Methods for Detecting Cavities Caused by Beavers in Forelands and Levees

Field survey at the Oder River in Brandenburg/Germany

Torsten Heyer (torsten.heyer@tu-dresden.de), Dirk Fleischer; Institute for Hydraulic Engineering and Technical Hydromechanics, TU Dresden (Germany)

Jörg Steidl; Leibniz-Centre for Agricultural Landscape Research (ZALF) e. V., Müncheberg (Germany)

Motivation

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. Furthermore, these **cavities can be dangerous with regard to river maintenance works**. 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.

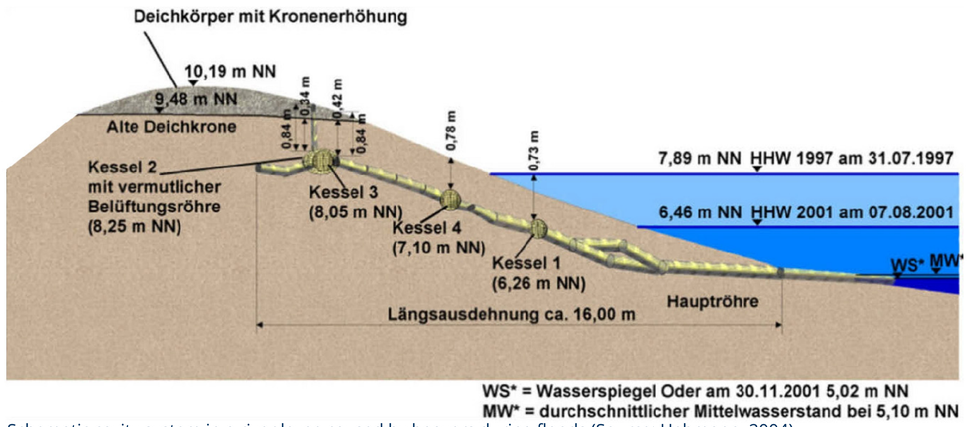

Figure 1 – Schematic cavity system in a river levee caused by beavers during floods (Source: Hahmann, 2004)

Figure 2 –Entrance to a beaver-caused cavity system in a river levee (Photo: LfU Brandenburg)

Figure 3 –Failure foreland sections due to beaver-caused cavities (Photo: Krüger)

Figure 4 –Accident during river maintenance works due to cavities (Photo: Van der Steen)

Field Survey & Methods

As a result of an initial research, the following 10 methods were tested in a field survey (partly also in laboratory pre-tests):

- **Ground penetrating radar (GPR)**
- **Frequency domain electromagnetics (FDEM)**
- **Microwave sensing**
- **Electrical resistivity tomography (ERT)**
- **Geomagnetics**
- **Tracking dog**
- **Multispectral imaging**
- **Thermal imaging**
- **Satellite radar interferometry (InSAR)**
- **UW-photogrammetry (UUV, GoPro)**

The validation of the measured data was carried out by means of **penetration tests**.

Results

As a result of the field investigations, which took place over the period June-September 2020, the following can be stated: :

— **none of the methods** investigated **could demonstrate a clear suitability** for cavity detection

— in the foreland area some cavities caused by beavers could be detected by the methods **ground penetrating radar, geomagnetics** and by **tracking dogs**

— (some) **cavities in the river levee** were **detected by ground penetrating radar** exclusively

— although the ground penetrating radar and geomagnetics were able to detect some cavities, both geophysical methods cannot be used for large-scale cavity detection at river levees, since a drone-based application is not possible

Discussion

Even though none of the investigated methods led to a clear success, the results obtained represent a good basis for further investigations on this topic.

In addition to **georadar, geomagnetics** and **tracking dogs**, the appropriate use of the **thermal imaging** and **multispectral cameras will be further investigated** in the future. Assuming their general capability of detecting beaver-caused cavities, the advantage of both methods is that airborne measurements are possible (drone-mounted).

The **hypothesis** that **beaver-caused cavities can be detected with infrared and/or multispectral cameras under certain environmental conditions** will be explored in a field test at a retention basin in Saxony/Germany. Since the detection of cavities is not only relevant for hydraulic engineering, a **closer cooperation with other experts, e.g. biologists is desirable.**

Figure 5 –Investigation area at the Oder River in Brandenburg/Germany - Oxbow lake along the waterside toe of a flood levee

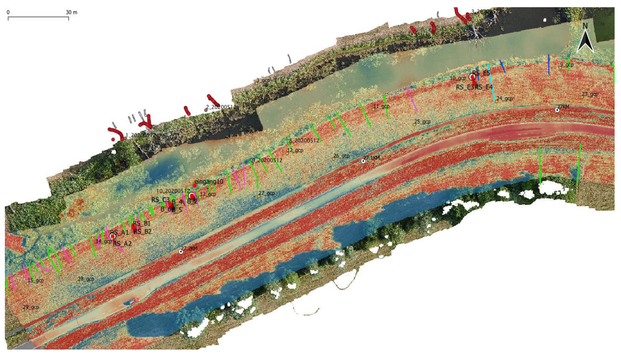

Figure 6 – Thermal image of the investigation area taken from a drone mounted infrared camera

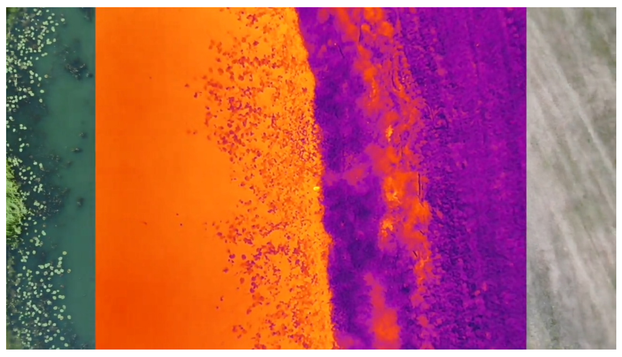

Figure 7 –Screenshot of a video created by a drone mounted infrared camera showing a beaver (yellow dot) and inhomogeneities in the foreland → **scan QR-code to watch the full video!**

Watch Video!

Project reports (in German only):

Research Report about Potential Methods

Report about Field Survey

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Contact Details:
Technische Universität Dresden
Institute for Hydraulic Engineering and Technical Hydromechanics (IWD)
Dr.-Ing. Torsten Heyer
01062 Dresden
Germany

Phone: +49 (0)351 463-33874
E-Mail: torsten.heyer@tu-dresden.de
Web: www.iwd.tu-dresden.de

LfU Landesamt für Umwelt

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IWD Institut für Wasserbau und Technische Hydromechanik