus degrees, which lead to icing of propellers). Additionally, trees over 15 m high have a negative impact, cancelling radio waves and limiting view of the camera drone which is required. In our opinion, the operation of a camera drone is suitable for the recording of beaver activities in small and inaccessible areas, but with limitations. Use of camera-drones to record beaver damage for beaver management should be investigated in further projects.
On September 26, 2017, we visited the National Museum of Mongolia and inspected archaeological finds made by researchers of the Mongolian Academy of Sciences in recent years. The greatest attention was paid to the exhibit “shiren havtaga” – leather bag, found in 2008 in the far west of Mongolia (cave burial in Chonot Mountain, Bulgan sum, Khovd province, N 46°01’47.7″, E91°25’21.4″, 1359 m a.s.l.). The bag was made by ancient craftsmen between 1020-1210 years from processed skin, size 10 × 10 × 3 cm. The characteristic relief of the leather clearly indicated that the artifact was made from the tail of an adult beaver. But German archaeologists in the Bonner exhibition catalog (Vogel, 2012) and the Mongolian explorers (Batsukh & Batbayar, 2014) mistakenly indicated that this bag is made from the skin of fish, in particular from snakehead fish Channa argus living in the Amur River basin. The find was made in the area where today the relict Eurasian beavers Castor fiber birulai exist. The beavers of this subspecies now live within the Mongolia, China, and Russia. They are under the patronage of the Red Books of Mongolia, China, and Republic of Tyva. A unique archaeological find indicates that: beaver derivatives always had utilitarian significance for the nomads of this region; and population in the Upper Irtysh River is relatively stable, at least for the last millennium.

Keywords: archaeological find, beaver leather bag, Castor fiber birulai, Mongolia.
In the Middle Ages, beavers were widespread throughout Poland. In the 13th century, the numbers of animals began to decline. In the XVI century, the first regulations for the protection of beavers were created. After the Second World War, it was assumed that Eurasian beavers were no longer present in Poland. In 1974, the program “Active protection of Eurasian beaver in Poland” was launched. The reintroduction action was a very important element of the active protection of beavers. According to the inventory carried out in 1977, the number of individuals was estimated at over 1000 individuals. At the end of the 1990s the beaver population was large and species was no longer threatened by extinction. Long-term efforts of hunters and scientists in reintroduction action have caused the beaver to be present throughout Poland. In recent years, the beaver population has increased significantly. The number of individuals is estimated at over 120,000. In Poland, the beaver is considered a partly protected species, and the hunting or trapping is allowed depending on the damage caused to landowners, which requires a permit of the Regional Director for Environmental Protection.

**Keywords:** beaver population, beaver management, Poland.
Humans gather together in the presence of deceased persons in rites. We bury or burn the dead bodies in funeral ceremonies. These behaviors transcend cultural boundaries. Ceremonies may vary between cultures, the pattern is undeniable: humans seem to find a form of value in guarding or watching the bodies of the deceased for a period of time after death. But we are beginning to discover that these behaviors may transcend species boundaries as well. Elephants are known to “moan” next to the dead bodies of members of their herd during several days and even members of other clans do so. Dolphins also stay at their dead calves for several days. Mother chimpanzees on the other hand, carry around the lifeless bodies of their daughters or sons for days. Similar practices have been observed among gorillas, baboons, macaques, lemurs and geladas. And magpies gather around dead members, try to revivify and cover them with all kind of vegetation. We observed a Eurasian beaver in Switzerland giving birth to a stillbirth cub 300 m away from the lodge where she already had 3 cubs of the year. The female has dug a recess 5 m off the pond shore. She lay there for over an hour, then gave birth very quickly to a dead cub. She examined the dead body for several minutes and then started to dig a 30 cm deep hole in the ground some 2 m away of the recess. She lay the carcass into that hole and fetched branches, weeds and other kind of vegetation and covered the dead body with it for over half an hour. What was the purpose of that behavior? Was it a clear intention of the beaver to “bury” the stillbirth or was it only an antagonistic behavior to avoid predators to find the lodge?

Keywords: Castor fiber, stillbirth, funeral, antagonistic behaviour.
Global Positioning System (GPS) telemetry is widely used in wildlife research to study habitat use and resource selection of animals. In order to evaluate the quality and reliability of GPS data, the factors influencing the performance of these devices must be known, especially when studying fine-scale space use and movement patterns. We evaluated the location error and fix success rate of GPS receivers in stationary tests and on Eurasian beavers (*Castor fiber*). The location error during stationary tests was on average 14 m, and increased with increasing vegetation closure and slope, and decreasing number of satellites. This potentially leads to the erroneous classification of GPS positions when studying beaver habitat use. The fix success rate was significantly higher during stationary tests compared to when GPS units were deployed on beavers (94% versus 86%), suggesting that animal behavior affects GPS performance. Further, GPS receivers did not obtain any positions underwater and underground, which potentially is useful to estimate activity periods. We discuss the possibilities for data screening, the use of buffer zones, and combination with other data loggers to avoid the erroneous classification of GPS positions.

**Keywords:** fix success rate, GPS, location error, riparian habitat.
Biochemical blood parameters are important for assessing animal health. They characterize the adaptive features of the species in various habitats. Blood tests of wild beavers are now conducted in Western European countries and in Russia. Researchers can estimate the condition of wild beaver population and assess their genetic origin [1;2]. We have blood tests of beavers from the Beaver Farm (Voronezsky Reserve) for 25 biochemical indicators. These animals were born at the Beaver farm. They are contained in monogamous couples. All animals were clinically healthy and physically active. We adopted the parameters of the biochemistry of serum of wild Eurasian beavers as a “norm” [1;2]. We determined that most of the biochemical indicators of the blood of the examined beavers correspond to the parameters of the blood of beavers from the wild. However, some indicators indicate a deviation from the norm. We noted excesses for the indicators: total protein (TP) to 72-74 g/l (64.89±3.78 g/l); urea (Urea) to 9.2 mmol/l (5.99±2.02 mmol/l); creatinine (Creat) to 114 mmol/l (88.69±21.62 mmol/l). We observed a decrease in Alb albumin to 21-22 g/l (36.43±1.7 g/l). Deviation from the norm values of TP, Urea, Creat, Alb arise as a result of functional disorders in the liver and kidneys. We believe that this is due to the genetic composition of beavers in the farm.

Keywords: Castor fiber; biochemistry of blood, beaver farm.
Understanding mating systems is essential as they reflect individual strategies to maximize reproductive success and thus drive evolution. Monogamy, where males and females form exclusive pairs for more than one breeding season, is particularly intriguing in this context, as there are real and potential costs of genetic monogamy to both sexes. However, molecular studies in a variety of species have revealed that social monogamy does not necessarily imply genetic monogamy due to occurrence of extra-pair copulations resulting in extra-pair offspring. Although common in birds, <10% of mammals are monogamous. Here we use single nucleotide polymorphism (SNP) to investigate the genetic mating system of the Eurasian beaver (Castor fiber), a species traditionally considered to be not only socially but also genetically monogamous. We found evidence for low frequency of extra pair paternity (EPP) and multiple paternity within litter. Only 5.4% young were produced by EPP and only 7% litter contain at least one extra pair young. Moreover, we found indications that only the pairs with old individuals engaged in EPP. None of the pairs produced more than one litter as a result of EPP and none of the EPP events resulted in mate change. Our findings suggest that EPP in beavers might be the consequence of a lapse in mate guarding ability of old males due to senescence.

Keywords: Castor fiber, extra-pair paternity, social monogamy, SNPs.
By request of the French ministry in charge of ecology, the National Hunting and Wildlife Agency has coordinated and managed the French beaver network since 1987. It is in charge of various aspects of beaver management and research. Our first goal, the monitoring of population distributions, shows the re-colonization of the beaver throughout its historical range. Our second goal is to advise various publics on management techniques to limit damage on human activities or conflicts, in particular those due to dams and associated flooding by beavers. The third goal of the network is to survey the absence of the Castor canadensis, a potential competing species detected in other European countries. Genetic analyses of the French beaver population are ongoing.

Keywords: network, distribution, dam, management.
The Eurasian beaver (Castor fiber) inhabited most river catchments of the Iberian Peninsula during the Holocene according to the fossil record and other data, until their extirpation by humans. By 2008 a beaver population was present in the Ebro catchment as the result of reintroductions and genetic analysis indicates that they are in the western evolutionarily significant unit lineage. Between 2008 and 2016 at least 200 beavers have been removed and killed by Spanish regional administrations in the Ebro catchment because the reintroduction is considered an illegal release. However, Spain has considered the beaver a protected species since 1986 under the Bern Convention and international laws and national obligations for restoring biodiversity were not evaluated during the Spanish beaver culling in the Ebro basin. In spring of 2018, the Spanish central government received correspondence from the EU Environmental Commission suggesting that the beaver policy must change in Spain under the umbrella of the EU Habitats Directive. We strongly believe that Spain should move to a policy that implements an effective protection of beavers and their habitats regardless of how the reintroductions occurred. In order to gain full protection for this species, we explore several legislation conservation actions under the fragmented Spanish national and regional laws.

**Keywords:** Bern Convention, Castor fiber, Eurasian Beaver, Ebro River, EU Habitats Directive, laws, Spain.
The use of Remote Frequency Identification (RFID) offers new potential in remote wildlife monitoring to reduce the invasive nature of studies requiring direct contact with study animals. Facilitated by the emergence of new technology, RFID can accurately record spatial data for individual animals identified by PIT tags (microchips). In this study, we developed a new remote, automatic, fixed position PIT tag reader, using antennas surrounding underwater lodge entrances to remotely monitor a wild population of the semi-aquatic mammal, the Eurasian beaver (*Castor fiber*) for the first time. We developed a method for the installation and use of this system and compared it with other methods of monitoring beaver activity at lodge entrances. We used the loggers to record entry/exit events across a sample of 10 lodges, over 3 nights per lodge. We use these data to give examples of its potential uses for studies on topics such as activity times, lodge/den occupancy, parturition and activity levels across sex and age demographics. We further suggest that research using RFID through fixed PIT tag readers should be given a high priority, when developing non-invasive studies where accurate spatial data at a single point is relevant.

**Keywords:** radio-frequency identification, PIT tags, *Castor fiber*, remote monitoring, non-invasive.
Until recently, the Eurasian Beaver (Castor fiber) has been extinct in Scotland (since the 16th century). Reintroductions can be contentious, especially when the species to be reintroduced may negatively impact already threatened species. Fishery bodies are anxious that the return of Eurasian beavers in Scotland may negatively impact salmonid populations. Beaver dams alter riparian habitats by impounding water and converting lotic habitats to lentic. These changes influence habitat requirements of many fish, particularly salmonids and beaver dams may also impede up and downstream migration. This study investigates the response of a brown trout (Salmo trutta) population to habitat modifications by reintroduced beavers in northern Scotland.

Here, we examine up and downstream passage of brown trout at a series of beaver dams using a passive integrated transponder system, allowing for the identification of passage attempts and success of individual fish. Fork length, density and abundance of brown trout between beaver altered habitats and control sites were also quantified. Brown trout successfully passed beaver dams in both up and downstream directions, although it is clear environmental conditions determine the degree of success. The largest trout were found in beaver ponds and there were seasonal variations in density and abundance.

**Keywords:** beaver dam, salmonids, passage, migration, abundance.
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