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Time for dam rebuilding by the Eurasian beaver

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Abstract The European beaver, the largest rodent in Europe, has enormous skills in transforming and adapting its habitat. It chooses a place for its habitat that provides it with food and a high degree of security. He builds dams to regulate water levels. It is assumed that beaver dams can survive for several dozen years, depending on the continuity of use. When a damaged dam is reused, beavers are able to quickly restore the structure to a suitable condition. By monitoring one of the dams for several years, we managed to record this interesting process. In this case, it was determined that the time needed to rebuild the dam and restore the water level was approximately 8 h. This, of course, depends on local conditions, but the data obtained allows for a better understanding of this process.

Keywords Eurasian beaver · Beaver's dam · Beaver's engineering

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Introduction

The European beaver (*Castor fiber* L.), which is found in Europe, has a major impact on the ecosystem it inhabits. Its construction activities affect the area where it has its habitat, the trees around this habitat and also affect the quality of the water and sediments collected in the ponds. The beaver is one of the species with the greatest technical capabilities (Wright et al. 2002, Rosell et al. 2005). It is regarded as a factor that shapes ecosystems (Wilby 2002; Jones et al. 1997; Gilad et al. 2004; Crain and Bertness 2006; Wright and Jones 2006). It builds burrows and lodges to increase its security, channels to extend its feeding areas and stores food for the winter. If the beaver's need for water depth in a particular location is not met by naturally occurring conditions, it builds dams to achieve an adequate water level and reduce runoff (Campbell-Palmer 2013). They influence the biodiversity of the landscape, although species richness may decrease within individual beaver sites (Rosell 2005). Beaver dams are important elements in river courses, and the resulting beaver ponds act as elements of a corridor that buffers the ecosystem against disturbance (Naiman et al. 1986). Beavers are most active from dusk to dawn. In the summer months, they are usually active from around 8 pm and tend to remain active for 12–14 h per day, although this can vary (Sharpe and Rosell 2003). Maintenance of structures (dams, lodges) increases in autumn in preparation for winter (Hodgdon and Lancia 1983;

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Pollock 2015). Dams are built by placing sticks and branches upstream to create support structures. Subsequently, bottom sediment is collected to form the base of the dam (Macdonald et al. 1995, Műller-Schwarze and Sun 2003). Baker and Hill (2003) reported that dams typically consist of logs, branches, twigs, bark, leaves, soil, mud, and sometimes rocks (Gurnell 1998). Beavers prefer to build dams on small to medium-sized streams with a width of 2–6 m and a low gradients (up to 6%) and usually settle first at sites with the lowest gradients (up to < 1–2%) (Suzuki and McComb 1998; Pollock et al. 2015), as well as in stream depths of 0.7–1 m (Hartman and Törnlöv 2006). They usually build several dams on a relatively small section of the stream, creating a kind of staircase in the stream. These steps consist of shallow floodplains with abrupt changes in slope at each point of the dam. A series of these dams in series also helps to dissipate the energy of a flood wave and can act as a buffer in the event of a dam failure because if one dam breaks, the others continue to operate (Pollock et al. 2003). With time and lack of maintenance, the dams break. Their durability is assessed differently. In general, they function for less than a decade (Gurnell 1998). In Finnish studies (Kivinen et al. 2020), it is around 3 years, although there are dams that last for many decades (Naiman et al. 1988). Damaged dams allow for greater heterogeneity in the river system by providing additional areas of habitat and free-flowing water (John and Klein 2004, Burchsted et al. 2010, Polvi and Wohl 2012) and can serve as a starting point for the construction of new dams when beavers attempt to reoccupy previously occupied dams. The aim of the manuscript is to depict the process of rebuilding the destroyed dam in relation to time.

Methods

The study area is located in north-west Poland, about 100 km north of Poznań, in the Lipka Forest District. The stream flowing there runs exclusively through forest areas. Several beaver dams were recorded along the stream. The monitored dam is the last, lowest-lying dam. At the edge of the pond, measuring devices were installed by Dataflow Systems to record the groundwater level. The monitoring well used for the analyses is located about 10 m from the dam itself. The depth of the well enables continuous monitoring of water level changes within the constructed beaver pond at 2 h intervals. The monitoring has been carried out continuously since May 2016. The existing dam was around 4 m long and around 1.3 m high before it was decommissioned.

Results

Over the years, the measurement results of the fluctuations in the water level in the beaver pond fluctuated by 70 cm (Fig. 1). In April 2021, the beaver dam was removed and the water level dropped by 140 cm. In September, the site was once again used by beavers, who rebuilt the dam in a maximum of 8 h and

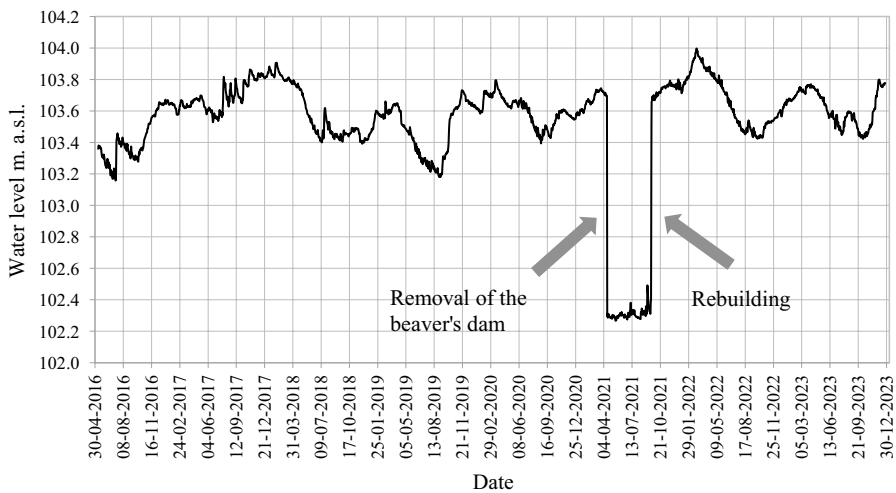

Fig. 1 Results of monitoring the water table in the beaver pond in the studied facility

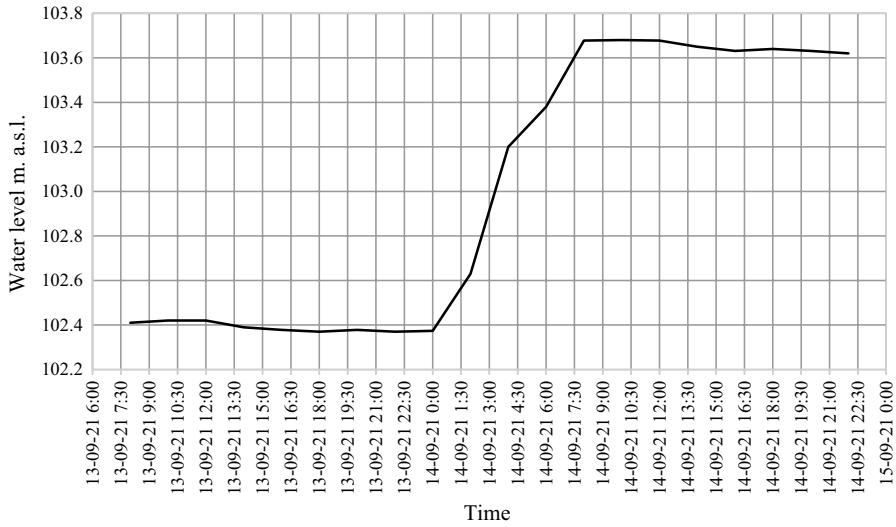

Fig. 2 The rate of rise of the groundwater table after the return of the beavers

brought the water level back to the level before the dam was removed. The time was counted from the stabilised water level, i.e. from 00:00 on 14 September 2021, until the water level stabilised after the dam was raised at 08:00 on 14 September 2021 (Fig. 2). After this time, the rebuilt beaver dam functions without any problems and the water level fluctuates by 50 cm in the following years.

Conclusions

The engineering capabilities of beavers are well known and are described in detail in the literature. We know how a beaver dam is built, what materials it is made of and what effects it has on the environment. However, the available literature contains little information on how long beavers build a dam. The temporal process of raising the water table through dam reconstruction by beavers described in the manuscript is quite unique. It is difficult to monitor the places where beavers live in the hope that natural changes will occur. In this case, it was recorded, but only 6 years after monitoring began. The results indicated that within approximately 8 h, the beavers restored the water level before the dam was removed. This is of course related to the local conditions, but the size of the stream, the lowland nature and the forest areas providing construction material create typical conditions for a beaver habitat (Neumayer et. al. 2020). The results obtained will likely contribute to further understanding of the construction skills of beavers and add to the knowledge of this species.

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Data availability The data used to support the findings of this study are include within the article.

Declarations

Conflict of interest The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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