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MANAGEMENT OF THE HYDROTECHNICAL TORRENT CONTROL STRUCTURES IN TEN TORRENTIAL VALLEYS LOCATED IN PRAHOVA COUNTY

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Abstract

The aim of this study was to assess the status of the hydrotechnical torrent control works located in ten managed torrential valleys from Prahova County. The works were visually assessed by using a simplified version of the methodology developed in 2014 by the staff of "Marin Drăcea" National Research-Development Institute in Forestry together with the staff from Faculty of Silviculture and Forest Engineering from Brașov. The damages and disfunctionalities were recorded separately for the transverse and longitude structures. The inventory was done between 6th of March and 16th of April 2016. In total, 144 hydrotechnical works were assessed (3 evacuation canals, 17 sills and 124 dams). The main identified damages consisted in detachments located in the overflowed area. Regarding the identified disfunctionalities, almost three quarters of inventoried works were affected by the clogging in various degrees (ranging generally between 50-70%), located both in spillway and apron. The high percentages of damages and disfunctionalities are due, most likely, to the lack or low number of interventions of maintenance and/or repair, especially for works carried out in the sixth and seventh decades of the last century. These findings should be regarded as a warning both for the local and national authorities, but also for the administrators of the forest fund.

Key words**:** *hydrotechnical structures, Prahova County, torrent control, torrential valleys*

INTRODUCTION

Hydrological and antierosional functions of the forests are very important in small predominately forested watersheds. Due to their high retention capacity, forests play a key role in preventing floods [2]. Properly managed, healthy, mixed, and ecologically stable forests provide the optimum hydrological function [14]. Recently, it has been reported that globally the frequency of extreme events has increased due to climate change, causing several damages to forests, flooding being among the ones with the highest impact [12].

In this context, the management of the hydrotechnical torrent control structures from the forested watersheds plays a key role and can lead to multiple effects in terms of hydrological, antierosional, economical and social plans [15].

One of the main functions of the torrent control structures is to reduce the intensity of erosion processes [8], especially in low forested watersheds. Also, the torrent control works are meant to avoid or reduce the damages that may be caused by torrential floods [19]. As an example, in Serbia, according to the records from the period 1915-2013, 848 torrential flood events were registered and 133 deaths caused by torrential events were recorded [13]. In Romania, the first studies regarding the management of torrential watersheds started in 1933, when "Marin Drăcea" National Research-Development Institute in Forestry was founded [10]. Like in Bulgaria, Macedonia, and Serbia, the time span between the fifth and the ninth decades of the last century was considered the "golden period" of erosion control in Romania [1], [11]. According to statistics, in the period 1950-2007, in Romania, more than 2,700 longitude hydrotechnical works and 14,600 transverse hydrotechnical structures were constructed [9]. These works are affected by continuing degradation mainly caused by the erosion, but also by the installation of forest vegetation, such as willows or alders, in the execution zone

of the constructions [4]. In this context, the monitoring of the torrent control structures provides useful information regarding their response to torrential floods and represents a key component in managing the resources required for their repairing [6].
The aim of this study was to assess the status of the hydrotechnical torrent control works located in ten managed torrential valleys from Prahova County.

MATERIALS AND METHODS

Ten torrential valleys from Prahova County were taken into consideration, namely Valea Florei, located closed to Posada village (N 45°16'41.6'', E 25°37'20.1''), Valea Conciului, located between Posada and Sinaia near national road no. 1 (N 45°17'27.2'', E 25°36'40.3''), Valea Orății, located near the town of Sinaia (N 45°17'42.7'', E 25°35'53.9''), Valea Dragă, located near Timișul de Jos train station (N 45°34'27,0'', E 25°36'49,1''), Valea lui Bogdan, located near Sinaia (N 45°18'27.7'', E 25°34'26.2''), Valea Doftanei, located very close to Paltinu Dam, Valea Urlătoarei, located near the neighborhood of Poiana Țapului (N 45°23'37.0'', E 25°32'05.5''), the valleys between Sinaia and Bușteni (the valleys located on the right bank of Prahova River), the valleys between Predeal and Timișul de Sus, the valleys between Măneciu and Cheia.
The works were visually assessed from downstream to upstream, by using a simplified version of the methodology developed in 2014 by the staff of "Marin Drăcea" National Research-Development Institute in Forestry together with the staff from Faculty of Silviculture and Forest Engineering from Brașov [17].
The damages and the disfunctionalities were recorded, separately for the transverse and longitude structures, respectively.
The inventory was done between 6th of March and 16th of April 2016.

RESULTS AND DISCUSSIONS

In total, more than 11 km of valleys were inventoried and 144 hydrotechnical works were assessed (3 evacuation canals, 17 sills and 124 dams). A larger number of dams, in comparison with other works, was also recorded for the Upper Tărlung Watershed, along the 21 torrential valleys [3].
Most of inventoried works were made of stone masonry with cement mortar, like in the case of torrent control structures within the Natura 2000 sites managed by RPLP Kronstadt and RPLP Săcele [18].
The main identified damages consisted in detachments located in the overflowed area (Figure 1), 58 works being in this situation.


Fig. 1. Dam with damages in the overflowed area

Moreover, approximately 15% of the inventoried structures had detachments also located on the left and on the right of the spillway (Figure 2).


Fig. 2. Damages located to the side of the spillway

The event of undermining of the body caused damages for 9% of the inventoried works (Figure 3). Undermining of the body was among the most common damages also in the case of Cârcinov River Catchment [16] or in the case of the Upper Basin of the Someșul Mic River [7].

Fig. 3. Undermining of the body of a work

Regarding the identified disfunctionalities, almost three quarters of inventoried works were affected by the clogging in various degrees (ranging generally between 50-70%), located both in spillway and apron (Figure 4).
About a third of the works were completely clogged in the spillway and about 15% in the apron.

Fig. 4. Dam with clogging in spillway and in apron

Moreover, the uncontrolled installation of forest vegetation was among the main disfunctionalities identified. The main species were represented by goat willow (*Salix caprea* L.), common aspen (*Populus tremula* L.), grey alder [*Alnus incana* (L.) Moench] and beech (*Fagus sylvatica* L.). Similar results were recorded also in the case of Cârcinov River Catchment, where 48 structures were affected by this event [13].
In our study, in 82 cases (57%), the vegetation was installed in the upstream of the work, and in 54 cases (38%) in the downstream of the work.
In 52 cases (36%) the forest vegetation was installed both in upstream and downstream of the structure (Figure 5).

Fig. 5. Uncontrolled forest vegetation installed both upstream and downstream of the structure

The high percentages of damages and disfunctionalities are due, most likely, to the lack or low number of interventions of maintenance and/or repair, especially for works carried out in the sixth and seventh decades of the last century. These deficiencies were also reported in the case of the torrent control structures within Natura 2000 sites managed by RPLP Kronstadt and RPLP Săcele [18].
Also, the poor funding in recent years could contribute as well to the lack of interventions.
These findings combined with the fact that in Romania's forest region more than 4.000 kilometers of hydrographic network are intensely torrentialised [5], should be a warning both for the local and national authorities, but also for the administrators of the forest fund.

CONCLUSIONS

Based on these results, we can say that in general, due to the recorded damages and disfunctionalities, the hydrotechnical works no longer efficiently fulfill the role for which they were constructed.

Even if generally the works made of concrete showed greater resistance over time, we still recommend the use of materials locally, namely the stone used in masonry, which, under proper maintenance, provides similar benefits like the structures made of concrete.

Taking into account the results of this study and corroborating them with the location of the most of the hydrotechnical torrent control works, we recommend that the repair work should been done with priority in the torrential valleys located upstream of important objectives such as national roads and localities of national interest.

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