INTRUDER OR RESOURCE? A BIBLIOMETRIC ANALYSIS OF METHODS AND APPROACHES IN THE CONTEXT OF BEAVER MANAGEMENT

"Marin Drăcea" National Research-Development Institute in Forestry

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PROGRAMME AND BOOK OF ABSTRACTS

9th INTERNATIONAL BEAVER SYMPOSIUM SEPTEMBER, 18th - 22nd 2022 BRAȘOV, ROMÂNIA

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CONTENT

WELCOME

Dear colleagues, from 18-22 September 2022 the 9th International Beaver Symposium (9IBS) will be held in Brasov, Romania to connect people, ideas and science supporting and enhancing our knowledge of beavers. The theme of the 9th IBS is:

BEAVERS AND THEIR ROLE IN RIPARIAN FORESTS

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CONFERENCE PROGRAMME

18th September, Sunday	Arrival day	
18:00 - 21:00	*Arrival and Registration (Aro Palace hotel lobby)*	
19th September, Monday	**Scientific Session I** **Beaver and Environment, Oral presentations and Q&A Sessions** **Session Moderator: Dr. Ancuta Fedorca**	
Time	**Title**	**Presenter**
08:00 – 10:00	*Registration and Coffee break (Aula Sergiu Chiriacescu)*	
10:00 – 10:45	Welcoming from: ▪ local/regional/national authorities ▪ local committee and organizers ▪ IBS committee. Romanian biodiversity, management and conservation of wildlife species	Prof. univ. dr. Ovidiu Ionescu (Transilvania University of Brasov)
10:45 – 11:00	Sediments in beaver ponds: influence of different land use types on chemical composition	Asta Kovrigina
11:00 – 11:15	Beavers in anthropogenic landscapes: a blessing or a burden? A case study in the Netherlands	Britt van Zelst
11:15 – 11:30	Beavermap: introduction of a new citizen science program	Erika Juhasz
11:30 – 11:45	*Coffee break*	
11:45 – 12:00	Beaver (*Castor fiber*) population size in Plitvice Lakes National Park and its impact on the tufa	Marko Augustinović
12:00 – 13:30	*Lunch break at Jon by Chef Jon Jordache*	
13:30 – 13:45	Does beaver activity affect space use by deer? A case study from Denmark	Martin Mayer
13:45 – 14:00	Plant productivity as impacted by beaver damming	Nichole-Lynn Stoll
14:00 – 14:15	A conceptual model for beaver dams location based on the land topography – a case study in the Romanian Black River basin	Alexandru Gridan
14:15 – 14:30	The hydrological impact of beaver restoration, on reducing peak flood levels, in the Milwaukee River watershed in Wisconsin, USA	Robert Boucher
14:30 – 14:45	Observation of hydrological changes at beaver-dam-sites using time lapse cameras and correlations with rainfall and waterline data at local level	Silvan Minnig
14:45 – 15:00	Local knowledge about the Eurasian beaver and perception of its impact on ecosystem services in the Carpathian basin	Viktor Ulicsni
15:00 – 15:15	The impacts of re-introduced beavers on stream water quality in southwest england: a multi-site study	Gareth Bradbury
15:30	**▪ Excursion at Natura 2000 site ROSCI 0170 Eutrophic forests and marshes from Prejmer**	
19:00	**▪ Dinner at Vila Bran**	

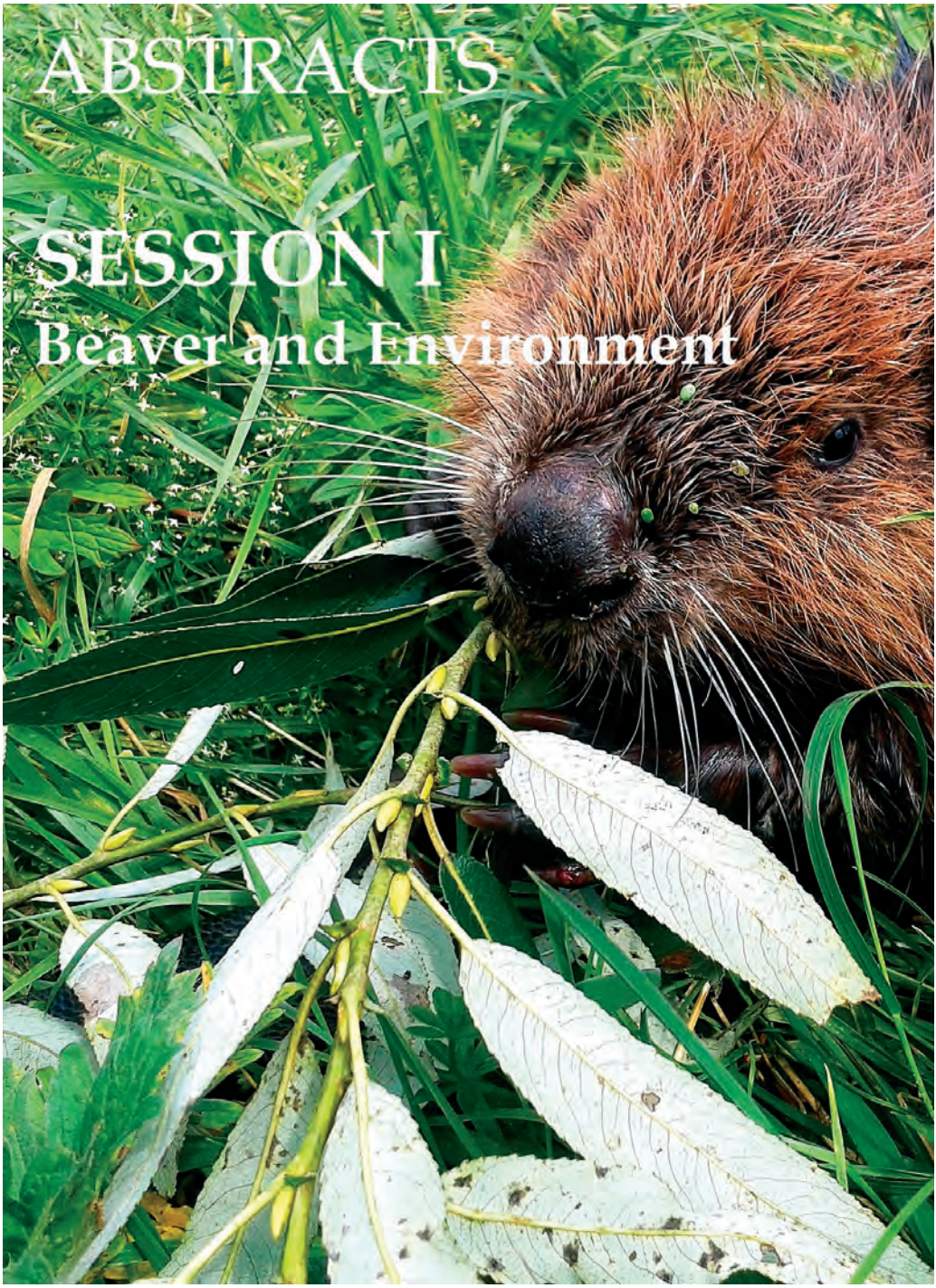
20th September, Tuesday	**Scientific Session II** **Beaver Management and Policy, Oral presentations and Q&A Sessions** **Session Moderator: Prof. univ. dr. Alius Ulevičius**	
Time	**Title**	**Presenter**
09:00 – 09:15	Developing understanding of the hydrological impacts of beaver reintroduction in Great Britain	Alan Puttock
09:15 – 09:30	Living with abundant beavers from social and ecological perspectives	Alius Ulevičius
09:30 – 09:45	Intruder or resource? A bibliometric analysis of methods and approaches in the context of beaver management	Anna Treves
09:45 – 10:00	Renewed coexistence: learning to live with reintroduced beavers in England	Auster Roger
10:00 – 10:15	An early perspective of beaver reintroduction in England	Claire Howe
10:15 – 10:30	Initial assessment of beaver damages in the Olt River basin	Claudiu Pasca
10:30 – 10:45	***Coffee break***	
10:45 – 11:00	„I am curious…" pathways of local ecological knowledge-acquisition about a recently reintroduced salient species, the Eurasian beaver	Dániel Babai
11:00 – 11:15	The action plan for beaver (*Castor fiber*) population conservation in Romania	Georgeta Ionescu
11:15 – 11:30	Artificial beaver lodges – An underestimated tool to mitigate human-beaver-conflicts	Niels Hahn
11:30 – 11:45	Beavers and humans as boundary builders and breakers	Inge Dekker
11:45 – 12:00	The beaver management in the Czech Republic	Jitka Uhlíková
12:00 – 12:15	Scotland's beaver strategy 2022-2045 – Finding a way forward	Martin Gaywood
12:15 – 13:30	***Lunch break at Jon by Chef Jon Jordache***	
13:30 – 13:45	Beaver in buffer zones of wetlands	Olgirda Belova
13:45 – 14:00	Population development and management of beavers in Scotland to present	Roo Campbell
14:00 – 14:15	Castor controlled the Chesapeake Bay in North America: Using historical evidence from the fur trade to infer *Castor canadensis* distribution, density, and ecological influence within the Chesapeake Bay watershed	Scott McGill
14:15 – 14:30	Keeping the Netherlands dry; mitigating conflicts with beavers	Vilmar Dijkstra
14:30	▪ **Excursion at Piatra Craiului National Park**	
19:00	▪ **Gala Dinner at Cheile Gradistei Restaurant**	

21st of September, Wednesday	Scientific Session III Beaver Biology and Ecology, Oral presentations and Q&A Sessions Session Moderator: Prof. univ. dr. Peter Busher	
Time	**Title**	**Presenter**
09:00 – 09:15	Mammals in beaver burrows: Effect of meteorological condition and lunar phases	Arūnas Samas
09:15 – 09:30	Genetic structure of Eurasian beaver in Romania: Insights after two decades from reintroduction	Ancuta Fedorca
09:30 – 09:45	Disease surveillance of free-living Eurasian beavers (*Castor fiber*) in England	Sophie Common
09:45 – 10:00	Level ponds: Alternative beaver management and aquatic macroinvertebrate biodiversity	Glynnis Hood
10:00 – 10:15	Does sap flow in trees influence species selection and autumn food caching?	Peter Busher
10:15 – 10:30	Foraging strategy and impact of the Eurasian beaver in floodplains threatened by invasive woody species	Erika Juhász
10:30 – 11:00	***Coffee break***	
11:00 – 12:30	Poster Session	
12:30 – 14:00	***Lunch break at Jon by Chef Jon Jordache***	
14:00 – 16:30	Poster Session	
16:30 – 16:30	Photo Session	
19:30	**▪ Traditional dinner prepared by the hosts at field station – trout farm Garcin (Transilvania University of Brasov)**	

22nd of September, Thursday	**Departure day**

Poster Session		
Title	**Session**	**Participant**
Habitats and macrozoobenthos in beaver-influenced low mountain streams with special focus on beaver dams	Beaver and Environment	Sara Schloemer
Modification and spatial variation of riverine nutrient concentrations due to beaver damming across Switzerland	Beaver and Environment	Annagret Larsen
The beaver influence in the shaping of riparian habitats - case study in ROSCI 0415-Lunca Bârsei	Beaver and Environment	Georgeta Ionescu
Large mammals at beaver sites in the middle mountains (the case of Southern Siberia)	Beaver and Environment	Ivan Trenkov
Habitat use by the northern water snake: association with beaver structures	Beaver and Environment	Peter Busher & Dominic Kemmett
How the beaver (*Castor fiber* L.) Regulates living space and changes habitat conditions - for the benefit of oneself and others	Beaver and Environment	Kristijan Tomljanović
Investigating the Eurasian beaver (*Castor fiber*) as a biological indicator of ecotoxicological exposure and effects in England	Beaver and Environment	Sophie Common
Relationships between the chemistry of water and bottom sediments in beaver ponds in forest areas in Poland	Beaver and Environment	Michael Wröbel
Digging activities of beavers as a possible solution to biodiversity conservation of small floodplain water bodies	Beaver Management and Policy	Ivan Bashinskiy
Diversity of conflicts generated by the Eurasian beaver in Central Europe	Beaver Management and Policy	Marianna Biro
Education meets beaver! The new "Beaver tour backpack" for beaver advisors in Baden-Württemberg	Beaver Management and Policy	Anke Simon
Preparatory actions for the reintroduction of the Eurasian beaver (*Castor fiber)* in Greece	Beaver Management and Policy	Antonia Galanaki
Zonation of the Black River hydrographic basin based on human/beaver conflicts risk	Beaver Management and Policy	Georgeta Ionescu
Public attitude about beavers in Croatia after 25 years – Guidelines for coexistence	Beaver Management and Policy	Linda Bjedov
Modern technologies and beaver monitoring in Slobozhanskyi NNP	Beaver Management and Policy	Nataliia Brusentsova

Georadar and geoelectrical tomography – Technical support for damage prevention of beaver digging activities – bank safety and highwater protection	Beaver Management and Policy	Karl-Andreas Nitsche
Use of remote water level monitors for the management of beaver dam impacts	Beaver Management and Policy	Roo Campbell
Where did all the beavers go?	Beaver Management and Policy	Gerhard Schwab
Life with the beaver, wetlands and climate change – Raising awareness and influencing policies on best beaver management practices	Beaver Management and Policy	Tatjana Gregorc
Species interactions in beaver engineered habitats link land-water ecosystem processes	Beaver Management and Policy	Valentin Moser
Post-translocation survival of wild Eurasian beavers from Scotland	Beaver Management and Policy	Roisin Campbell-Palmer
Investigations regarding methods for detecting cavities caused by beavers in forelands and levees	Beaver Management and Policy	Torsten Heyer
Long-term dynamics of the beaver (*Castor fiber*) population in the Voronezsky Reserve (Central Russia)	Beaver Biology and Ecology	Aleksandr Mishin
Biodiversity survey in dammed beaver territories in switzerland: Study design and methods	Beaver Biology and Ecology	Silvan Minnig
Testing for Eurasian beaver (*Castor fiber*) family size and structure in three regions of Switzerland with different population densities	Beaver Biology and Ecology	Silvan Minnig
Analysis of plants used by beavers (*Castor fiber* et *C. canadensis*)	Beaver Biology and Ecology	Karl-Andreas Nitsche
Migration and behavior of fishes at beaver dams	Beaver Biology and Ecology	Thomas Kreienbühl
Evaluating biodiversity impacts of beavers on invertebrate and vertebrate communities using environmental DNA	Beaver Biology and Ecology	Tom Spencer
Wood-eating, dam-building, and 50 million years of beaver evolution	Beaver Biology and Ecology	Grant Bowers



ABSTRACTS

SESSION I

Beaver and Environment

SEDIMENTS IN BEAVER PONDS: INFLUENCE OF DIFFERENT LAND USE TYPES ON CHEMICAL COMPOSITION

Asta Kovrigina[1]✉, Vaidotas Valskys[1], Alius Ulevičius[1]

Abstract

Beaver is the keystone species, which dramatically influences river hydrology, aquatic, and terrestrial biota. This can have a major impact upon water resource management, flow regimes and water quality. Chemical pollution of sediments is an important ecological and environmental issue. Accumulation of heavy metals in sediments of beaver ponds was studied in the river catchments of different land use: (i) extensively used (EU) agricultural territory (Eastern Lithuania), (ii) urbanized territory (UT) with dense transport network (suburbs of Vilnius), and (iii) intensively used (IU) agricultural territory (middle Lithuania). Nine heavy metals (arsenic, cadmium, copper, zinc, barium, zirconium, iron, manganese, vanadium) were determined with X-ray fluorescence Thermo Scientific Niton® XL2 spectrometer in 48 sediment samples. Significant differences ($p < 0.05$) between concentrations of copper and zinc were found in the sediments of EU and UT beaver ponds. Differences ($p < 0.05$) between concentrations of cadmium, barium, zirconium, and manganese were found in the sediments of EU and IU beaver ponds. The sediments of IU and UT beaver ponds were found to have the largest differences ($p < 0.05$) between concentrations of arsenic, cadmium, copper, zinc, barium, zirconium, iron, vanadium. The study showed that the concentrations of chemical elements found in the EU were lower, than in the IU and the UT beaver ponds. Concentrations of heavy metals found indicate that the chemical composition of sediments in beaver ponds may depend on intensity and type of land use.

Keywords: beaver ponds, chemical composition, sediments, land type, X-ray fluorescence.

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BEAVERS IN ANTHROPOGENIC LANDSCAPES: A BLESSING OR A BURDEN? A CASE STUDY IN THE NETHERLANDS

Britt van Zelst [1]✉

Abstract

After more than 150 years of local extinction, beavers are now once again a common species in the Netherlands. Beavers were reintroduced in 1988 in the Biesbosch, followed by multiple other reintroductions. Now that there are an estimated 5000 beavers inhabiting the Netherlands, it can be said that the reintroductions were successful. The beaver has recolonized our wetlands and once again become an integral component of Dutch nature. Due to high habitat availability, the beaver population growth is expected to continue, both in number and distribution. While we are slowly getting used to living with the beaver again and we are becoming more aware of the positive effects that beavers have on our ecosystems, we occasionally see the emergence of human-beaver conflicts, especially in densely populated areas. For example, beavers can form a threat to our water safety as they destabilise our dikes on which we rely to mitigate flood risk. My presentation discusses beavers in the Netherlands and sharing anthropogenic, contemporary landscapes in the future. This requires scientists and stakeholders to join forces to develop collaboratively creative knowledge-based and publicly supported designs on how beavers and humans can coexistence in the Netherlands.

Keywords: sustainable human-beaver coexistence, sharing anthropogenic landscapes, ecosystem services and disservices, the Netherlands.

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BEAVERMAP: INTRODUCTION OF A NEW CITIZEN SCIENCE PROGRAM

Erika Juhász[1,2]✉, Dávid Czabán[3], Marianna Biró[1]

Abstract

Beavers can dramatically transform their habitat, which has a significant impact in terms of both nature and people. For local residents and tourists who visit floodplains and wetlands regularly, this landscape alteration is easy to observe. As citizen scientists, residents and tourists can be effectively involved in research on he ecosystem engineer beavers. Reciprocal learning could inform environmental education, contribute to conflict management, and improve our scientific knowledge about the species. In 2021, we launched a citizen science program, the BeaverMap (HódTérkép in Hungarian), which helps us to collect not only occurrence data of beavers, but also document the experiences and perceptions of the informants about beaver effects. Informants can submit an observation by providing a placemark, uploading documentary photos, and answering a questionnaire. We ask our informants to provide a description about the activity and site-specific effects of the species. Our main goal is to increase publicity in he Carpathian Basin; however, data sent from other parts of the world are also welcome. The website was only available in Hungarian until the summer of 2022; in the first half year more than 350 uploads were received. The English-language website for international data collection is planned to be launched in August, 2022. In this presentation, we show examples on how we used citizen science data in Hungary, and our future goals regarding to this. Beaver occurrence data indicated on the BeaverMap can refine the results of regional beaver distribution surveys. Opinions of local people about ecological impacts of beavers and conflict situations help augment our field research. An adequate beaver management strategy should be built on the exact field monitoring of beavers and their effects, while still thoughtfully considering the statements of local people.

Keywords: distribution, landscape alteration, ecological effect, human-wildlife conflict, public participation, reciprocal learning.

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BEAVER (*CASTOR FIBER*) POPULATION SIZE IN PLITVICE LAKES NATIONAL PARK AND ITS IMPACT ON THE TUFA

Marko Augustinović [1]✉, Monika Petković[1], Ksenija Hocenski[1], Marijan Grubešić[2], Vedran Slijepčević[3], Duško Ćirović[4]

Abstract

Beavers were first reintroduced in Croatia in 1996 and by 2010 the beaver population has spread more than 300 km in a southwestern direction, colonising the area of the Plitvice Lakes National Park, whose main phenomenon is the formation of tufa. One of the objectives of the research was to determine the influence of the beaver on the tufa formation process. A combination of field methods was used to determine the distribution, number of territories, and number of individuals in the National Park area. Data from observed beaver activity signs were processed and centres of beaver activity (core areas) were located. Population density was estimated using the method of observation at dawn and dusk during two seasons. The current beaver population in Plitvice Lakes National Park is stable and occupies 32% of the area of all water bodies. In 10 areas, 11 beaver shelters (burrows, lodges and caves) were found. The average colony size is 1.8 individuals and the average territory size is about 1.5 km. Although beavers have been present for more than 10 years in NP Plitvice Lakes, the estimated population size is small and may be influenced by the presence of three large predators - Eurasian lynx, brown bear and grey wolf.

Keywords: beaver, tufa, Plitvice Lakes National Park, population, predators.

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DOES BEAVER ACTIVITY AFFECT SPACE USE BY DEER? A CASE STUDY FROM DENMARK

Malene Svanholm Pejstrup[1], Jonas Robert Andersen[1], **Martin Mayer**[1,2]✉

Abstract

Beavers can change habitat composition by cutting down trees, digging, and damming activities, thereby affecting species richness and abundance. Although there is large body of literature regarding the effects of beaver activity on a wide range of taxonomic groups, ranging from plants to mammals, relatively little is known about how space use by ungulates is affected by beavers, especially in human dominated landscapes. Here, we present a case study from Denmark that investigated potential effects of beaver activity on roe deer and red deer. Beavers could either facilitate the presence of deer by providing food resources (increased abundance of deciduous trees and shrubs) or compete with them for resources via exploitative competition. We predicted to find stronger interspecific interactions between beavers and roe deer, because these two species have a more similar feeding ecology (browsers) compared to red deer (primarily grazers). Using transect counts recording both cut and uncut stems of woody plants, we describe beaver browsing patterns and provide evidence that they alter plant species composition. We then assessed deer presence and relative abundance in relation to the distance from water and in areas with varying beaver activity. Our findings provide limited evidence that areas with high beaver impact were avoided by roe deer, likely due to exploitative competition, whereas red deer space use was not affected by beavers. An improved understanding of the complex effects beavers can have on ungulates will be relevant for wildlife and forestry management, potentially being an important tool to reduce human-wildlife conflicts.

Keywords: competition, facilitation, forestry, red deer, roe deer.

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PLANT PRODUCTIVITY AS IMPACTED BY BEAVER DAMMING

Nichole-Lynn Stoll[1]✉ and Cherie Westbrook

Abstract

Beavers have long been recognized as habitants of peatlands, with their range extending over 95% of the peatlands in Canada. While there is a wealth of research on the water and C cycles within peatlands, even some studies in places where beavers are present, there is currently limited knowledge of the role of beavers in influencing the ecohydrological processes of peatlands. Beavers excavate ponds and pile the peat into berm-like dams which increases open water area by an order of magnitude, changes groundwater flow patterns, and raises and stabilises the water table. These hydrological changes are known to alter plant community composition; the first response of plants to a change in abiotic conditions is usually a change in plant phenology. We investigated beaver dam impacts on plant phenological patterns in a Canadian Rocky Mountain peatland inhabited by beavers. Digital repeat photography was utilized to determine if beaver damming affects the length of the growing season and the timing and duration of peak plant growth. Photos were acquired weekly at permanent vegetation plots between May and September 2022 with an unpiloted aerial vehicle flown at ~8 m above the ground surface in three treatments (active beaver, abandoned beaver, and no beaver). Water table depth was monitored in each treatment with level sensors. The analysis will focus on comparing plant greenness values using the green chromatic coordinate among treatments to see if plots located near active beaver dams experience accelerated green up over the growing season and/or reach a greater maximum greenness. The study has implications for understanding how beavers influence peatland carbon-climate feedback in a warming climate.

Keywords: beaver damming, plant productivity, greenness, UAV.

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A CONCEPTUAL MODEL FOR BEAVER DAMS LOCATION BASED ON THE LAND TOPOGRAPHY – A CASE STUDY IN THE ROMANIAN BLACK RIVER BASIN

Alexandru Gridan[1]✉, Mihai Fedorca[1], Elena Ciocirlan[1,2], Iulia Baciu[1], Maria Spătaru[1], Mihai Nită[2]

Abstract

The Eurasian beaver, *Castor fiber*, is considered an ecosystem engineer, and through construction behavior it can produce changes in the hydrology and habitat. In Romania, the beaver disappeared at the end of the nineteenth century and was reintroduced in 1998. With its reintroduction, an exponential growth of populations was observed. One of the most significant areas where beaver activity impacted the environment by constructing dams was the Black River basin. The aim of this study was to create a predictive model of beaver dam distribution based on the hydrological and topographic land characteristics. Two digital altimetric models (SRTM and LIDAR) of the study area were used to perform the analyzes.Results indicate that dams mainly are found in areas where the accumulation of flow is about 900 cm^3/s, the topographic humidity index has values between 3.85 and 25.64 and the depth of the valley is less than 361.67 cm. The model shows high accuracy and we conclude that the overall quality of the data sets is sufficient for predicting the distribution of dams on uncolonized watercourses thus minimizing potential conflicts and damage.

Keywords: beaver dam distribution, predictive model, flow accumulation, valley depth, humidity index.

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THE HYDROLOGICAL IMPACT OF BEAVER RESTORATION, ON REDUCING PEAK FLOOD LEVELS, IN THE MILWAUKEE RIVER WATERSHED IN WISCONSIN, USA

Robert Boucher[1]✉, Qian Liao[2] and Changshan Wu[3]

Abstract

The objectives of the study were: (1) assess the potential of beaver reestablishment in the Milwaukee River watershed in Wisconsin, (900 square miles, with discharge into Lake Michigan) through GIS modeling and through habitat assessment field surveys; and (2) conduct hydrological modeling to evaluate impacts of beaver constructed dams on river hydrological processes and flood mitigation in the watershed. This presentation gives a synopsis of the results of the study (December 2020) where researchers from University of Wisconsin (Milwaukee) School of Freshwater Sciences, Dr. Qian Liao (Civil Engineering, Hydrologist) and Dr. Changshan Wu (GIS, Geography) modeled the Milwaukee River watershed to measure the potential flood mitigation benefits of beaver created wetlands. The field habitat study was conducted by Robert Boucher and three field assistants to evaluate the beaver habitat suitability throughout the six sub basins. From these sites, 52 ideal wetlands habitat areas were selected as having a high ponding potential to reduce downstream flooding and/or lower the hydrograph of the streams during rain events. Modeling analysis with both realistic past storms and synthetic frequency storms supported the hypothesis that beaver dams that are largely dispersed in the upper tributaries of the watershed can potentially mitigate flood flows in urban zones in the lower end of the watershed. Modeled beaver dams could have reduced the peak flows by 7-40% according to past storm simulations, and by 25-50% according to synthetic storm simulations. This was a partnership study with Milwaukee RiverKeeper, and the University of Wisconsin, funded by the Milwaukee Metropolitan Sewerage District, (MMSD) which provides sanitary water utility services and has flood mitigation authority for the City of Milwaukee, Wisconsin in the USA.

Keywords: beaver, hydrology, watershed restoration, geomorphology, peak flood reduction, wetlands, floodplain resilience, geography gis, habitat, ecosystem engineer, keystone species.

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OBSERVATION OF HYDROLOGICAL CHANGES AT BEAVER-DAM-SITES USING TIMELAPSE CAMERAS AND CORRELATIONS WITH RAINFALL AND WATERLINE DATA AT LOCAL LEVEL

Silvan Minnig[1]✉ and Polli, T.[2]

Abstract

The Eurasian beaver (*Castor fiber*) was successfully reintroduced in Switzerland between 1956 and 1977, and now occupies large portions of its former distribution range. By the turn of the millennium, beavers had started to recolonise small streams in Switzerland, from the from the mouth of a stream where it flows into a larger stream to the source The natural limnologic conditions and often flat morphologic relief have led to a large number of beaver dam territories over the Swiss Plateau, with one to twenty dams per site. The beavers' damming activities can locally transform streams from running water to still water conditions, and so trigger a transition from rhitral to litoral communities if the dam conditions remain stable over a long period. We examined these conditions in three different dam locations using photometric observations made with two different timelapse-cameras. In addition, we analysed correlations between dam situation and water line at dam sites, and local meteorological and hydrological data. Using the disturbance index for the local amount of rainfall to analyse the water run-off over the dam, we were able to predict dam locations using the two abiotic parameters of rainfall and water level. This is relevant for plant and animal ecology in three beaver dam sites. For the future management of beaver dams, plant and animal settlement and fish migration in small streams, we recommend the observation of dam sites over a longer period in low-, middle- and high-water conditions using timelapse cameras like TIKEE and RECONYX before deciding to undertake any intervention, especially with regard to aquatic species like fish, macroinvertebrates or macrophytes. Finally, we place these observations in the context of analogous measurements taken from the first large beaver dam analogue (BDA) revitalisation project in a small stream in Switzerland.

Keywords: Eurasian Beaver (*Castor fiber*), hydrological Dynamics at Beaver dam sites, meteorologic correlations, special timelapse camera, RECONYX and Tikee camera trap, Beaver Dam Analogs (BDA), Switzerland .

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LOCAL KNOWLEDGE ABOUT THE EURASIAN BEAVER AND PERCEPTION OF ITS IMPACT ON ECOSYSTEM SERVICES IN THE CARPATHIAN BASIN

Viktor Ulicsni[1,2]✉, Dániel Babai[2], Erika Juhász[3], Zsolt Molnár[1], Marianna Biró[1]

Abstract

Despite the fact that Eurasian beavers play a significant role in forming the floodplains and their ecosystem services, the local perception of its impacts is understudied. Studies about the local perception of the impact of beavers' activity on ecosystem services are mostly limited to the North American beaver, Castor canadensis. Our main objective was to study the local knowledge on beavers and the perceptions of their impact on local ecosystem services and livelihoods in ecologically diverse, rural landscapes of Romania and Hungary. We also studied local peoples' perception of beavers' general harmfulness and usefulness. The study areas were located in different types of watersheds, and differently used rural landscapes: Kászon Basin (Romania), Szigetköz (Hungary), and Mura River valley (Hungary). Structured interviews were carried out with 45 knowledgeable and 45 randomly selected local informants. Knowledgeable informants were recommended by residents (and selected using snowball method) as 'inhabitants knowledgeable about beavers'. We found that locals were knowledgeable about legal status, biology and behavior of beavers and their multiple impact on nature and ecosystem services even though in two of the three landscapes beavers only reappeared 5–10 years ago. Perceptions included mostly negative impacts on provisioning services, while both negative and positive impacts on regulating and cultural services were perceived, including some contradictory impacts of the species. In spite of the actual and anticipated potential future harms caused by beavers, most people appreciated its precise building mastery and 'cute' nature. While evaluating harms and benefits, both real and potential impacts came up, and informants presumed that beavers influence other people's lives more negatively than their own. Locals did not recognize the conservational benefits of beavers in their personal life. We argue that communication between nature conservationists and locals should reflect this complexity of perceptions, while reciprocal learning could help to mitigate local conflicts and develop adaptive management strategies.

Keywords: local perceptions, ecosystem services, ambivalences, local knowledge, 'adorable nuisance'.

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THE IMPACTS OF RE-INTRODUCED BEAVERS ON STREAM WATER QUALITY IN SOUTHWEST ENGLAND: A MULTI-SITE STUDY

Gareth Bradbury[1]✉, Alan Puttock[2], Gemma Coxon[2], Stewart Clarke[3]

Abstract

Beavers slow water flow through dam building and create diverse wetland environments, encompassing highly ecologically productive zones and deeper oxygen-limited areas with anaerobic pathways. This has the potential to help improve water quality through the settling out of solids and uptake and cycling of nutrients. Opposing this is the periodic release of solids and nutrients due to burrow and canal excavations, dam breaches and nutrient excreta from the beavers themselves and the diverse fauna supported in their wetlands. This study uses regular water grab sampling upstream and downstream of three beaver sites across two years to assess balances of suspended solids, nitrogen, carbon and phosphorus. Sediment dynamics are also revealed through the use of sonar monitoring in ponds and continuous in-situ turbidity sensor measurements upstream and downstream. Results from the first year of monitoring are presented, including intra-site switching of source and sink states and inter-site variability..

Keywords: beaver, pond, sediment, eutrophication, pollution, nitrogen, phosphorus, carbon.

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ABSTRACTS

SESSIONS II

Beaver Management and Policy

DEVELOPING UNDERSTANDING OF THE HYDROLOGICAL IMPACTS OF BEAVER REINTRODUCTION IN GREAT BRITAIN

Alan Puttock[1]✉, Hugh Graham[1] and Richard Brazier[1]

Abstract

Hydrological extremes such as floods and droughts pose a significant environmental and societal risk globally. Across Europe this threat is exacerbated by the intensive management of our anthropogenic landscapes and is expected to increase with climate change. In the face of these hydrological extremes the value of landscape restoration to create more resilient environments and provide a host of nature-based solutions for people and nature is increasingly being recognised. Beavers are considered ecosystem engineers and can profoundly alter ecosystem structure and hydrological function through their engineering activity, which particularly via the building of dams, ponds and canals can create complex wetland environments. The creation of wetlands as beavers return to our landscapes could have major impacts upon flow regimes and related water resource management issues. Results will be presented from hydrological monitoring across a range of sites in Great Britain where the Eurasian beaver (*Castor fiber*) has been reintroduced. Analysis will seek to develop our understanding of the hydrological impacts of beavers and determine whether beaver engineering results in flow attenuation across the multiple scales and land uses monitored. Together these monitoring projects aim to form an evidence base for understanding the potential role that beavers could play in multiple benefit, natural process based, water resource management strategies. To inform beaver reintroduction strategies in Great Britain it is also beneficial to understand where beaver damming and wetland creation could occur across our landscapes. A suite of modelling tools will be presented for determining beaver habitat suitability, dam capacity and mapping associated opportunities, which in conjunction with empirical monitoring aims to provide understanding at management and policy relevant scales.

Keywords: beaver wetland creation, flow attenuation, hydrological functioning, water resource management.

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LIVING WITH ABUNDANT BEAVERS FROM SOCIAL AND ECOLOGICAL PERSPECTIVES

Alius Ulevicius[1]✉

Abstract

The history of the current beaver population in Lithuania started after World War II due to natural immigration and deliberate reintroduction mainly from 3-4 relict parental populations. Mixed genetic origin of founders and appropriate environment conditions probably caused the relatively fast growth of the beaver population throughout the country. In 13-14 generations beavers spread over a 65 thousand square km area in Lithuania. In the last two decades, beaver numbers have stabilised at approximately 80 thousand individuals. The increasing beaver density has led to closer contacts with humans. The initial fascination with beavers and their activities has in many areas of Lithuania changed to negative attitudes towards this keystone species. During the Soviet era approximately 80%of the natural hydrographical network in Lithuania was converted into drainage channels and many farmers in Lithuania depend on the proper function of these drainage systems. However, these systems are also preferred habitats of beavers. The Damming activity of beavers modify drainage channels into broad wetlands, which significantly impact their draining function and negatively impacts farming activity. While this is the main conflict between beavers and local agricultural communities, it also creates a broader conflict between agriculture and nature protection/renaturalization stakeholders. Since beavers act as a renaturalization agent of the anthropogenic drainage network and wetlands created by beavers now form a significant proportion of wetland ecosystems Lithuania the challenge is how to balance the needs of agriculture with the ecosystem functions provided by beavers. Here I discuss the conflicts between beavers and humans in Lithuania, as well as potential management options designed to mitigate these conflicts while at the same time encouraging the benefits of beaver ecology to the environment.

Keywords: beaver, social perspectives, ecologycal perspectives, coexistence.

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INTRUDER OR RESOURCE? A BIBLIOMETRIC ANALYSIS OF METHODS AND APPROACHES IN THE CONTEXT OF BEAVER MANAGEMENT

Anna Treves[1]✉ and Elena Comino[1]

Abstract

Beavers play a very important role in nature as ecosystem engineers, transforming the environment and creating new habitats. However, in a human modified environment, beaver activities often clash with human activities, creating conflicts that require management. Beavers are thus compared to intruders (invasive species) and their positive environmental impacts are not recognized. In this context, it is important to evaluate how many studies consider beavers and related-species as a resource and not a problem. Our paper aims to answer this question by investigating models, methods and approaches applied in the context of the beaver. In particular, we focus on the methods applied to evaluate current and future distribution, possible effects or conflicts, type of management approach and purposes (i.e. conservation, conflict management or ecological restoration). The analysis was conducted by a systematic review of the literature coupled with a bibliometric approach. The bibliometric approach was performed with the software VOSviewer and the web-interface for bibliometrix Biblioshiny. The data were collected from the Scopus and Web of Science databases using several keywords such as beaver, management, conservation, model distribution, restoration, etc. The preliminary results give an overview of approaches and methods currently at the base of the definition of beaver management strategies, classifying them according to target subject (Eurasian or North American beaver), year of publication, number of citations, country of application. Moreover, the most popular methods were identified creating chronological and thematic maps. The final result will allow us to identify how frequently beavers have been managed as a tool for freshwater ecosystem restoration.

Keywords: human-beaver interaction, management approaches, literature review, freshwater ecosystem, ecosystem engineers .

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RENEWED COEXISTENCE: LEARNING TO LIVE WITH REINTRODUCED BEAVERS IN ENGLAND

Roger Auster[1]✉ and Richard Brazier[1]

Abstract

Beavers are being reintroduced to England following a 400-year absence. Since they were last in the country, English people have come to know and modify a landscape in which beavers have been absent. As they return and their populations grow, beavers will be a "new" presence in the area for the humans who live there today. As such, local people may be unfamiliar with the species, including having little knowledge about the animal's behaviour, possible impacts, available management, and how to coexist. As the beaver population grows therefore, humans will be undergoing a learning process and adapting management frameworks as they come to understand what it means to live alongside beavers in the modern day. This talk will present findings from a suite of social research on the interactions between humans and beavers in a context where they are being reintroduced. Using England as a case study, it will discuss some of the challenges to overcome and opportunities to be had as humans and beavers learn to live alongside one another in 21st century Europe. The talk will then conclude by introducing the concept of Renewed Coexistence; a process of coexistence between humans and reintroduced species (Auster et al., 2022).

Keywords: coexistence, engagement, renewed coexistence, reintroduction, social science .

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AN EARLY PERSPECTIVE OF BEAVER REINTRODUCTION IN ENGLAND

Claire V. Howe[1]✉, Delphine Pouget[2] and Elly Andison[3]

Abstract

The Eurasian beaver (*Castor fiber*) became extinct in England around the 16th century. The first release of beavers into an outdoor fenced enclosure occurred in the early 2000s and since then releases into enclosures have taken place at a further 35 sites. A five-year trial was authorised in 2015 to observe and monitor beavers that had been living in the wild in south-west England and explore the prospect of a formal England-wide reintroduction. Escapes from enclosures as well as unlawful releases (releases into the wild without a licence) have resulted in at least five and possibly six wild-living beaver populations in England. Following the success of the trial and a growing interest in beaver reintroduction, the English government conducted a consultation seeking public and stakeholder views on further reintroductions, putting forward options to promote coexistence and manage any future challenges. The outcome of this is still to be published, however the government is looking positively at further releases into the wild. Building on experiences across Europe, Natural England (the government's advisor on the natural environment) has been working collaboratively with the Environment Agency (regulator, operator and advisor with a significant role for rivers and wetlands) and a range of stakeholders to develop measures to support and facilitate the reintroduction of beavers in England. Our objectives are to promote beaver reintroduction in a way that supports the re-establishment of lost natural ecosystem processes, whilst balancing the risks and conflicts that can arise. In this presentation we talk about the steps we are taking to help people live alongside this formerly native species and how we plan to engage with other countries to build best practice guidelines for living with beavers.

Keywords: beaver reintroduction, coexistence, human-beaver interaction.

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INITIAL ASSESSMENT OF BEAVER DAMAGES IN THE OLT RIVER BASIN

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Abstract

The modern history of the beaver in Romania began with the repopulation of this species in three hydrographic basins (Olt, Mureş and Ialomiţa), which took place at the end of the 20th century. After a period of accommodation in which there were very few reports of the presence of the species, along with the numerical growth of the population, the inherent problems also began. This article aims to initiate a periodic inventory of the damage produced by Eurasian beaver, to highlight on the one hand the trend of this phenomenon, and on the other hand, the degree of acceptance shown by the local population towards the species. Since the complete inventory of damages requires a great financial and human effort, the survey method was chosen. The surface of the Olt hydrographic basin was divided into squares of 5x5 km (25km^2), which were intersected with the hydrographic network. The main course and the tributaries up to degree III were taken into account, manually removing the squares where the hydrographic network had too little coverage and were not considered relevant for the study. Finally, 20% of the total of 325 squares were used resulting in 65 sample areas. Questionnaires were used to collect the data, but field trips were also carried out in the period 2012-2014. In order to quantify the level of damage, data was collected regarding the cultivated species, the development phase, the period of the year in which damage was recorded, the affected surface, the number of woody species, the estimated value of the damage, etc. The application of the questionnaires at the level of Town Hall Meetings revealed a relatively low interest in the species considering that the percentage of unanswered questionnaires was between 57.1 and 100%, with a higher weight for the counties of Sibiu and Vâlcea located at the extreme of the species' range. From the point of view of the level of damage, more than 65.7% of those surveyed declared that the damage is insignificant or low, 18.6% found average damage and only 12.9% considered the damage significant and very significant. About 3% were unanswered questions. Most of the damage was recorded to agricultural crops (70%), 13% were included in the category of damage to banks, dikes, roads, 10% flooded lands, 6% forest trees and 1% fruit trees. In terms of value, 85% of the damages were in the category <50 RON (~10€), 11% in the category 50-250 RON (~10-50€), and only 4% of the damages had values over 250 RON (>50€).

Keywords: beaver damage, human acceptance, Eurasian beaver.

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„I AM CURIOUS…" PATHWAYS OF LOCAL ECOLOGICAL KNOWLEDGE-ACQUISITION ABOUT A RECENTLY REINTRODUCED SALIENT SPECIES, THE EURASIAN BEAVER

Babai Dániel[1]✉, Ulicsni Viktor[2], Bede-Fazekas Ákos[2,3], Biró Marianna[2], Juhász Erika[4], Molnár Zsolt[2]

Abstract

As an ecosystem engineer, the Eurasian beaver (*Castor fiber*) has a significant impact on the landscape and its ecosystem services. The drastic changes created by beaver activities in the environment draws the attention of scientists to acknowledge local understandings of these changes. However, we know little about the local knowledge acquisition pathways related to changing landscapes. We studied landscapes where the local ecological knowledge related to the Eurasian beaver was already lost by the 20th century and only has been developing recently. We made 90 semi-structured interviews in three regions of the Carpathian Basin (in Hungary and in Romania) about the local ecological knowledge of the beaver, and systematically gathered spontaneous statements about pathways of knowledge acquisition. We investigated how the appearance of the beaver in a landscape activates pathways of knowledge acquisition. We found 1253 spontaneous statements about the beaver, where participants indicated how information was acquired. The most important pathways of knowledge acquisition were personal observation, inductive reasoning based on existing knowledge, and the communal institution of narrative knowledge sharing (rumour) which homogenised local knowledge. Although the three studied regions were different in character, the proportions of different athways of knowledge acquisition did not differ significantly. Even the general experience about the environment and the economic personal involvement had no mpact on the patterns of different knowledge-acquisition pathways. Interestingly, non-local sources (newspapers, TV, internet) played a subordinate role. Our results suggest that beavers triggered an intensive everyday discourse, knowledge acquisition, and sharing of ecological knowledge in rural communities. These patterns should be taken into consideration in social debates on the beaver. These mechanisms help local communities adapt to the challenges of living in close contact with species with as high an impact as that of the beaver and inform nature conservation about the importance of proper communication to develop collaboration with local communities.

Keywords: knowledge-acquisition, personal observation, knowledge-sharing, Eurasian beaver, Central-Europe.

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THE ACTION PLAN FOR BEAVER (*CASTOR FIBER*) POPULATION CONSERVATION IN ROMANIA

Georgeta Ionescu[1]✉, Claudiu Pasca[1,2], Alexandru Gridan[1], Ramon Jurj[1], Mihai Fedorca[1,2], Ancuta Fedorca[1,2]

Abstract

The action plan for the conservation of the beaver population in Romania is a document that is complementary to the "Set of Management Measures" developed in 2015, within the POIM CLMAN Project: "Elaboration of management measures sets, at national level, for Castor fiber, Lutra lutra and Mustela lutreola species ". The action plan was conceived as a concise and operative document, created with a view to apply a sustainable management of this species by the institutions/ organizations with responsibilities in the field. It ensures the application of the provisions of the international conventions to which Romania is a signing party, including guides and recommendations regarding the conservation of beaver populations at the European level, taking into account the current legislative and the administrative framework and the actual social context in Romania.The action plan is a flexible document, structured on 4 objectives and 17 activities, which should be reviewed periodically and adapted in such a way as to ensure the achievement of the purpose for which it was designed and respond to the wider context of the objectives at the European level.

Keywords: beaver, action plan, management, measuring.

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ARTIFICIAL BEAVER LODGES - AN UNDERESTIMATED TOOL TO MITIGATE HUMAN-BEAVER-CONFLICTS

Niels Hahn[1]✉, Stephan Frei[2], Simone Foltyn[2], Timo Skorzak[3]

Abstract

Due to adaptive wildlife management approaches the co-existence of beavers and humans in modern times usually goes smoothly. Nevertheless, the beavers' activities in human dominated landscapes can cause a whole bunch of known conflicts. Implemented beaver management systems like in the federate state of Baden-Württemberg (South-West Germany), have well-filled toolboxes to react on and solve human-beaver-conflicts. We describe a problem solution of a long-lasting (> 10-years) beaver conflict in the terrain of a timber industry company. The resident beaver family built their natural bank lodge in the dam of a rainwater retention basin which flanks a small creek. The beavers perforated the dam to such an extent, that the functionality of the hydraulic facility was no longer in use because creek-water filled up the retention basin. Therefore, eliminating the beaver territory was the main solution discussed between the involved stakeholders. Instead, weighing up the pros and cons, we decided to keep the beavers in their territory by providing two differently constructed artificial beaver lodges before destroying the original one and repairing the perforated dam of the retention basin. Both artificial lodges were monitored with inside installed wildlife cameras taking three sequenced single pictures and 10-15-second-long videos after each detected motion. The set-up of the unsystematic surveillance since October 2020 allowed us to compare the acceptance and usage of both types of artificial lodges. We counted the number of beavers in each of the lodges and calculated the usage-frequency. The video sequences were used to compile ethograms which gave an insight of the beavers' behavior in the artificial lodges. Among observed other vertebrates using the artificial lodges, the interaction between beavers and muskrats was analyzed too. By comparing both of our constructions and considering available other experiences we conclude that artificial beaver lodges can be a future-tool to mitigate human-beaver conflicts.

Keywords: human-beaver-conflict, artificial beaver lodge, management tool, monitoring, camera trapping.

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BEAVERS AND HUMANS AS BOUNDARY BUILDERS AND BREAKERS

Inge Dekker[1]✉

Abstract

This multispecies ethnography explores the developing beaver-human entanglements along the southern Dommel river basin. It analyses how valuation studies are helpful for understanding the complexity of multispecies water infrastructures. Building on Heuts and Mol's (2013) suggestion to perceive valuing as a practice, I trace perspectives on and practices of caring for a 'good river'. Dutch water management has been undergoing a paradigm shift in the past thirty years. The river is not only perceived as a sociotechnical infrastructure serving human needs, but became recognized as a link in the 'nature network' and as habitat. Along the Dommel, multiple river restoration projects emerged to improve biodiversity and water quality and storage. The first beaver in the Dommel river basin was observed seven years ago, and slowly but surely the population is expanding as they construct homes in the very waterscape from which their conspecifics were eradicated 300 years ago. These descendants of reintroduced families in Belgium and the Netherlands now spread to unforeseen places. With the recent arrival of beavers, another layer of complexity is added to the already changing water management. Beavers, as ecosystem engineers, are able to change the water infrastructure by damming, digging and tree felling. Do their practices indicate what is a 'good river' to them? Various surveillance activities trace the signs beavers leave in the landscape. Then changes made by beavers are mitigated by planting trees, making space, placing gauze, pipes and sometimes lethal control. Beaver activities are sometimes seen as undermining the human ideas of a 'good river'; waterbodies that consist of stable levees and relatively constant water levels. Multiple, seemingly contradictory, practices are currently experimented with and left in tension as we are learning to live together. This research illustrates how beavers challenge the appropriateness of current human valuing practices caring for the 'good river'.

Keywords: multispecies infrastructure, valuing, mediation, ethnography.

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THE BEAVER MANAGEMENT IN THE CZECH REPUBLIC

Jitka Uhlíková[1]✉

Abstract

The Eurasian beaver has been returning to the Czech Republic since the end of the 1980s. With the increased distribution of this conflict species, arose the need for the preparation of a Beaver Management Plan, which the Ministry of Environment adopted in 2013. It is a set of protective, management, legislative, and educational measures providing the management of this species. The plan's main objective is to ensure the existence of a viable population of the Eurasian beaver in the Czech Republic while reducing the amount of damage caused by beavers. After 9 years of implementing the management plan, also due to the increasing number of beavers, it is necessary to update it with the following strategy: to prevent and reduce beaver damages to water works and create living space for beavers, while still maintaining the positive impact of their dams on biodiversity, on ecomorphological river habitat quality, and water retention in the landscape. The main shortcomings of current beaver management are insufficient public relations, insufficient support and application of preventive measures, sporadic testing of technical measures for reducing damage, and frequent removal of conflict dams due to the absence of financial and administrative tools that would allow them to be sustained. More information about the management plan is available on its website http://www.zachranneprogramy.cz.

Keywords: beaver, management plan, implementation, the Czech Republic.

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SCOTLAND'S BEAVER STRATEGY 2022-2045 - FINDING A WAY FORWARD

Martin Gaywood[1]✉ and Jamie Copsey[2]

Abstract

Scotland's Beaver Strategy 2022-2045 sets out a route map for action over the coming decades. Its development involved more than 50 organisations from across government and non-government bodies, and land management, environmental, and other sectors, using an approach facilitated by the IUCN SSC Conservation Planning and Specialist Group (CPSG). This ambitious and forward-looking approach to managing and restoring a species is one of the first of its kind in Britain. The reintroduction of the Eurasian beaver (*Castor fiber*) to Scotland has been a major topic of debate since the mid-1990s. Initial assessments of feasibility and desirability were eventually followed by a trial reintroduction in Knapdale, Argyll in 2009, the first licensed reintroduction of a mammalian species in Britain. In the meantime, there were increasing numbers of reports of beavers in Tayside, resulting from accidental or unauthorised releases. Following the production of the 'Beavers in Scotland' report to the Scottish Government in 2015, and the launch of a Beaver Management Framework, beavers became a European Protected Species in 2019. However, translocations to Scottish sites outside Tayside and Knapdale were not permitted. This changed in November 2021 when the Scottish Government announced support for wider beaver restoration. Throughout this time views and experiences have differed markedly between stakeholders. Many beaver supporters have highlighted the benefits they can bring, with aspirations for wider restoration. Others have voiced their concerns over the impacts of beaver activities on certain land uses, conservation interests and fisheries. The production of Scotland's Beaver Strategy, 'owned' by the stakeholders, is therefore timely and necessary. It draws on research and our experiences of living with beavers and reflects the aspirations and concerns of stakeholders as wider restoration begins.

Keywords: Eurasian beaver, *Castor fiber*, Scotland, strategy, conservation, management, translocation, stakeholder, engagement, consensus.

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BEAVER IN BUFFER ZONES OF WETLANDS

Olgirda Belova[1]✉

Abstract

Once abundant and protected since the 16th century (Grand Duchy of Lithuania, 1st Statute, 1529), the Eurasian beaver, Castor fiber L. was almost completely eradicated in Lithuania. Thanks to further legal protection and targeted conservation measures like hunting restriction, reintroduction, translocation, natural recolonization, water protection, habitat restoration etc., the beaver is an example of successful species restoration and are presently spread widely throughout Lithuania. While the return of the beaver to Lithuania is an ecological success story, some landowners and foresters consider the beaver a problematic species because their building and foraging activities may negatively impact agriculture and forestry. However, beavers' impact on the wetland environment is multifunctional and provides benefits for biodiversity, species distribution and welfare. The aim of this study is to document the beaver's role in wetland buffer zones, which are vital in the prevention of anthropogenic pollution. We sampled the beaver population in three areas using non-lethal, unbaited barbed wire traps deployed 1-2 m from the water edge in active wetland buffer zone sites. Our pilot study found that beaver dams act as filters of nutrients and heavy metals like lead. Because of this the beaver activity could be considered a bioindicator in wetland buffer zones especially when considering the ages of dams. Dams serve as specific sponges reflecting the environmental health of wetlands and can be useful for bioassessment.

Keywords: *Castor fiber* L., wetland, buffer, dam age, bioassesment.

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POPULATION DEVELOPMENT AND MANAGEMENT OF BEAVERS IN SCOTLAND TO PRESENT

Roo Campbell[1]✉, Roisin Campbell-Palmer[2], Jenny Bryce[3], Martin Gaywood[3]

Abstract

Beavers in Scotland consists of three unconnected populations: Knapdale in Argyll (founded from an official release of 33 animals between 2009 and 2020), Tayside (from escapes or unauthorised releases in the early 2000s), and on the river Beauly/Glass near Inverness (likely from escapes in the 2010s). The Tayside population represents ~95% of the Scottish total, which is the focus this presentation. Three surveys have been undertaken since 2012, involving the mapping of beaver activity signs to estimate the distribution of beaver family territories. From 2012 to 2017-2018, the number of territories in Tayside increased by 24% per annum. From 2017-2018 to 2020-2021, the rate of increase was 30% per annum, with the 2020-2021 count of territories totalling 251. These increases were matched with an expansion in range and the establishment of beavers in the River Forth catchment. Since 2019, data are available on the numbers of beavers removed from Tayside under licence through shooting or live-capture for translocation. From 2019 to 2021, 289 beavers were shot and 84 trapped, with an increase in the proportion trapped vs shot in each year from 17% to 28%. Removals in 2019 and 2020 were compared to the changes in the numbers of territories in river sections. In both years ~12% of territories were affected by removal with 14-15% of the estimated population taken, but this exceeded 25% in several river sections. However there was little evidence that this resulted in the loss of territories or a reduction in the local population. Indeed, the rate of increase in the number of territories in each river section correlated positively with the number of beavers removed per territory. The reasons for this association are discussed. Overall, the Tayside population appears robust and will continue as an important source population for translocations elsewhere throughout Britain.

Keywords: beaver, *Castor fiber*, monitoring, translocation, control, cull, trapping, population viability.

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CASTOR CONTROLLED THE CHESAPEAKE BAY IN NORTH AMERICA: USING HISTORICAL EVIDENCE FROM THE FUR TRADE TO INFER CASTOR CANADENSIS DISTRIBUTION, DENSITY, AND ECOLOGICAL INFLUENCE WITHIN THE CHESAPEAKE BAY WATERSHED

Scott McGill[1]✉

Abstract

The first Europeans to explore the Chesapeake Bay environs were not as interested in colonizing as they were trading with Indigenous tribes for furs. Through alliances created by mutual self-interest with Indigenous tribes, early Europeans, including members of the Jamestown colony in Virginia, made the long overdue forays into the Chesapeake in the early 1620's. In 1631, English trading posts were established on Kent and Palmer islands, and trading of furs on the Chesapeake entered its brief heyday. Through intercultural relationships, the fur trade united Europeans and native tribes, and pitted Europeans against one another because of competition for furs and trading relationships, as well as territory. Throughout the 1630's, many thousands of beaver fur were traded and sent back to Europe to supply raw materials for the burgeoning hat industry. Early promotional materials for Maryland tracts of land featured enticing descriptions of the fur trade. Historical evidence can by inference lead one back into the landscape of the Chesapeake watershed as it was in the 1630's. All indications point to beaver as the dominant hydrologic force that controlled the Chesapeake Bay watershed and all its major tributaries. Combined with geologic evidence, history paints a picture of the riparian landscape in which beaver meadows and "stage zero" valley morphology were dominant, while riffle pool single thread channels were not as prevalent as they are in the present day. Using history as a guide for restoration, nature-based approaches are gaining favor in the Eastern United States, and beavers are becoming a major component of long-term restoration strategies, replacing invasive diesel heavy land grading approaches.

Keywords: beaver dam analogue, water quality, Chesapeake Bay, stream restoration, wetland restoration, trophic cascade, flood reduction.

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KEEPING THE NETHERLANDS DRY; MITIGATING CONFLICTS WITH BEAVERS

Vilmar Dijkstra[1]✉

Abstract

Beavers went extinct in the Netherlands in 1826. In 1988 reintroductions started and currently about 5.000 – 6.000 individuals are present in the country. While one stimulus for beaver reintroductions may have been that beavers ”just belong” in a wet country like the Netherlands, reintroductions were initiated because the beaver is an important wetland ecosystem engineer and a keystone species for wetland biodiversity. It is important that such a species is part of Dutch ecosystems. The success of the beaver reintroductions in a small, low lying (one-third is beneath sea level), densely populated (17,5 million, 425/km²) country, is creating new challenges. It is important to balance the positive ecosystem functions provided by beavers, keep the public informed and favourable towards beavers and mitigate potential damage caused by beaver activity. The Dutch Mammal Society (DMS) is cooperating with several organisations to find solutions and develop new methods for education, prevention and mitigation measures. In 2021 the Dutch ‘Knowledge Centre Beavers’ started as a website (www.kenniscentrumbever.nl). The main goal is to inform the public and organisations about beavers and provide the latest knowledge about solving problems associated with beavers. One of the biggest issues in The Netherlands is beavers digging/burrowing in dykes: The Netherlands has 3.600 km of primary dykes and 14.000 km of regional dykes. A new initiative is to develop high water refuges in floodplains in the form of ground hills (old school), floating devices or incorporated into the dyke. Partners in this project are the (regional) water authorities and Dutch Railways. The DMS is increasingly more involved in advising in projects about beaver policy and projects in the field where beavers may cause significant damage, like improvement of dykes, roads and railways. Furthermore, innovative projects and landscape risk analyses are undertaken to mitigate conflicts with beavers. The ultimate goal of the DMS is to develop perspectives to handle beaver issues and in that way create a sustainable beaver population.

Keywords: beaver, social perspectives, beaver conflicts, coexistencey.

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ABSTRACTS

SESSION III

Beaver Biology and Ecology

MAMMALS IN BEAVER BURROWS: EFFECT OF METEOROLOGICAL CONDITION AND LUNAR PHASES

Arūnas Samas[1]✉, Tiškutė D., Rutkauskas D., Ulevičius A.

Abstract

Under optimal water body structure, burrows are the main constructions made by beavers. The majority of burrows in a beaver site are used temporarily as transitory shelters between feeding periods during the warm season(s) and are rarely used in winter. Often beaver burrows collapse and are not rebuilt. Nevertheless, all beaver burrows, both intact and collapsed, may be used by a wide spectrum of animal species, from invertebrates to mammals. Our study focuses on correlations between outside temperatures, precipitation and activity of mammals in beaver burrows. The attractiveness of beaver burrows to mammal species depends on specific life history requirements. Burrows are often used as overnight or over-winter shelters, hunting and feeding sites and cub protection places. One of the most important factors determining the significance of beaver burrows to other species is the microclimate inside a burrow. We found that the temperature inside the beaver burrow strongly correlated with the air temperature both in warm and cold seasons but was milder than the outside temperature. In winter, temperatures inside burrows was higher than outside temperatures and it never dropped below -10°C, even when temperatures outside the burrow were below -20°C. In summer, temperatures inside burrows were significantly lower than temperatures outside and never exceeded 20°C. With the decrease of outside temperatures in winter, the usage of burrows increased and peaked when temperatures were between -2 to 0°C. In summer mammals used burrows more actively when the temperature inside the burrow was between 12 to 16 °C.

Keywords: beaver, meteorological effect, lunar phases, beaver burrows.

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GENETIC STRUCTURE OF EURASIAN BEAVER IN ROMANIA: INSIGHTS AFTER TWO DECADES FROM REINTRODUCTION

Ancuta Fedorca[1,2], Elena Ciocirlan[2], Claudiu Pasca[1,2], Mihai Fedorca[1,2], Alexandru Gridan[1], Georgeta Ionescu[1]✉

Abstract

Once exploited for fur, meat, and extracting the yellowish exudate called castoreum, the Eurasian beaver disappeared from Romania during the 18th century. After the reintroductions carried out two decades ago beavers are currently thriving in the Danube River basin. Using nine nSSR markers we analysed samples from 98 individuals, and we found no genetic substructure, suggesting high dispersal and gene flow capabilities. The stepwise mutation model (SMM) indicated the existence of a recent genetic bottleneck, though the Eurasian beaver retains high levels of genetic diversity and population growth facilitated variation in nSSR loci. A fine-scale spatial correlation in females was detected, contrasting with males' dispersing longer distances. While the movement and establishment of individuals' new territories were made under natural predation pressure, the mix following natural expansion improved fitness and could contribute to a higher genetic diversity than the source population. With any reintroduction, a focus on capturing individuals from various geographic origins, as well as securing many suitable founding individuals (adults, subadults and juveniles) with mixed origins could secure the post-genetic bottleneck recovery and higher genetic diversity. Beyond this conservation success, future management strategies should consider building a National Action Plan (NAP) for the species, including a permanent genetic monitoring programme for Eurasian beaver.

Keywords: population, reintroduction, evolutionary, gene flow.

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DISEASE SURVEILLANCE OF FREE-LIVING EURASIAN BEAVERS (*CASTOR FIBER*) IN ENGLAND

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Abstract

The Eurasian beaver (*Castor fiber*) is thought to have become extinct in England in the 16th century, although currently up to six wild, free-living populations currently exist because of authorised and unauthorised releases. A five-year trial was authorised in 2015 to observe and monitor one population that had been living in the wild in south-west England. Following the success of the trial alongside growing interest in beaver reintroduction, a government-led consultation was launched seeking views on further reintroductions of this species in England and the management of the species in the wild. To inform decision making and disease risk management for future releases, a disease surveillance programme for free-living wild beavers found dead in England has commenced, as the source and health status of existing populations is unknown. The aim of this work is to improve understanding of beaver health in England and conservation outcomes. To date, detailed post-mortem examinations have been performed on eight beavers. Gross and microscopic examinations plus allied diagnostic tests were used to diagnose disease and investigate aetiology. Samples collected during pathological examinations were tested for hazards previously identified by the disease risk analysis as of possible risk to the beavers, native populations of rodents, native populations of other mammals, livestock, humans in contact with beavers and the general human population in England. Moreover, disease surveillance aimed to identify novel parasites of beavers which might require consideration as a hazard to future translocations. Results of tests for the detection of zoonotic parasites such as Echinococcus multilocularis, Francisella tularensis, Brucella spp., Giardia spp., Trichinella spp., hantaviruses and Taenia spp. have been negative. Five suspected deaths by road traffic collision have been identified which has highlighted the risk that road traffic collisions represent to released beaver populations, with requirement for management in the future.

Keywords: disease surveillance, England, Eurasian beaver, free-living, reintroduction, parasites.

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LEVEL PONDS: ALTERNATIVE BEAVER MANAGEMENT AND AQUATIC MACROINVERTEBRATE BIODIVERSITY

Glynnis A. Hood[1]✉, Anne C.S. McIntosh, and Glen T. Hvenegaard[1]

Abstract

Increasingly, pond levellers are recognized as a cost-effective tool to counter flooding by beavers, while still maintaining water levels in beaver-modified wetlands. Yet, little is known about their impacts on wetland biodiversity, including resultant effects on aquatic macroinvertebrates. Macroinvertebrates are important ecological indicators and drive ecosystem function through processing of organic matter and serving as important prey species. Immediately before and exactly one year after installing ten pond levellers in east-central Alberta, Canada, we sampled aquatic macroinvertebrate communities among four within-pond habitat types (beaver channel, beaver lodge, open water, vegetated edge). Then we analyzed several measures of invertebrate biodiversity (e.g., Shannon index, evenness, species richness, and density) and community composition (including functional feeding groups). Counter to our hypotheses, there were no differences in any biodiversity measures for macroinvertebrates pre- and post-installation. However, omnivores decreased one-year post-installation, while shredders increased. There was no difference in macroinvertebrate use of within-pond habitats, and water chemistry measures were the same regardless of year. Management actions related to flooding by beavers often result in regular draining of wetlands, despite associated consequences for aquatic biodiversity. We suggest that the more stable pond levels created by pond-levelling devices do not change macroinvertebrate biodiversity in notable ways. Pond levellers provide economic and ecological benefits, while still managing human-beaver interactions.

Keywords: beaver, management tool, alternative management, pond levellers, aquatic macroinvertebrates

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DOES SAP FLOW IN TREES INFLUENCE SPECIES SELECTION AND AUTUMN FOOD CACHING?

Peter Busher [1]✉

Abstract

Why do beavers select specific tree species during autumn tree cutting and food caching? Many potential hypotheses have been suggested: Beavers cut and cache the most available trees; Beavers cut and cache based on time minimization/energy maximization strategies (optimal foraging models); Beavers cut and cache trees based on a size distance relationship (central place foraging models). Ultimately, beaver tree selection depends on specific habitat characteristics, specific tree species availability, the availability of other woody species (shrubs) and the presence of palatable aquatics. No study to date has examined the relationship between tree selection, storage in the food cache and sap flow (movement of nutrients in sap within a tree). From 2020 – 2021 data on sap flow in selected tree species cut by beavers was collected to test the general hypothesis that beavers select tree species based on sap flow and store these species most often in the food cache. Preliminary data suggest that the single tree species most often cut and stored, Betula lenta (black birch or sweet birch), has consistently higher sap flow than other tree species observed in the food cache (red maple, white oak, white pine). These data provide further insight into how beavers make foraging decisions during the critical autumn cutting and food storage period and suggest a new line of research to better understand beaver foraging behavior.

Keywords: foraging, tree selection, sap flow, food caching.

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FORAGING STRATEGY AND IMPACT OF THE EURASIAN BEAVER IN FLOODPLAINS THREATENED BY INVASIVE WOODY SPECIES

Erika Juhász[1,2]✉, Ákos Bede-Fazekas[1,3], Krisztián Katona[4], Zsolt Molnár[1], Marianna Biró[1]

Abstract

The Eurasian beaver can exert a significant impact on the species composition and structure of woody vegetation. The Habitat Directive of the European Union protects both the ecosystem engineer species (Annex II and IV) and the softwood gallery forests (Annex I). These floodplain forests are threatened by the rapid spread of invasive woody species. Understanding the foraging strategy of beavers, as one of the drivers of vegetation change, has a paramount importance in this environment. The beavers' foraging decisions were examined in the Danube water catchment area, Hungary, at 20 study sites located along six rivers. We collected data about the available and utilized woody plant units (trunks and branches) in two transects per site parallel to the watercourse. During the surveys, we registered taxon, trunk diameter, and type of utilization. Beavers generally preferred softwood species (*Salix* spp. and *Populus* spp.) over invasive hardwood species (*Acer negundo*, *Fraxinus pennsylvanica*, and *Amorpha fruticosa*) and thin units against thicker ones. Foraging intensity was lower, while the taxon and diameter selectivity were stronger in greater distance from the water, reflecting beavers' central-place foraging strategy. Units with greater diameter were carved or debarked rather than felled. Invasive species were usually released from foraging by beavers after reaching a thickness of ~13 cm, while even the thickest softwood trees were utilized.Selective foraging has a larger direct impact on softwoods than on invasive species. However, the response of the vegetation will depend also on the survival and renewal of the utilized trees, as well as the species composition of the recruitment layer. Only the reconstruction of degraded floodplain habitats could create more favourable hydrological conditions for native softwoods. High levels of beaver disturbance make these reconstruction projects even more urgent on continental scale.

Keywords: selective foraging, ecological effect, conservation conflict, invasion ecology, alluvial forest.

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ABSTRACTS

POSTER SESSION

HABITATS AND MACROZOOBENTHOS IN BEAVER-INFLUENCED LOW MOUNTAIN STREAMS WITH SPECIAL FOCUS ON BEAVER DAMS

Sara Schloemer [1]✉ and Daniel Hering

Abstract

Beavers and their dams, once common in small streams throughout the palearctic zone, are returning to their original range. The resulting beaver ponds, secondary streams, beaver meadows and a large amount of deadwood change and diversify the appearance and biocenosis of the stream ecosystems. We studied how beaver activity affects the invertebrate community during 2018 and 2019 in low order mountain streams in the northern Eifel (NRW), where beavers were reintroduced in 1981. In order to find out which invertebrate communities colonise beaver-induced habitats and how these differ from beaver-uninfluenced stream sections, we investigated lotic and lentic habitats in water stretches with and without beaver influence. Habitats were differentiated by substrate type and flow velocity, and compared in terms of species composition, feeding types and flow preferences. One focus of the study was the beaver dams themselves, which were sampled taking into account their maintenance status. Nine different areas covering the top, middle and base zones of eight maintained and eight abandoned beaver dams (dams that are still present but no longer repaired by the beavers) were sampled using a specially designed suction device. Our results show that the influence of beavers leads to a higher species diversity of the community overall. Especially maintained beaver dams, which offer a great diversity of environmental conditions and habitat types, turned out to be hotspots of biodiversity. Here, taxa community composition reflected higher flow velocities in the middle and lower areas of a dam, where passive filter feeders predominate (e.g., Simulidae, Hydropsychidae, Philopotamidae). The lack of maintenance reduces the flow velocity in abandoned dams, which leads to an increase in trickle areas and thus enables the occurrence also of species using atmospheric oxygen (e.g., Dianous coerulescens). Within the top of a dam, on the other hand, shredders (e.g., representatives of the Limnephilidae), were particularly common.

Keywords: beaver dams, beaver reintroduction, habitat change.

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MODIFICATION AND SPATIAL VARIATION OF RIVERINE NUTRIENT CONCENTRATIONS DUE TO BEAVER DAMMING ACROSS SWITZERLAND

Kaspar Berger[1], Joshua Larsen[2], Christof Angst[3], Cecile Auberson[3], Natalie Ceperley[1,4], Raphael d'Epagnier[1], Christopher Robinson[5], Bettina Schaefli[1,4], Sarah Turnheer[3] and **Annegret Larsen**[6]✉

Abstract

Swiss streams, especially smaller ones, suffer from excess nutrient pollution (BAFU, 2016). In this project, we evaluate how nutrient fluxes are modified by beaver cascades and meadows and their spatial variation across Switzerland. We mobilised a network of volunteers to monitor beavers sites during winter and summer 2021/22. Volunteers sampled upstream and downstream sections of rivers dammed by beavers and we then tested the effects of discharge variability on nutrient concentrations at the times of sampling. This approach reveals how beaver dams modify nutrient loads in rivers and which beaver dam systems are most effective at delivering the important ecosystem service of reducing nutrient loads in low-order streams.Bundesamt fuer Umwelt (BAFU), 2016. Zustand der Schweizer Fliessgewaesser. Umwelt-Zustand. BAFU.

Keywords: beaver, beaver dams, riverine nutrient concentrations.

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THE BEAVER INFLUENCE IN THE SHAPING OF RIPARIAN HABITATS - CASE STUDY IN ROSCI 0415-LUNCA BÂRSEI

Claudiu Pasca[1,2], Popa Marius[1,2], **Georgeta Ionescu[1,2]**✉, George Sîrbu[1,2], Ileana Ionescu[1]

Abstract

The NATURA 2000 ROSCI 0415 Lunca Bârsei site is unique in origin, evolution, hydrological and edaphic characteristics. The area was naturally populated with beavers around 2009 when individuals migrated in stages from the Olt River. The particularly favourable conditions promoted the development of a unique beaver population in Romania, which is why it was proposed as a NATURA 2000 site in the year 2016. Beavers impact the riparian environment by utilising their preferred woody vegetation (willow to the detriment of alder) and by flooding some surfaces and changing soil conditions. Additionally, beavers change the hydrological flow and the water temperature since the presence of dams and the low flow rate facilitates water heating. Green biomass is abundant in open areas, where the trees have low consistency and can reach 31.9 t/ha while it is only 2.9 t/ha in very shady areas. The forest biomass was also heterogeneous, with both primary succession and secondary succession trees present. The anthropogenic impact and/or the cutting of woody vegetation by beavers, in conjunction with rising water levels, has led to changing vegetation conditions that are no longer conducive to many forest species.

Keywords: beaver, restoration, human impact, riparian.

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LARGE MAMMALS AT BEAVER SITES IN THE MIDDLE MOUNTAINS (THE CASE OF SOUTHERN SIBERIA)

Ivan Trenkov[1]✉ and Aleksandr Mishin[2]

Abstract

We analyzed behavioral reactions of large mammals at beaver sites located in taiga midlands in the Reserve "Kuznetsky Alatay" (Southern Siberia, Russia). The research region is 308 – 650 meters above sea level. Typical beaver habitats in the Reserve are small rivers or streams, where beavers can build dams. We used trail cameras to register large mammals visiting the beaver sites. Observations were made at seven beaver ponds during summer period between 2018- and 2019.We registered eight species of mammals (except beavers): elk (*Alces alces*), siberian roe deer (*Capreolus pygargus*), red deer (*Cervus elaphus sibiricus*), brown bear (*Ursus arctos*), sable (*Martes zibellina*), American mink (*Neovison vison*), otter (*Lutra lutra*), and Siberian chipmunk (*Tamias sibiricus*). Elk visited beaver sites usually at nighttime to drink and eat. They stayed for less than two minutes in front of the trail camera. Some elk used beaver ponds during daytime to avoid biting gnats. The quantity of males and females was equal. Roe deer also ate and drank water at beaver sites and this happened more often during daytime. There were more females than males. Brown bears were attracted to beaver sites by the opportunity to prey on beavers. We registered a few bears at the different locations. One of them tried to destroy the beaver lodge (unsuccessfully). The next night beavers started to repair it. A sable visited the beaver lodge three times to leave scent marks. Other mammals were registered only once and did not demonstrate any specific behaviors. Beavers create unique conditions with stagnant water (ponds) in this region where few reservoirs/ponds occur without beavers. The results of our research illustrate the positive effect of beaver engineering activity for ungulates and bears in the middle mountains of Southern Siberia.

Keywords: beaver, *Castor fiber*, keystone species, ecosystem engineering.

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HABITAT USE BY THE NORTHERN WATER SNAKE: ASSOCIATION WITH BEAVER STRUCTURES

Dominic Kemmett and **Peter E. Busher**[1]✉

Abstract

The behavior of the North American beaver (*Castor canadensis*) - principally the construction of dams and lodges – both expands the area and increases the spatial complexity of critical wetland habitat for many amphibians and reptiles including frogs, salamanders, and turtles. However, no study has explored the relationship between beaver habitat and snake abundance and activity. This is basic and critical data since many snake species are considered sensitive and/or endangered. We examined beaver habitat in an urban to semi-urban environment along Sawmill Brook, in the West Roxbury neighborhood of Boston, Massachusetts, USA for the presence of the Northern Water Snake, Nerodia sipedon. We walked two separated 140 m transects (one in an active beaver area and one an inactive area) over a 10-week period from June to August 2019 documenting the presence of snakes and their use of beaver structures. Water snakes were significantly more likely to be encountered on beaver structures in the active site compared to the inactive site and more water snakes were encountered in beaver-influenced habitat following the conclusion of their spring breeding season.

Keywords: beaver structures (dams and lodges), Northern Water Snake, habitat selection

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HOW THE BEAVER (CASTOR FIBER L.) REGULATES LIVING SPACE AND CHANGES HABITAT CONDITIONS - FOR THE BENEFIT OF ONESELF AND OTHERS

Kristijan Tomljanović✉, Marko Vucelja, Linda Bjedov, Marko Augustinović, Marijan Grubešić

Abstract

The role of the beaver, as the greatest builder in nature, is especially evident in the preservation of aquatic and wetland habitats. Today, when many watercourses have been turned into canals and often lined with stone or concrete, it is extremely useful to preserve or create natural wetland habitats, which the beaver does well. In Croatia, with numerous rivers and streams, the increase of the beaver population has resulted in numerous beaver dams and accumulation lakes are formed, which the flora and fauna of wet habitats subsequently re-inhabit. Thousands of dams and dam systems, created in recent years throughout Croatia, have created new habitat conditions, both on natural watercourses and on regulated channels. The beaver demonstrates skill in construction that results the emergence of new deficient ecosystems. The example of one locality, which has been researched and mapped in detail, results in a system of 13 dams, three of which are large, and 10 smaller auxiliary dams. The study area consists of four accumulation lakes and two large beaver lodges. In total, the beavers installed 100 m3 of material. Numerous species of fauna and flora, characteristic of aquatic ecosystems, have been recorded in the lakes. Significant amounts of sediment material in the lakes stand out, which creates a fertile base for wetland vegetation. The importance of the accumulated water in the lakes came to the fore in the summer during the dry season. The constant presence of elevated water levels in the lakes had a negative impact only on older black alder trees, where these trees dried up.

Keywords: beaver, beavers dam, wetland habitats, game species.

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INVESTIGATING THE EURASIAN BEAVER (CASTOR FIBER) AS A BIOLOGICAL INDICATOR OF ECOTOXICOLOGICAL EXPOSURE AND EFFECTS IN ENGLAND

Sophie M. Common[1]✉, Suzane M. Qassim[2], Claire V. Howe[2], Anthony W. Sainsbury[1]

Abstract

There are several known populations of free-living Eurasian beavers (*Castor fiber*) in the South of England and there is currently great interest in reintroducing the species more widely across England. As sedentary and herbivorous aquatic rodents, beavers are of interest as biological indicators of contaminants within freshwater ecosystems. A disease surveillance programme for Eurasian beavers in England is being undertaken by the Disease Risk Analysis and Health Surveillance (DRAHS) team, Zoological Society of London (ZSL), in partnership with Natural England. As part of this programme, detailed post-mortem examinations are performed on free-living beavers found dead in England. This work provides the opportunity to begin building an archive of morphological measurements and tissues which could, in future, aid in investigations of both the levels and adverse effects of contaminants of existing and emerging concern in beavers. However, the understanding of ecotoxicological exposure and effects in beavers is currently limited, particularly in relation to tissue-specific accumulation and the pathological effects of different chemical contaminants. Further information is required to improve our understanding of (i) chemicals of concern which can be detected in beavers, (ii) any adverse effects of these chemicals, and (iii) best practice in post-mortem examination and tissue collection and archiving to maximise the utilization of samples from these animals in the future. This information will, in turn, inform the costs and benefits of developing a contaminant surveillance programme using beavers to gain insight into (i) chemical pathways and lower trophic level mammal exposure, (ii) total body burden of chemicals in beavers, (iii) effects of chemicals on beaver health, and (iv) explore specific measures in beavers that could be compared to other mammalian species of ecotoxicological interest in England.

Keywords: archive, contaminants, ecotoxicology, England, Eurasian beaver, indicator.

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RELATIONSHIPS BETWEEN THE CHEMISTRY OF WATER AND BOTTOM SEDIMENTS IN BEAVER PONDS IN FOREST AREAS IN POLAND

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Abstract

The effects of beaver construction on the environment are well known with both positive and negative effects reported. In forest areas, beavers increase the retention capacity by building dams on watercourses and raise the water level. At the same time, they can cause flooding in tree stands, leading to their death. One of the impacts of beaver construction is the stagnation of water and the accumulation of bottom sediments, which can contribute to the eutrophication of the reservoir. This manuscript presents the results of chemical analyses of water samples and bottom sediments from 20 beaver ponds across Poland. The main objective of the study was to determine the relationship between the content of individual elements in reservoirs and bottom sediments. The chemical analyses were carried out in a certified laboratory for chemistry of the natural environment, which is part of the Polish Forest Research Institute. The focus was on the analysis of the content of heavy metals (Cu, Zn, Pb, Cd) and elements such as Al, Fe, Mn, K, Na, Mg, Ca, N, S, C, P. Statistical analyses were carried out using R.

Keywords: Eurasian beaver, water, bottom sediments, heavy metals.

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DIGGING ACTIVITIES OF BEAVERS AS A POSSIBLE SOLUTION TO BIODIVERSITY CONSERVATION OF SMALL FLOODPLAIN WATER BODIES

Ivan Bashinskiy[1]✉

Abstract

Modern climatic processes, together with the anthropogenic disturbance of the hydrological regime of rivers, lead to the cessation of water exchange of floodplain water bodies with main river channels, which creates significant changes in aquatic communities. Along with the alteration of aquatic ecosystems, in recent decades, there has been a recovery of the population of Eurasian beavers throughout Eurasia. The activities of beavers can cause significant changes in the structural and functional organization of ecosystems, increasing water coverage of the territory, and influencing biodiversity. Therefore, at present, nature-based solutions based on beavers' building activities are actively applied in different parts of the world. In particular, it is a widespread practice to create beaver dam analogues on watercourses. However, similar activities for water bodies and solutions based on beaver digging activities are almost absent. The presence of beavers in small floodplain water bodies can lead to significant changes in ecosystems. Their digging activities alter the shoreline relief and the structure of littoral habitats. Burrows and adjacent depressions of the bed are important habitats for invertebrates, fish, amphibians, and mammals. Beaver activity is known to play an important role for the endangered Russian deman (*Desmana moschata*), which uses the same burrows as the beaver. Beaver-created canals between water bodies improve connectivity and water exchange. All of this together affects the alpha and beta diversity of floodplain water bodies ecosystems. In some cases, digging by beavers increases the hydroperiod by deepening the water bodies, which could affect the metamorphosis of semiaquatic insects and amphibians.New studies are needed to assess the scale of beavers' impact on floodplain water bodies and oxbows, which could help us understand the necessity of developing new nature-based strategies based on beaver activity – not only dams, but other structures and microhabitats.

Keywords: beaver digging, burrows, floodplains, lakes, nature-based solutions

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DIVERSITY OF CONFLICTS GENERATED BY THE EURASIAN BEAVER IN CENTRAL EUROPE

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Abstract

Although the beaver's reintroduction is a success story for nature conservation in Europe, their activities are becoming a source of conflict with relevant stakeholder groups. Based on interviews conducted with nature conservationists and locals residents in the last 10 years in Hungary and Romania, we made an attempt to summarize different types of conflicts generated by this rapidly expanding native species. The goal of this presentation is to initiate discourses about these conflicts and identify possible solutions. Effects causing economic damage and dangerous situations are generally considered human-wildlife conflicts (e.g. felling trees in plantations, crop damage, flooding, and burrowing in dykes). Some of these conflicts are arising as a consequence of changed use of riverine landscapes and ecosystems since the species was extirpated. Additionally, ambivalent and also "internally conflicting" perceptions were recognized as local residents perceive beaver as both cute and harmful at the same time. Local residents admire beavers for their precise building techniques, but are concerned by the damage caused by the species. However, in other cases, the beaver's impacts are less visible, as selective foraging can lead to conflict inside the nature conservation community (conservation–conservation conflict). The protected beaver (Annex II/EC/1992) prefers the native deciduous softwood species in protected alluvial forests (Habitat Directive/Annex I/EC/1992). Beaver foraging activity makes the maintenance of this vulnerable habitat more difficult by exacerbating the spread of invasive woody species in the place of willows, which have decreased sprouting activity in the drier floodplain environment. Human interventions mitigating human-beaver conflicts can also harm the natural state of the habitat (by causing disturbance during dam removal). The absence of a well-planned beaver management strategy may create new, non beaver-related conflicts, whereas the deterioration of the relationship between nature conservationists and other stakeholders is hampering cooperation on other issues of nature conservation importance.

Keywords: human-wildlife conflict, human-human conflict, conservation conflict, ambivalent perceptions, conflict mitigation, beaver management strategy.

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EDUCATION MEETS BEAVER! THE NEW "BEAVER TOUR BACKPACK" FOR BEAVER ADVISORS IN BADEN-WÜRTTEMBERG

Anke Simon[1]✉

Abstract

For two decades, beavers have been reclaiming their former habitats in Baden-Württemberg, a state in the southwest of Germany. This does not always happen without conflicts in the intensively used landscape. Therefore, it is very important to impart knowledge about these fascinating and ecologically important animals. As early as elementary school age, students should get to know the beaver as an important creator of near-natural, species-rich habitats. Knowledge about the biology of the beaver, its way of life and its role in the ecosystem helps to mitigate possible conflicts. Public relations is therefore an important part of beaver management. On behalf of the Stuttgart Regional Council we developed the "Beaver Tour Backpack" to support the volunteer beaver advisors in their work. It enables the professionally well-trained advisors to easily get started with nature education work. The backpack contains a variety of materials for designing "beaver tours" for elementary school-children. The centerpiece is the "Beaver Tour Guide", a booklet with the story of the adventures of a young beaver on the way to find a new home. His adventures are linked to appropriate activities and nature experience games. The backpack provides material for an approximately three-hour guided tour in a beaver habitat. Also included are the materials needed for the different games, as well as hands-on materials such as a beaver fur, a skull, a jaw and paw prints. Personal relationships and direct experience are the key for sustainable learning. The wild beaver is made tangible and understandable, because "only what I know, I can appreciate and only what I appreciate, I can protect."

Keywords: New Beaver Tour Backpack, southwest of Germany, target group primary school children, public relations, beaver management, support volunteer beaver advisors, booklet with the beaver story and nature experience games, hands-on materials, beaver fur, skull, jaw and paw prints.

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PREPARATORY ACTIONS FOR THE REINTRODUCTION OF THE EURASIAN BEAVER CASTOR FIBER IN GREECE

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Abstract

The Eurasian beaver Castor fiber is known to have occurred in Greece until the 19th century. The last report on beaver existence in the country comes from Peloponnese, southern Greece, in the 19th century, although the animals are believed to have disappeared much later from northern Greece. In 2021 the Department of Biology at the Aristotle University of Thessaloniki and beaver experts from Europe and the UK Beaver Trust commenced a project to prepare for the reintroduction of the beaver in Greece. An ecological report on beaver reintroduction was prepared by the Greek team, covering aspects of the species ecology, its role as a keystone species, information on the natural environment, human activities, protection status and land uses of pre-selected candidate areas, and the basic steps of a release strategy, based on IUCN Guidelines for reintroductions and other studies from European countries. A feasibility survey assessment was prepared by experts from the UK and Germany, who visited the candidate areas to determine the suitability of both specific current locations and the general prospect thereafter for any subsequent range expansion, which also covers all technical aspects of beaver reintroduction. Their analysis reveals that all areas visited contain beaver habitat in terms of both release locations and larger landscapes which were suitable for wider recolonization. Many areas of northern Greece and bordering nations are heavily wooded and would afford further potential in time for future beaver expansion. The project also includes dissemination and lobbying actions, such as meetings with the Greek Ministry of Environment, competent authorities, national parks and NGOs. The project team has communicated so far the expected beaver reintroduction through social media (Facebook: Hellenic Beaver), articles in the press, interviews on national TV shows and conference presentations.

Keywords: Eurasian beaver, reintroduction, Greece, feasibility study, release strategy.

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ZONATION OF THE BLACK RIVER HYDROGRAPHIC BASIN BASED ON HUMAN/BEAVER CONFLICTS RISK

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Abstract

After its reintroduction to Romania, the beaver population grew steadily, which in some areas caused conflicts with human activity. To maintain a favourable conservation status of the species, it is necessary to harmonize conservation interests and flood mitigation. We implemented an existing European modelling framework on a 1x1 km ETRS grid dividing the Black River basin habitats into three categories in terms of proposed management: a) regions from national protected areas; b) areas with sustainable management and c) hazard-prone areas for the population. However, there are habitats where the presence of the species is undesirable and incompatible with flood protection and management. Areas with sustainable management occupy 60.5%, hazard-prone areas for the human population (without beavers) 25.2%, and 14.4% are included in NATURA 2000 network as SCI. Riparian habitat zonation in the Black River basin is indispensable in managing Castor fiber at the national level since the basin has the highest densities of beaver in Romania. Moreover, this can be used as a pilot study and replicated nationally.

Keywords: beaver, habitats, zonation, managements.

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PUBLIC ATTITUDE ABOUT BEAVERS IN CROATIA AFTER 25 YEARS - GUIDELINES FOR COEXISTENCE

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Abstract

Constantly increasing beaver population over the last 25 years in Croatia has influenced public attitudes about the beaver. During the first ten years of recolonization, as beavers gradually spread and appeared in new locations, there was a general enthusiasm concerning beavers. After 15 years from first reintroduction in some areas, habitat carrying capacity was reached and first damages were recorded. After 20 years beaver problems became a common occurrence. In the past 3 years the beaver population has experienced a pronounced progression, which significantly affected the public's attitude, especially in areas of permanent beaver residence with high family densities. As part of the LIFE BEAVER Project, workshops were held with the aim of educating and informing the public. At the same time, through group workshops, we collected public opinion and suggestions related to beaver protection, protection from beavers, and coexistence with beavers. From 150 workshop participants we identified several concrete views and guidelines, of which we highlight the 10 most representative ones: 1) importance for conservation and biodiversity in aquatic ecosystems, 2) issues with beaver problems relative to dams, coastal erosion and agricultural damage, 3) need for completion and adoption of the Beaver Management Plan, 4) identification of defined management zones relative to beaver management, 5) required research to determine optimal beaver numbers and habitat capacity, 6) establishment of preventative measures to reduce beaver damage, 7) improved institutional coordination for the implementation of beaver protection and management, 8) improved communication and associated information systems, 9) development of a compensation system for damages, and 10) need for balance between public acceptance and responsive management. After 25 years from the first beaver introduction in Croatia there is still no Beaver Management Plan nor was beaver protection status changed, regardless of high population densities.

Keywords: public, beaver, beaver management, damage prevention.

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MODERN TECHNOLOGIES AND BEAVER MONITORING IN SLOBOZHANSKYI NNP (UKRAINE)

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Abstract

Eurasian beaver (*Castor fiber*) is a key species of wetland ecosystems and a symbolic species of the Slobozhanskyi National Nature Park (NNP), Ukraine. Following changes in climatic conditions and the drying of many forest waterbodies, significant changes in the size of the beaver population and in the spatial distribution of these animals has occurred in the Park. Therefore, monitoring studies of the beaver have received much attention for the past 10 years. Every year, the Park organizes and conducts beaver counts, which, in addition to the Park staff, involves from 1 to 16 volunteers from different parts of Ukraine. The event usually lasts for a week and consists of training via theoretical courses, fieldwork, educational lectures, and presenting films about beavers. Involving volunteers allows assessment of all beaver sites in the Park in a short time while collecting a large array of data. Modern technologies provide more opportunities for studying beaver ecology. Beaver sites were studied using remote sensing. The analysis of satellite images allowed establishing the time of occurrence of the large beaver pond and the peculiarities of its development in the northern part of the Slobozhanskyi NNP. When satellite imagery was not enough, unmanned aerial vehicles (UAVs) were used to study beaver sites in detail. Orthophotomaps based on drone surveys helped map hard-to-reach channels and beaver lodges, to assess the dynamics of woody vegetation changes on individual beaver sites. To assess animal activity, a camera trap was installed near one lodge from April to December 2019. The camera trap recorded 112 events with 5 mammalian species. During the study period, beavers were the most active near the lodge at night in autumn. Modern approaches to beaver monitoring studies have many advantages and some disadvantages that are needed to be considered in further work in Slobozhanskyi NNP.

Keywords: *Castor fiber*, monitoring, National Nature Park, modern technologies.s.

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GEORADAR AND GEOELECTRICAL TOMOGRAPHY – TECHNICAL SUPPORT FOR DAMAGE PREVENTION OF BEAVER DIGGING ACTIVITIES – BANK SAFETY AND HIGHWATER PROTECTION

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Abstract

Digging activities of beavers - on road embankments, highwater dikes, and railroad embankments are under certain circumstances a great danger. If beaver tunnels are detectable, the undermining can be easily removed by various measures (comp. ANGST, 2018 and relevant Beaver- Management-Handbooks). It is often not possible to identify exactly where tunnels or burrows are located. Putting up warning signs is not sufficient to avert serious consequential damage. Georadar is a geophysical process for measurement method that creates a gapless profile section of the surfaces. Similar to sonar or echo sounder, it works according to the transmitting-receiver principle, whereby high frequency electromagnetic waves are emitted by the transmitting unit or transmitting antenna. These are reflected by objects and layer boundaries in the subsurface, picked up by a receiving antenna (receiver) and digitally stored, cleaned of disturbance variables and displayed as a radargram directly during the measurement. This not only allows cavities to be detected, but also their extent, height and diameter.Geoelectrical tomography is a ground testing method used to determine spatial structures in the subsurface, including cavity exploration. Using a measuring chain with up to 100 electrodes, the apparent electrical resistance is measured by injecting a constant and low-frequency alternating current. For each electrode, the injected current, the measured voltage difference and the resulting apparent electrical resistance are stored on a measuring computer. The final result is an image of the spatial distribution of the electrical resistivity in the subsurfaces along a profile or within a volume. Boreholes or pressure soundings or even the use of mini cameras can be used for exact interpretation. In the Torgau area, this method was successfully used for dike control and monitoring (JACOBS, 2003).There was no direct intervention by mechanical measures on occupied beaver lodges and no destruction of the bank structure and vegetation, plannedable application of analysis. The process included the cost for damage prevention as well an optimal risk assessment. Existing conflict potential between beaver protection, beaver management, and highwater protection can be minimized using the technique briefly outlined here.

Keywords: management, damage prevention, georadar, geoelectrical tomography.

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USE OF REMOTE WATER LEVEL MONITORS FOR THE MANAGEMENT OF BEAVER DAM IMPACTS

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Abstract

Dam building by beavers is one of the species' most well-known behaviours and one that brings biodiversity and ecosystems services through wetland creation. However, flooding from dam building can sometimes be a source of conflict with human land-use. Beaver dams over two weeks old are protected in Scotland but landowners can apply to NatureScot to remove older dams where their presence affects infrastructure and livelihoods. In areas where farmland is affected by beaver damming, landowners can manage the problem through frequent checks of drainage channels and watercourses, and then remove dams where they are found. Early intervention means that licenses are not required and dam removal can discourage the establishment of beaver territories at sensitive sites. Dam building can also alert landowners to the presence of beavers at sites that are sensitive for other reasons, such as where burrowing can impact infrastructure. However, frequent checks can be a burden on landowner time. NatureScot has been trialling the use of remote water level monitors that send regular updates via the mobile network. NatureScot staff can view data through a web interface and the systems send 'alarms' to predefined email addresses (e.g., NatureScot staff and relevant landowners) when water levels breach (rise) and drop below (fall) a threshold. An email alarm of a rise not followed by an alarm of a fall alerts land managers to the possible presence of a beaver dam. To date, in most cases these units have been used to manage repeated damming by beavers around farmlands. In one case, the system was used to provide rapid response to allow the trapping of a beaver that occasionally visited a ditch next to an irrigation pond impoundment, into which it had burrowed. The utility of the system is explored and examples of the signal of damming on water levels shown.

Keywords: beaver; Castor fiber; dam; conflict; farmland; infrastructure; flooding; remote monitoring; internet-of-things; IoT.

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WHERE DID ALL THE BEAVERS GO?

Gerhard Schwab[1]✉

Abstract

During the early early years of the Bavarian Beaver Management, roughly a thousand beavers were reintroduced into a number of European countries. In my poster I present the locations of the reintroductions, the movement of the beavers into a number of other countries during the last two decades, and their current distribution. Out of the approximately 1000 individuals reintroduced, over 10,000 beavers now populate these countries.

Keywords: beaver, reintroductions, migration, Bavaria, Europe.

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LIFE WITH THE BEAVER, WETLANDS AND CLIMATE CHANGE - RAISING AWARENESS AND INFLUENCING POLICIES ON BEST BEAVER MANAGEMENT PRACTICES

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Abstract

Approximately 150 to 250 years ago, the Eurasian beaver was completely extirpated from Slovenia and Croatia. After reintroduction, beavers are still recolonizing historical habitats in both countries. More than two centuries of absence were enough for the beaver to disappear from the public perception. During this period, beavers lost not only their natural but also their social habitat. Returning beavers are often considered as a "new" species and even as a pest by local inhabitants and by different stakeholders (foresters, farmers, landowners and even some biologists) because they are not acquainted with the biology and ecology of the species or with the range of beavers' impacts on the environment. Conflicts with the beaver occur with a rising population. Felling trees, feeding in agricultural fields, and local flooding due to beaver dams or clogged culverts are frequently reported as beaver damage. Previous enthusiasm for the beaver's return is consequently changing to a negative attitude towards the species. The project LIFE BEAVER - LIFE with the beaver, wetlands and climate change aims to welcome the return of the beaver. To assure public acceptance of beavers and to create a positive human attitude towards it, reliable information about the beaver's life emphasising its positive impact on the environment has to be provided to all relevant stakeholders and target groups. Specifically the project aims to:

- raise awareness about beavers in general, stressing their important role in the freshwater ecosystems;
- counter the raise of a negative attitude towards the beaver as a pest;
- present beaver management techniques to minimise unwanted effects of beaver activities,
- examine and redefine the term "damage" in relation to effects of autochthonous species in its natural environment,
- prepare guidelines for further water management strategy and agricultural policy,
- set evidence-based arguments for change of existing compensation schemes.

Keywords: Eurasian beaver, awareness raising, Life programme, education, beaver management, ecosystem services, beaver range modelling.

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SPECIES INTERACTIONS IN BEAVER ENGINEERED HABITATS LINK LAND-WATER ECOSYSTEM PROCESSES

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Abstract

Conservation action for freshwater biodiversity is needed due to losses in habitat area and quality. Restoration of freshwater habitat is challenging because it is difficult and resource intensive to recreate natural dynamics. Ecosystem engineering by beavers could support these restoration efforts. Construction and foraging activities of beavers create mosaic-like habitats, which in many situations have been documented to increase local species richness and abundance. However, while knowledge on some community aspects related to beaver activities are well known, knowledge about links between different species communities and the land-water boundary are limited. My research is designed to explore the potential of beavers as conservation agents, especially at the land-water boundary. I hypothesise that beaver activities strengthen links between aquatic and terrestrial habitats and increase overall landscape diversity while providing resource hotspots for other organisms. Thus, beaver activities could be an important tool to restore biodiversity and strengthen ecosystem services and functions. The results of this study will provide a baseline for future evidence-based aquatic ecosystem conservation and appropriate beaver management policies.

Keywords: beaver, community, ecosystem, blue-green.

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POST-TRANSLOCATION SURVIVAL OF WILD EURASIAN BEAVERS FROM SCOTLAND

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Abstract

As an alternative to the lethal control of wild Eurasian beavers (*Castor fiber*) in human-conflict situations in Scotland, trapping and translocation have been undertaken. Over the last 3 years, 92 beavers have been trapped, then quarantined in purpose-built zoo facilities at Five Sisters Zoo for health screening and disease testing, before translocation to other locations. Using Kaplan-Meier probability of survival analysis yields a 93% probability of survival of adult beavers to 1 years post-translocation (95%CI 85-99%, n = 43), and currently 88% of all translocated beavers of all ages over the last 3 years have been confirmed as still being alive (95%CI of 80-94%). The median time to death for those beavers that did not survive trapping, quarantine and translocation was 34 days (95%CI 13-95 days). Stress is recognised as a factor in deaths in previous translocation projects elsewhere. While there appeared to be a decrease in post-translocation survival for beavers held in quarantine or captivity for longer periods, this failed to reach statistical significance at a 95% confidence level via Mann-Whitney analysis (p = 0.94). Many other beaver translocation projects internationally have achieved far lower survival rates. The high survival rates in these British translocations may be due to over a decade of experience in the trapping, handling, and care by much of the staff involved, and illustrate the valuable role that zoos can play in conjunction with other conservation organisations in native species conflict resolution, rewilding and conservation while protecting animal welfare.

Keywords: translocation, survival rates, conflict mitigation, trapping, species restoration.

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INVESTIGATIONS REGARDING METHODS FOR DETECTING CAVITIES CAUSED BY BEAVERS IN FORELANDS AND LEVEES

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Abstract

With its successful recolonization in Europe, the beaver as a protected species receives a high, mostly positive attention by the public in many places. However, in regions where beaver habitat overlaps with that of humans, conflicts also arise. This is especially true for rivers where adjacent levees are intended to protect agricultural land and settlements from flooding. In case of flooding, beavers could use these levees as a place of refuge. In doing so, beavers dig tunnels and dens in dimensions that can significantly increase the failure probability of the levees or may even lead to sudden failure. Provided these cavities can be detected in a relatively short time over long levee sections, appropriate counter measures can be taken. Motivated by this problem, the aim of a project on the Oder River in the federal state of Brandenburg (Germany) was to find methods for the detection of beaver-caused cavities in levees and their foreland and to test them with regard to their suitability and practicability. As a result of an initial research, 10 methods were identified and their applicability was tested in a field survey. This included land-based geophysical methods (e.g. ground penetrating radar, microwave sensing) and drone-based remote sensing techniques (e.g. thermal imaging) as well as the conventional use of tracking dogs. Due to the fact that none of the investigated methods led to the desired detection success, it showed that further research regarding this topic is required. However, the field test identified the methods with the highest detection potential. Furthermore, results and findings of the survey serve as basis for a knowledge exchange between biologists and engineers aiming for a long-term development of an applicable and reliable methodology for the detection of cavities caused by beavers.

Keywords: beaver, cavity detection, levees, flood risk.

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LONG-TERM DYNAMICS OF THE BEAVER (*CASTOR FIBER*) POPULATION IN THE VORONEZSKY RESERVE (CENTRAL RUSSIA)

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Abstract

The beaver population of the Voronezhsky Reserve has a long history. It is an aboriginal population and it was the most significant source of animals for reintroduction to other Russian regions (Lavrov, 1981). The main beaver habitats here are small rivers and floodplains marshes. Beaver research started here in 1920s after the Reserve was founded in 1923.There are three stages in the history of the beaver population. The first stage was an increase in the number of beavers, when the reserve staff started an effective wildlife protection program that lasted until the 1940s. Beavers colonized all available habitats and food supplies started to dwindle. The second stage occurred during the 1940s when the beaver population declined. The third stage began in the 1950s when the population size stabilized. This stage continues to the present time. This stage is characterized by population fluctuationsaround an average level (about 300 individuals), with a fluctuation periodicity of 10 years. The relationship of these fluctuations with the influence of climatic factors and hydrological situation has not been revealed. The main factors of population control are considered to be population density and changes in the sex and age composition of the family (Nikolaev, 1997).More than 250 beaver settlements were registered during the history of the Reserve. We are observing a decrease in the quantity of beaver sites at rivers. The main reason is the development of black alder (*Alnus glutinosa*) forests at floodplains, which are unproductive for beavers, and a decrease in the amount of available food. At well-watering marshes with abundant aquatic vegetation we are observing an increase of beaver population. We expect that the beaver population in the Reserve will remain at a sustainable and viable level.

Keywords: beaver, Castor fiber, population dynamics.

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BIODIVERSITY SURVEY IN DAMMED BEAVER TERRITORIES IN SWITZERLAND: STUDY DESIGN AND METHODS

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Abstract

The Eurasian beaver (*Castor fiber*) was successfully reintroduced in Switzerland between 1956 and 1977, and now occupies large portions of its former distribution range. Since the turn of the century, beavers have shown intense dam building activity in small streams. The dams transform the streamsinto small ponds and lakes, creating localised running and still water sites for rhitral and litoral groups of organisms. For the National Beaver Study 2020–23, in the module 'biodiversity survey' we examined 16 different beaver dam territories on the Swiss Plateau, from Lake Constance to Lake Geneva. We tested the stream-dam-pool-ecosystem (SDPE) dynamic created by beavers, with two main parameters for the stream and the ecosystem: [A] natural or impaired stream eco-morphological conditions in [B] open and woodland ecosystems. In each of four quadrants, we tested at least 3 to 5 beaver territories to determine their effect on biodiversity in relation to a small number of abiotic and biotic parameters. For this, we established a 100m study perimeter around each main dam in the territory (25m down- and 75m upstream from the main beaver dam). A 100m control perimeter was established 250m to 650m outside of this territory to contrast with the dam pool sites. Within these thirty-two 100m perimeters, we used standardised protocols to survey the five biogenic groups of aquatic plants, macroinvertebrates, dragonflies, amphibians and fish. We then combined this biogenic data with data on the activity of the beaver on each main dam site, the dam profile itself, the pool quantity, fish habitat index, and the water temperature data up and downstream to provide evidence on biodiversity in each site when contrasted with the control site. This allowed us to compare open and woodland sites and the difference in biodiversity in the study and control site.

Keywords: Eurasian Beaver (*Castor fiber*), stream-dam-pool-ecosystem (SDPE) by the two parameters ecomorphology open vs. woodland, aquatic plants, macroinvertebrates, dragonflies, amphibians, fish, abiotic stream parameters, Switzerland.

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TESTING FOR EURASIAN BEAVER (CASTOR FIBER) FAMILY SIZE AND STRUCTURE IN THREE REGIONS OF SWITZERLAND WITH DIFFERENT POPULATION DENSITIES

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Abstract

The Eurasian beaver (Castor fiber) was successfully been reintroduced in Switzerland between 1956 and 1977. Today, the beaver occupies large areas of its former distribution range. In some regions in Switzerland beaver territory density is very high. We test the hypothesis that young beavers stay longer in their families if the population density is high and if family size is therefore larger than in less dense areas. To identify individual beavers, we used the beaver tail morphology method and surface measurements from photos taken using camera traps, in a method adapted from Schwaiger and Schwemmer (2012). In two pilot-studies (2019/2020 and 2021), we examined and improved the method in view of a main study planned for winter 2023. The pilot studies tested different camera traps and modes, camera trap constructions, the seasonality of the field work, the duration of field surveys and analysis of the images using the computer-based programmes IC-Measure 2.0 and Image-J, with a metric reference under the field trap. The observations took place in three different regions, with high, medium, and low population densities. In the pilot study in 2019–20, we examined one site using three different camera traps.The white-flash models were equipped with filters and the traps used the same, fixed construction throughout the territory. At this site, we were able to identify many different individuals. The second pilot study examined for the first time the hypothesis of density and family size incorporating the improvements from the previous pilot study. The second study took place in summer 2021. The extreme hydrologic conditions caused by the intense thunderstorm season and the changed activity patterns of the beavers that summer negatively influenced the findings. Nevertheless, the field trap method proved effective in acquiring good pictures of the beavers' tails and the study identified some possible improvements, especially in terms of the quantity of photos and opportunities for food presentation in field trap sites. Using the adapted method, we will repeat the study 2023 based on the results from the 4th national beaver census in 2022 in some regions in Switzerland that have different colony densities.

Keywords: Eurasian Beaver (*Castor fiber*), population density, family size, beaver tails, camera traps, field traps, Switzerland.

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ANALYSIS OF PLANTS USED BY BEAVERS (*CASTOR FIBER* ET C. *CANADENSIS*)

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Abstract

In the process of evolution, combined with adaptation to semi-aquatic habitats, beavers, as opportunistic herbivores, show an enormously high adaptability to habitats and to available food resources. Based on an extensive study of relevant literature, specifically on the feeding ecology of beavers, a table was developed by the author to list the plant species that beavers use. Food during the growing season, mainly herbaceous plants and aquatic plants, has been less studied and described. Especially due to the increasing spread of new species of plants, the species spectrum of plants used by beavers will also change in future (NITSCHE, 2018).As a result, a total of 634 utilized plant species were identified, of which 266 are woody plant species and 368 are herbaceous plant species. 31 species from 10 genera of conifers (*Gymnospermae*) were used, with spruces (*Picea*), firs (*Abies*), and pines (*Pinus*) making up the majority. Among deciduous shrubs, willows (*Salix*) represent the main share with 39 species. 58 plant species found in the beaver diet contain toxic substances, of which 23 are woody plants and 35 are herbaceous plants. Details and discussion of this issue can be found in NITSCHE (2017). In the composition of the diet of herbaceous plants, a high proportion of grasses are utilized (e.g. 20 *Carex* species and the use of cultivated plants (*Beta* sp., *Brassica oleracea*), which will increase in the future, especially in the intensively used cultivated landscapes of Central Europe. In this analysis, about 85% of the plants used by beavers are recorded.In many publications on the feeding ecology of beavers, plants were only recorded by genera. This is also related to identification, e.g., in the case of willows (*Salix*), which are difficult to determine due to hybridization. Many publications use only the common names or vernacular names for the plants and scientific classification is thus largely excluded. Few publications address the use of herbaceous plants. There is a major deficit here. The use of herbaceous plants is often only mentioned in a rudimentary way and hardly any information can be found on the degree of use. A striking feature of the publications on woody plant use is that the authors use different methods, i.e. the results are not compatible for uniform modeling of feeding ecology. The intensity of use, the amount of food used is only reported in a few specific publications. From the distribution range of the beaver in Siberia, Mongolia and China scientific data on food ecology are difficult to access or only general information is available.

Keywords: biology, feeding ecology, plant utilizationers, Switzerland.

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MIGRATION AND BEHAVIOR OF FISHES AT BEAVER DAMS

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Abstract

Water bodies in Switzerland have been and still are under strong pressure, for example due to flood protection, water withdrawals and agriculture. In the densely populated Mittelland, for example, more than a third of the watercourses are in poor ecological and morphological condition. In agriculturally dominated landscapes, almost half of the watercourses are in poor condition. In addition, there is climate change with its known effects on water bodies. In this context, the population expansion of beavers in Switzerland hits the small watercourses. It has not yet been studied how the interaction of fish and beavers changes in such impaired water bodies. For example, beavers build high and solid dams in strong deepened waters. With this study, we are trying to find out whether and under which conditions (discharge, water temperature, season) fish can overcome dams in the Swiss context. Therefore, we study the behavior of local fish species at three different sites in Switzerland, mainly brown trout (*Salmo trutta*), but also chub (*Squalius cephalus*) and bullhead (*Cottus gobio*), at and around four beaver dams. The sites were chosen considering the characteristics of the different dams. One site is located in a stream where the beaver dam can almost naturally stretch its width. As a result, the dam is narrow and permeable and it seems that the beaver, although present, hardly (has to) maintain it. One site where we look at two dams is in a heavily artificial and incised stream that flows straightened through the area. The dam here is high and very solidly built.The beaver often maintains these dams. The third dam construction lies between the two described ones (intermediate), but it hosts more fish species (trout, chub, bullhead) than the others (only trout). To evaluate the behavior of the fishes and to see if they pass the beaver dam we work with passive integrated transponder (PIT) tags implanted into the fish. Therefore, we placed downstream and upstream of each beaver dam a pair of RFID antennas, to capture the signal of the PIT tags. We installed two antennas to measure direction of fish movement and detection efficiency of all antennas. We marked two different groups of fish: First, we tagged the fish in the local area downstream the beaver dam and in the pool (local group); Second, we marked fish from further upstream the dam and relocated these fish below the dam (experimental group). The upstream migration over the dam will be correlated to the water level difference between top and below the dam to evaluate the impact of flood dynamics. The local group will help us to learn more about natural behavior of the different fish species at the beaver dam sites, for example during the spawning periods. The results of this study should help to understand fish behavior at, and migration over beaver dams in the Swiss river context. Results should be ready to present in late 2023.

Keywords: PIT tagging, brown trout, chub, beaver dam, Switzerland.

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EVALUATING BIODIVERSITY IMPACTS OF BEAVERS ON INVERTEBRATE AND VERTEBRATE COMMUNITIES USING ENVIRONMENTAL DNA

Tom Spencer[1]✉, James Gilbert[1], Cath Bashforth[3], Claire Howe[2], Lori Lawson Handley[1]

Abstract

The Eurasian beaver, Castor fiber, missing from the British Countryside for the last 300 years is now making a comeback. Wider UK reintroductions provide a key opportunity to research the impacts of beavers on biodiversity across entire ecological communities, different landscapes and spatial and temporal scales using modern and powerful monitoring tools like eDNA. Organisms release DNA into their environment, which can then be captured by sampling water, and sequenced (via "metabarcoding"), to describe entire communities of animals and plants. Providing a cost-effective method for surveying all biodiversity rather than focussing on a few priority species. In this project we are using eDNA metabarcoding to evaluate the biodiversity impacts of beaver introductions across a wide environmental gradient in the UK. Using eDNA data collected from enclosed reintroduction projects and control sites we are investigating 1) how beavers impact the distribution of conservation priority vertebrates and invertebrates, 2) how the composition of invertebrate and vertebrate communities shifts as beavers alter habitats, 3) how beavers influence the transfer of aquatic subsidies to terrestrial consumers (e.g. spiders) and alter food webs, and 4) how these impacts vary across space and time. eDNA has been collected from a number of locations across England, Wales, Scotland and Finland with different altitudes, hydrology, soil chemistry and flora. Beaver sites are paired with a local control site which has not been influenced by beaver activity and will be sampled across several years to show change across temporal as well as spatial scales. Since this project is in its early stages, we present an overview of our questions and methodology, and preliminary results from eDNA metabarcoding of UK Sites.

Keywords: eDNA, Biodiversity, Beavers, UK, Finland, Reintroductions, Ecological Networks.

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WOOD-EATING, DAM-BUILDING, AND 50 MILLION YEARS OF BEAVER EVOLUTION

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Abstract

The two living species of beavers are remnants of a long line of diverse rodents with many unusual abilities. These two species are unique among terrestrial vertebrates not just for their dam-building, but for their direct consumption of woody plants. These strange behaviors present an evolutionary puzzle. Did dam-building arise as a consequence of wood consumption, or was it the other way around? At what point in the beaver family tree did these behaviors arise? What is the broader evolutionary history of the beaver lineage? This presentation aims to summarize the extent of our current knowledge of beaver evolution. Beavers are members of Castorimorpha, a primarily North American group of rodents that also contains the kangaroo rats and pocket gophers. Beavers themselves belong to Castoridae, of which only two species survive. Many of the early members of this family were burrowers, and those that were aquatic showed evidence of an aquatic lifestyle long before they developed the robust teeth necessary to feed on wood. Later beavers evolved consumption of woody plants to supplement their diet, and dam building is thought to have arrived near the origin of the genus Castor, as a result of the beaver's existing ability to fell trees for food. Castor canadensis is thought to have diverged from C. fiber over seven million years ago by migrating to North America from Eurasia, where the Castor genus likely evolved.

Keywords: beaver, evolution, paleontology, fossils, dam-building, xylophagy.

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BEHAVIOURAL LATERALIZATION IN CAPTIVE AND WILD EURASIAN BEAVER

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Abstract

We studied motor preferences in Eurasian beaver (Castor fiber) in the wild and captivity. 260 hours of observations with photo/video registration were carried out for 42 captive beavers of the Voronezh Beaver breeding ground from July, 2019 to August, 2021. For the data on wild individuals, Voronezh Reserve trail cameras' recordings (2014-2021) of wild beavers behavior were analyzed. Evaluation of preferences in the use of forelimbs at the group level was carried out according to the handedness index (IHI). Also, for each individual, the Malashichev Unimanual Coefficient (MUC) was calculated, showing the expression of single limb action in the manual behavior of an individual.The animals were also presented with specially designed T-shaped feeders of different diameters. Separately we evaluated the asymmetric transfer of plant material (branches) on one side of the body by mouth.The analysis of video recordings revealed a correlation between the limb preference and the material (food and building) transfer bias in wild beavers: when moving branches, beavers place most of them on the side opposite to the leading limb ($r(s) = -0.76$, $P = 0.012$). Significant differences in MUC were found between beavers differing in the environmental enrichment of living conditions ($H=27.9$, $P<0.001$, Kruskal-Wallis test: In beavers living in natural conditions and engaged in building activities, the degree of unimanuality is higher than in captive beavers ($P<0.05$, post-hoc test), significant differences were also found in the degree of preference ($F(2;47) =3.55$, $P=0.037$, ANOVA; in beavers in pens, the median [HI] was 0.140, for wild beavers it was 0.415). No significant correlation was found between lateralization and levels of cognitive activity and boldness ($P<0.05$, multinomial regression). The degree of expression of motor preferences in beavers increased significantly in complex manipulation tasks ($W = 0$, $P < 0.001$). Beaver temperament, however, did not affect motor asymmetry.

Keywords: beaver, motor preference, functional asymmetry, Malashichev Unimanual Coefficient.

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