IMPROVE RIVER LIFE

Improving degree of conservation of Natura 2000 target species and habitat types through improvement of river connectivity

Project number: LIFE22-NAT-HR-Improve River LIFE/ 101114250

Report on the integration of databases on artificial barriers on watercourses and gap analysis results

Co-funded by the European Union

NATURA 2000

ENVIRONMENTAL PROTECTION AND ENERGY EFFICIENCY FUND

REPUBLIC OF CROATIA
Ministry of Environmental Protection and Green Transition

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Project name	Improve River LIFE - Improving the conservation status of target Natura 2000 species and habitat types through improved river connectivity
Project number	LIFE22-NAT-HR-Improve River LIFE/101114250
Title	Protocol for restoration and maintenance of riparian vegetation
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Contents

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INTRODUCTION

T.3.1 task - Mapping based on available data (Desktop mapping)

This report covers the activities carried out under the task **T.3.1 Mapping based on available data** , part of the work package WP3, coordinated by **the Ministry of Environmental Protection and Green Transition (MZOZT)** , in cooperation with **Croatian Waters (HV)** . The aim of the task was to collect and analyse available data on artificial river barriers in order to assess their basic characteristics.

DATA SOURCES

The available source of data on artificial obstacles on watercourses was the National Register of Hydrotechnical Facilities (NRHO) (Croatian Waters), which contains information on 35 types of hydrotechnical structures in GIS format, and the VEPAR project database (35 types of hydrotechnical structures and other elements such as vectorized waterways) implemented by the Croatian Navy and completed in 2022. Through it, the NRHO was supplemented with new field data, including estimates of the dimensions and status of obstacles, and the data was provided by the Croatian Navy. The European AMBER project developed the mobile application "Barrier tracker" and the transnational database Barrier Atlas for storing data on obstacles across Europe (https://amber.international/about/), which contains about 630,000 unique records of obstacles (including about 80 from Croatia). The mobile application has been translated into Croatian.

Characteristics of available databases, their integration and gap analysis

The GIS layers of the VEPAR project were divided by VGO (water management departments: VGO for the southern Adriatic basins, VGO for the northern Adriatic basins, VGO for the middle and lower Sava, VGO for the upper Sava, VGO for the Danube and lower Drava and VGO for the Mura and upper Drava) and by type of structure, and the NRHO consisted of layers by type of water structures for the entire country. It was determined that the entire NRHO was contained within the VEPAR database, so the VEPAR project data were used further, with some specific types of obstacles supplemented by NRHO due to differences in classification (e.g. mills). NRHO and VEPAR contain predominantly point layers and some line layers (Tables 1 and 2). The spatially divided VEPAR project data (6 x 35 layers) were merged into a single GIS file of hydrotechnical structures. Then, from the list of water structures, those that, based on their geometric characteristics, can be concluded to represent an obstacle to the movement of fish and the transport of sediment, were selected. All these buildings were already shown as points except for the culverts which were converted from line objects to point objects (center of the line). Longitudinal coastal fortifications and embankments are left in the representation as linear structures that can interfere with the transverse connection of watercourses. Attribute tables of GIS layers in VEPRU and AMBER contained dozens of columns with different types of hydrotechnical facilities included in the database. From the VEPAR project, 18 types of water structures were identified that can be assumed to be obstacles.

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Table 1. Types of hydrotechnical facilities in the NRHO.

NAME OF THE STRUCTURE IN VEPAR DATABASE[1]		POTENTIAL OBSTACLE*		NUMBER IN NRHO
		TRANSVERSAL	LONGITUDINAL	
TOČKE				
1	BRANA AK	YES	NO	53
2	BRANA MLIN	YES	NO	5
3	BRANA RET	YES	NO	51
4	BRZOTOK	NO	NO	80
5	CEP	NO	NO	439
6	CS_N	NO	NO	439
7	HE IZGRAĐENA	YES	NO	59
8	KASKADA	NO	NO	4
9	KUPALIŠTE	NO	NO	69
10	LUKA N	NO	NO	16
11	MLIN	YES/NO	NO	576
12	PERO	YES	NO	262
13	MOSTOVI_SPOJENI_2	NO	NO	2295
14	PILANA	YES/NO	NO	13
15	PRAG_N	YES	NO	496
16	PREGRADA_N	YES	NO	1719
17	PRELJEV N	YES/NO	NO	44
18	PREVODNICA_N	YES	NO	2
19a	PROPUSTI	YES/NO	NO	4251
20	STEPENICA_N	YES	NO	2779
21	TERMOELEKTRANA	NO	NO	7
22	USTAVA_N	YES	NO	315
23	UTOK_N	NO	NO	40
LINIJE				

[1] BRANA AK – accumulation dam, BRANA MLIN – water mill dam, BRANA RET – retention dam, BRZOTOK -fast flow, CEP - cap, CS_N – pumping station, HE IZGRAĐENA – build hydropower plant, KASKADA - cascade, KUPALIŠTE – swimming area, LUKA N – nautical port, MLIN – mill, PERO – wing dam, MOSTOVI_SPOJENI_2 – bridges, PILANA – saw mill, PRAG_N – weir, PREGRADA_N – barrier, PRELJEV N – spillway, PREVODNICA_N – ship lock, PROPUSTI SPOJENI_2 – culvert, STEPENICA_N – step, TERMOELEKTRANA – termal power plant, USTAVA_N – weir, UTOK_N – mouth, NASIP _L – embankment, OB_UT_L – revetment, POT_OBL-KO_L – submerged revtment, cut cannal, REGZ_ZAT_L –cap regulator, ŠLJUN_L – gravel embankment, ZIDL_L – wall, AKU/RET - akumulacija/retencija, JEZERO UMJETNO - umjetno jezero, RIBNJAK - ribnjak,
ŠLJUNČARE – gravel pit, SOLANE – saltworks; * - mark YES/NO, or NO/YES means that it cant be determined if it is an barrirerr or not

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NAME OF THE STRUCTURE IN VEPAR DATABASE[1]		POTENTIAL OBSTACLE*		NUMBER IN NRHO
		TRANSVERSAL	LONGITUDINAL	
24	NASIP _L	NO/YES	YES	1243
25	OB_UT_L	NO	YES	1271
26	POT_OBL-KO_L	NO	YES	331
27	PROKOP_L	NO	NO	17
19b	PROPUSTI	YES/NO	NO	757
28	REGZ_ZAT_L	NO	NO	146
29	ŠLJUN_L	YES	YES	4
30	ZIDL_L	YES	YES	64
POLIGONI				
31	AKU/RET	YES/NO	NO	173
32	JEZERO UMJETNO	YES/NO	NO	13
33	RIBNJAK POLY	NO	NO	55
34	ŠLJUNČARE	NO	NO	20
35	SOLANO	NO	NO	4

Table 2. Hydrotechnical facilities that potentially represent obstacles in the VEPAR database

	POTENTIAL OBSTACLES IN VEPAR[1]	NUMBER IN VEPAR
1	BRANA	11
2	BRANA_AK	73
3	BRANA_RET	64
4	CHE	2
5	HE	37
6	JEZ_AKU	15
7	JEZ_RET	10
8	KASKADA	10
9	MHE	56
10	MLIN	28
	PERO	843
11	PILANA	9
12	PRAG	637
13	PRAG-GAT	1
14	PREGRADA	2065
15	PRELJEV	38
16	PROPUST	5058
17	RHE	2

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	POTENTIAL OBSTACLES IN VEPAR[1]	NUMBER IN VEPAR
18	STEPENICA	3848
19	USTAVA	380
	Ukupno	**13187**

Culverts were represented as points (Table 1. 19a; 4251) and as lines in the database (Table 1. 19b; 757) in only one VGI, and all were converted into point geometry (line centroids) so that there were 5008 of them in total. Culverts are located mainly on the large rivers Sava, Drava and Danube and represent a partial obstacle to the movement of fish along the coast, which can be important for young fish. They are geometrically represented as lines, and some as points , and the data were merged and entered into the database, although they are also in separate line and point layers. From the VEPAR database dataset, hydrotechnical objects that can affect the transverse passage for aquatic organisms due to their geometric characteristics (Table 2) were extracted and entered into the obstacle database. Spatially separated data by VGOs were merged and coordinates for all objects in the WGS84 system were calculated.

The AMBER database has identified around 80 reported structures from the territory of the Republic of Croatia. The AMBER project classifies hydrotechnical structures that may represent potential obstacles for fish into 21 groups. These are mainly transverse obstacles, and only point data are entered into the database (Table 3). AMBER describes 19 identical attributes (columns) for all types of hydrotechnical structures, and divides them into three groups depending on the level of expertise of the person entering them into the database (Table 4, Figures 1, 2 and 3).

Table 3. Categories of point data from AMBER translated from English to Croatian and their compatibility with VEPAR categories and categories transferred to the project database

AMBER - English	**AMBER - Croatian**	**VEPAR -category**	**IMPROVE RIVER LIFE - category**
Dam	**Brana**	**Brana** **Brana AK,** **Brana RET**	**Brana**
A dam is a barrier that blocks or constrains the flow of water and raises the water level.	Brana je prepreka koja zaustavlja ili ograničava tok vode i podiže njezinu razinu.		
Dam Type	**Vrste brana**		
Overflow Dam	**Preljevna brana**	**Preljev**	**Preljev**
An overflow dam is a barrier in which water can flow over the top of the structure.	Preljevna brana je prepreka kod koje se voda može prelijevati preko vršnog dijela objekta.		
Wing Dam	**Pero**	**Pero**	**Pero – linijski podatak**
A wing dam is a dam that only extends	Pero je brana koja se samo dijelom proteže u rijeku ili potok.		

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AMBER - English	AMBER - Croatian	VEPAR -category	IMPROVE RIVER LIFE - category
partially into a river or stream.			
Check Dam	**Stepeničasta brana**	**Stepenica**	**Stepenica**
A check dam is a barrier used in mountainous regions to cause sedimentation or reduce the slope of the river.	Stepeničasta brana je prepreka koja se gradi u planinskim regijama s ciljem sedimentacije odnosno smanjenja nagiba rijeke.		
Arch Dam	**Lučna brana**	**Nema u Vepru**	**Lučna brana**
An arch dam is a barrier with a curved structure.	Lučna brana je prepreka zakrivljene strukture.		
Barrage Dam	**Baraža**	**Zapornica**	**Zapornica**
A barrage dam is a barrier that consists of gates which can be opened and closed.	Baraža je prepreka koja se sastoji od zapornica koje se mogu otvarati i zatvarati.		
Embankment Dam	**Nasipna brana**	**Kategorije nema u bazi Vepar**	**Nasipna brana**
An embankment dam is large a barrier which resists the pressure of the water by the mass of its design.	Nasipna brana je velika prepreka koja pruža otpor pritisku vode svojom projektnom masom.		
Weir	**Prag**	**Prag**	**Prag, prag-gat**
A weir is a barrier aimed at regulating flow conditions and water levels.	Prag je prepreka čiji je cilj regulacija toka i razina vode.		
Weir Type	**Vrste pragova**		
Vertical Weir	**Vertikalni prag**	**Kategorije nema u bazi Vepar**	**Vertikalni prag**
A vertical weir is a weir that consists of a vertical drop wall or a crest wall.	Vertikalni prag je prag koji se sastoji od okomitog zida ili grebena.		
Sloping Weir	**Kosi prag**	**Kategorije nema u bazi Vepar**	**Kosi prag**
A sloped weir is a weir that consists of a slope that overflows over the top.	Kosi prag je prag s kosim preljevom na vrhu.		
Stepped Weir	**Stepenasti prag**	**Kaskade**	**Kaskade**
A stepped weir is a weir that is	Stepenasti prag je prag koji je prepoznatljiv po		

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AMBER - English	AMBER - Croatian	VEPAR -category	IMPROVE RIVER LIFE - category
recognizable by its stair-like shape.	svojem izgledu u obliku stepenica.		
Culvert	**Propust**	**Propust**	**Propust**
A culvert is a structure aimed at carrying a stream or river under an obstruction.	Propust je objekt čiji je cilj usmjeravanje potoka ili rijeke ispod zapreke.		
Ford	**Gaz (plitki prijelaz)**	**Gaz**	**Gaz**
A ford is a structure in a river or stream which creates a shallow place for crossing the river or stream by wading or in a vehicle.	Gaz je objekt u rijeci ili potoku koji stvara plićak za prelaženje rijeke ili potoka gaženjem ili vozilom.		
Sluice	**Otvor zapornica**	**Ustava**	**Ustava**
A sluice is a movable barrier aimed at controlling water levels and flow rates in rivers and streams.	Otvor zapornica je mobilna prepreka čiji je cilj kontrola razine i toka vode u rijekama i potocima.		
Ramp	**Rampa**	**Rampa**	**Rampa**
A- ramp or a bed sill is a structure aimed at stabilizing the channel bed and reducing erosion	A ramp or riverbed sill is a structure whose purpose is to stabilize the riverbed and reduce erosion.		

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Table 4. AMBER project attribute data .

The required database attributes are:
For non-experts:
Barrier photo
Date of record
Barrier location (Location)
They are optional.
Barrier Type
Barrier Height
Extent
Condition
For experts additionally:
Object category with additional features
Weir – vertical, sloped, stepped
Dam - overflow dam, wing dam, check dam, arch dam, embankment dam, do not know
Additional information
Is there a fish pass (yes or no).
River width estimate in meters
Water level at the time of observation (low, medium, high)

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Question	Obligation to submit record	Automatic or manual	Answer types
Barrier Photo	Obligatory	Automatic opening, manual shutter control and option to retake image: camera opens upon opening "record obstacle" page	User defined (photo)
Date of record	Obligatory	Automatically, upon taking photo	Date in format Hours/minutes/seconds & Day/month/year
Barrier Type	Optional	Manual	Weir, dam, culvert, ford, sluice, ramp (with images to aid in making the choice)
Barrier Height	Optional	Manual	Height categories: <0.5 meters; 0.5 - 1.0 m; 1.0 – 2.0 m; 2.0 – 5.0 m; 5.0 – 10.0 m; >10.0 m
Does the barrier extend across the entire watercourse?	Optional	Manual	yes/no
Is the barrier in working condition?	Optional	Manual	yes/no/don't know
Please add any additional notes	Optional	Manual	
Barrier Location (Geo-location of obstacle)	Obligatory	Automatic, upon taking photo. Prompt for GPS (locate) to be used if not switched on. App records whether location was taken based on GPS, phone signal or both.	lat/long coordinates via GPS chipset on phone and where there is a suitable signal, the phone signal.

Figure 1. View of the first level page "Record a new obstacle" with the attributes included in the AMBER application

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Category selected following 'obstacle type' question	Additional information collected (pt1)	Additional information collected (pt2)
Weir	Vertical, sloped, stepped	-
Dam	overflow dam; wing dam; check dam; arch dam; barrage; embankment dam; don't know	-
Culvert	(1) width of culvert; don't know	
Ford	(1) depth category: dry; shallow (<15cm); deep (>15cm); don't know	-
Sluice	(1) width of sluice gate; don't know	(2) depth of sluice gate; don't know
Ramp		

Figure 2. View of the second level page "Record a new obstacle" with the attributes included in the AMBER application

Question	Additional information collected (pt1)
Fish pass present?	yes/no/don't know
River width	Estimate in meters; don't know
River Name	Name of rive
Flow conditions	Flow condition at time of recording: Low/regular/ high

Figure 3. View of the second level page "Record a new obstacle" with the attributes included in the AMBER application

Given that the AMBER database is the project's reference database that stores data for the whole of Europe, we implemented database integration in such a way as to transfer hydrotechnical facilities from the VEPAR database to 21 classes with English names from the AMBER project. For this purpose, we used the technical documentation of the AMBER mobile application, which has already been translated into Croatian. This was not entirely unambiguous, and several groups were combined into one, and some subgroups could not be determined from the available data (Table 3). The necessary attribute data applicable to the AMBER project was taken from the attributes of hydrotechnical facilities in the VEPAR database. This was only possible for the height attribute for part of the objects. Heights from VEPAR were converted into height classes of the Amber project and thus harmonized and applied in the unified database. All data were combined and transferred to the WGS84 coordinate system, entered into the downloaded table of the AMBER project (compatibility was ensured), after which they were entered into GIS. It was determined that none of the databases had accurate spatial accuracy in displaying obstacles and that the deviation in relation to the location of watercourses or each other was from 0 to 10 meters.

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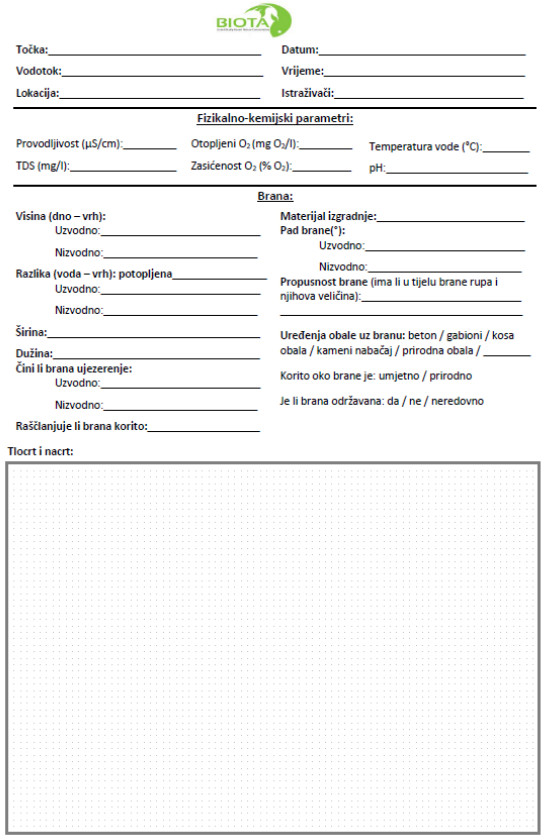
Categories from VEPAR that are not in AMBER:

- PREGRADE - Barriers are transverse regulatory structures whose task is to reduce the speed of water flow in torrents, thereby stopping and depositing torrential sediment. The heights of the partitions are 2 meters and more and consolidate the transverse profile of the torrent bed in the longitudinal and transverse sense.

- REGULACIJSKE PREGRADE - Regulation barriers are transverse regulation structures that are built mainly between existing river islands and the coast in order to reduce or completely eliminate river flow.

The data from AMBER was expanded with relevant attributes related to walkability from the VEPAR database, and based on further analysis, i.e. the need for prioritization, additional attributes will be entered for a more complete database. Part of the additional data will be collected directly by field visits and filling out a form that is planned to be created based on a combination of data from the forms developed by the BIOTA association for the Korana river as part of the "Free Korana river" project and The Nature Conservancy (TNC) for the obstacle mapping project in the state of Maine (USA) for natural and man-made obstacles (Figure 4).


BIOTA

Točka:_____ Datum:_____

Vodotok:_____ Vrijeme:_____

Lokacija:_____ Istraživači:_____

Fizikalno-kemijski parametri:

Provodljivost (µS/cm):_____ Otopljeni O_2 (mg O_2/l):_____ Temperatura vode (°C):_____

TDS (mg/l):_____ Zasićenost O_2 (% O_2):_____ pH:_____

Brana:

Visina (dno – vrh):
Uzvodno:_____
Nizvodno:_____

Razlika (voda – vrh): potopljena_____
Uzvodno:_____
Nizvodno:_____

Širina:_____

Dužina:_____

Čini li brana ujezerenje:
Uzvodno:_____
Nizvodno:_____

Raščlanjuje li brana korito:_____

Materijal izgradnje:_____

Pad brane(°):
Uzvodno:_____
Nizvodno:_____

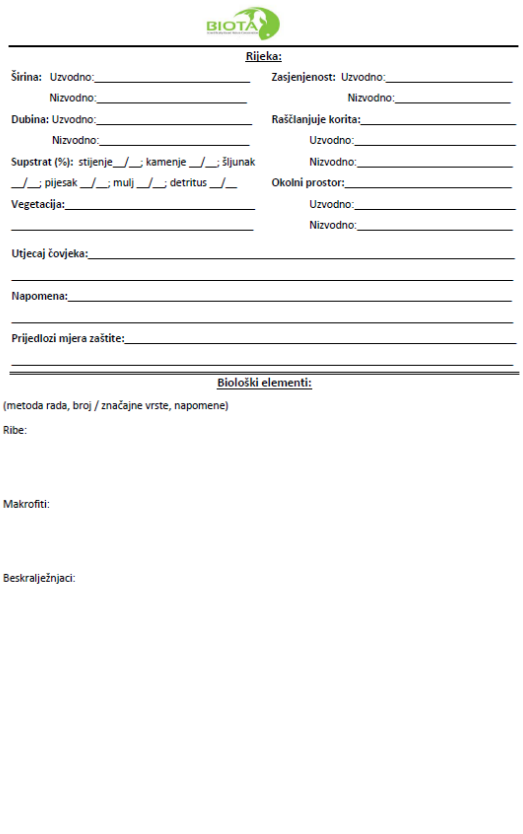
Propusnost brane (ima li u tijelu brane rupa i njihova veličina):_____

Uređenja obale uz branu: beton / gabioni / kosa obala / kameni nabačaj / prirodna obala / _____

Korito oko brane je: umjetno / prirodno

Je li brana održavana: da / ne / neredovno

Tlocrt i nacrt:


BIOTA

Rijeka:

Širina: Uzvodno:_____ Zasjenjenost: Uzvodno:_____
Nizvodno:_____ Nizvodno:_____

Dubina: Uzvodno:_____ Raščlanjuje korita:_____
Nizvodno:_____ Uzvodno:_____

Supstrat (%): stijenje__/__; kamenje __/__; šljunak __/__; pijesak __/__; mulj __/__; detritus __/__ Nizvodno:_____

Okolni prostor:_____

Vegetacija:_____ Uzvodno:_____
_____ Nizvodno:_____

Utjecaj čovjeka:_____

Napomena:_____

Prijedlozi mjera zaštite:_____

Biološki elementi:

(metoda rada, broj / značajne vrste, napomene)

Ribe:

Makrofiti:

Beskralježnjaci:

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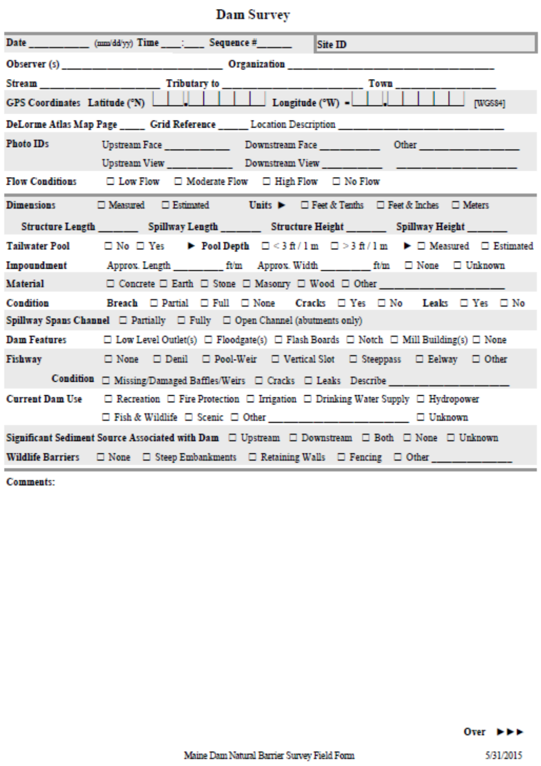


Dam Survey

Date __________ (mm/dd/yy) Time ___:___ Sequence #______ Site ID

Observer (s) ____________________ Organization ____________________

Stream ______________ Tributary to ______________ Town ______________

GPS Coordinates Latitude (°N) ______ Longitude (°W) -______ [WGS84]

DeLorme Atlas Map Page ____ Grid Reference _____ Location Description ____________

Photo IDs Upstream Face __________ Downstream Face __________ Other ______________

Upstream View __________ Downstream View __________ ______________

Flow Conditions ☐ Low Flow ☐ Moderate Flow ☐ High Flow ☐ No Flow

Dimensions ☐ Measured ☐ Estimated Units ▶ ☐ Feet & Tenths ☐ Feet & Inches ☐ Meters

Structure Length ______ Spillway Length ______ Structure Height ______ Spillway Height ______

Tailwater Pool ☐ No ☐ Yes ▶ Pool Depth ☐ < 3 ft / 1 m ☐ > 3 ft / 1 m ▶ ☐ Measured ☐ Estimated

Impoundment Approx. Length ________ ft/m Approx. Width ________ ft/m ☐ None ☐ Unknown

Material ☐ Concrete ☐ Earth ☐ Stone ☐ Masonry ☐ Wood ☐ Other ______________

Condition Breach ☐ Partial ☐ Full ☐ None Cracks ☐ Yes ☐ No Leaks ☐ Yes ☐ No

Spillway Spans Channel ☐ Partially ☐ Fully ☐ Open Channel (abutments only)

Dam Features ☐ Low Level Outlet(s) ☐ Floodgate(s) ☐ Flash Boards ☐ Notch ☐ Mill Building(s) ☐ None

Fishway ☐ None ☐ Denil ☐ Pool-Weir ☐ Vertical Slot ☐ Steeppass ☐ Eelway ☐ Other

Condition ☐ Missing/Damaged Baffles/Weirs ☐ Cracks ☐ Leaks Describe ______________

Current Dam Use ☐ Recreation ☐ Fire Protection ☐ Irrigation ☐ Drinking Water Supply ☐ Hydropower

☐ Fish & Wildlife ☐ Scenic ☐ Other ______________ ☐ Unknown

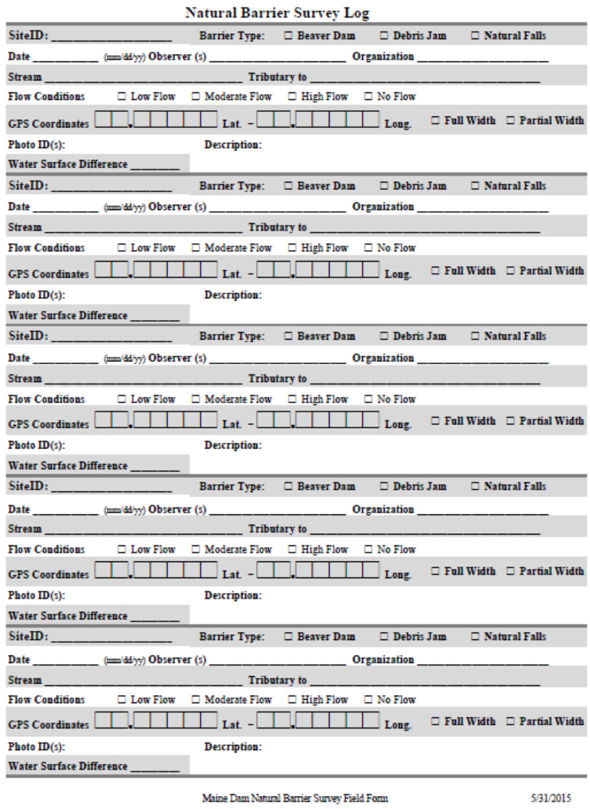
Significant Sediment Source Associated with Dam ☐ Upstream ☐ Downstream ☐ Both ☐ None ☐ Unknown

Wildlife Barriers ☐ None ☐ Steep Embankments ☐ Retaining Walls ☐ Fencing ☐ Other ______________

Comments:

Over ▶▶▶

Maine Dam Natural Barrier Survey Field Form 5/31/2015



Natural Barrier Survey Log

SiteID: ______________ Barrier Type: ☐ Beaver Dam ☐ Debris Jam ☐ Natural Falls
Date __________ (mm/dd/yy) Observer (s) ______________ Organization ______________
Stream ______________ Tributary to ______________
Flow Conditions ☐ Low Flow ☐ Moderate Flow ☐ High Flow ☐ No Flow
GPS Coordinates ______ Lat. -______ Long. ☐ Full Width ☐ Partial Width
Photo ID(s): Description:
Water Surface Difference ________

SiteID: ______________ Barrier Type: ☐ Beaver Dam ☐ Debris Jam ☐ Natural Falls
Date __________ (mm/dd/yy) Observer (s) ______________ Organization ______________
Stream ______________ Tributary to ______________
Flow Conditions ☐ Low Flow ☐ Moderate Flow ☐ High Flow ☐ No Flow
GPS Coordinates ______ Lat. -______ Long. ☐ Full Width ☐ Partial Width
Photo ID(s): Description:
Water Surface Difference ________

SiteID: ______________ Barrier Type: ☐ Beaver Dam ☐ Debris Jam ☐ Natural Falls
Date __________ (mm/dd/yy) Observer (s) ______________ Organization ______________
Stream ______________ Tributary to ______________
Flow Conditions ☐ Low Flow ☐ Moderate Flow ☐ High Flow ☐ No Flow
GPS Coordinates ______ Lat. -______ Long. ☐ Full Width ☐ Partial Width
Photo ID(s): Description:
Water Surface Difference ________

SiteID: ______________ Barrier Type: ☐ Beaver Dam ☐ Debris Jam ☐ Natural Falls
Date __________ (mm/dd/yy) Observer (s) ______________ Organization ______________
Stream ______________ Tributary to ______________
Flow Conditions ☐ Low Flow ☐ Moderate Flow ☐ High Flow ☐ No Flow
GPS Coordinates ______ Lat. -______ Long. ☐ Full Width ☐ Partial Width
Photo ID(s): Description:
Water Surface Difference ________

SiteID: ______________ Barrier Type: ☐ Beaver Dam ☐ Debris Jam ☐ Natural Falls
Date __________ (mm/dd/yy) Observer (s) ______________ Organization ______________
Stream ______________ Tributary to ______________
Flow Conditions ☐ Low Flow ☐ Moderate Flow ☐ High Flow ☐ No Flow
GPS Coordinates ______ Lat. -______ Long. ☐ Full Width ☐ Partial Width
Photo ID(s): Description:
Water Surface Difference ________

Maine Dam Natural Barrier Survey Field Form 5/31/2015

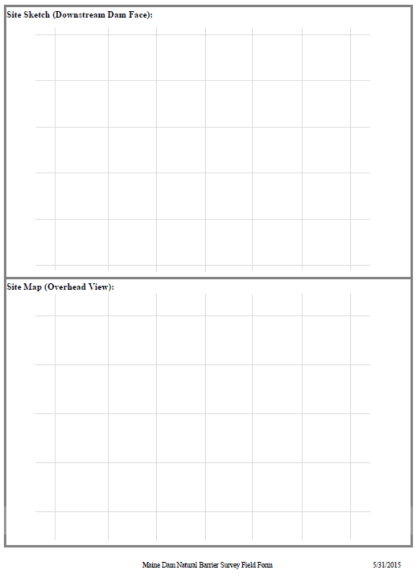


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Figure 4. Examples of forms developed by BIOTA and TNC.

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The database is located on the internal and public web portal of the Nature Protection Information System - Bioportal (https://interni.bioportal.hr/gis/ ; https://bioportal.hr/gis), through which it will be available to experts and the general public.

The final set of attribute data included for inclusion in the internal Bioportal contains mandatory elements from the AMBER database and the most relevant data from the VEPAR database that are applicable to all types of obstacles (Table 5 and Table 6). Elements specific to individual types of hydrotechnical facilities (e.g. turbine type, spillways) could not be included in the common database for reasons of clarity in order to avoid an excessive number of incomprehensible attributes that are relevant for 1% or even fewer facilities. After the completion of the field survey, it will be seen whether the AMBER data set is satisfactory for Croatian needs or whether it will need to be expanded in accordance with the presented templates (Figure 4).

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Table 5. Attribute data of the layer on the internal Bioportal (planned expansion) with the source of the database

Attribute	Barrier type (cro.)	Barrier type (eng.)	lng	lat	Name of the river	Barrier height (m)	Barrier height (span)	Barrier characteristics	Perception	Date of entry of the barrier	Link
Database from which the attribute was retrieved	VEPAR	AMBER	AMBER		VEPAR	VEPAR	AMBER	VEPAR	VEPAR	AMBER	AMBER
Possible values	VEPAR USTAVA PREGRADA BRANA_RET BRANA_AK KASKADA STEPENICA MLIN PILANA PRAG-GAT JEZ_AKU MHE HE CHE RHE PERO JEZ_RET PRELJEV	Weir Dam Ramp Ford Culvert sluice_gate Cases Cases Barrier Accumulation Dam Stepped Weir Mill Saw Mill Small Hydropower Hydropower Retention Dam Lake Retention Overflow	WGS84		Geographical name or water body number (HV)	in meters	0.5 – 1 m 1 – 2 meters Lt 0.5m 2 - 5m gt 10m ON 5 – 10 meters 0.5 – 1 meter Lt 0 , 5m	Various construction descriptions	Description of the current state	Date	http://...

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Table 6. Overview of attribute data from AMBER that are included (have data) and that are not included (do not have data) in the GIS database layer on the internal Bioportal; February 2025.

AMBER attribute	WEB GIS LAYER
type	included
ing	included
Latin	included
fish_pass	not included
extension	not included
depth	not included
width	not included
usefulness	not included
flow_conditions	not included
height	included
sub_type	not included
type_overflow	not included
type_dam	not included
type_HE	included
type_turbine	not included
country	not relevant
river_name	included
river_width	not included
notebook	included
notebook 2	included
created_at	included
about_id	not included
basin_id	included
type of turbines	included
Hyperlink	included

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CONCLUSION

Height as an attribute is present in all reservoir dams, retention dams, thresholds, barriers and steps. Since there is no attribute of fish passage for any hydrotechnical facility, height is a certain indicator of passage, as well as the complexity of its removal, and these are the types of obstacles on which it would be most effective to continue further research, i.e. to collect additional data. Also, it is important in the future to assign attributes of obstacle functions and the institution responsible for using the obstacle, and the database will also contain links to their photos, especially for priority obstacles, since the database currently does not have the ability to add photos.

From Table 7 it is evident that about 40% of potential obstacles relate to culverts under roads for which most of the attribute data is missing in the database. This is a huge number of objects (about 5000) that represent a potential obstacle, but it is not clear how significant they are. Road crossings over watercourses are a specific topic that needs to be discussed with the transport sector, and in this sense it would be more efficient to conduct their analysis with a lower priority. In this case, they largely do not represent obstacles or are minor jumps and they have been removed from further statistical analyses. Penas as incomplete obstacles are also not proposed for priority analysis.

Table 7. Types of obstacles in the combined database Amber and Vepar

BRANA	dam	11	0,08%
BRANA_AK	Acumulation dam	73	0,55%
BRANA_RET		64	0,49%
CHE	Puppinng hydropower plant	2	0,02%
HE	Hydropower plant	37	0,28%
JEZ_AKU	Acummulation lake	15	0,11%
JEZ_RET	Rettention lake	10	0,08%
KASKADA	cascade	10	0,08%
MHE	Small hydropower plathn	56	0,42%
MLIN	Mill	28	0,21%
PERO	Wing dam	843	6,39%
PILANA	Saw mill	9	0,07%
PRAG	weir	637	4,83%
PRAG-GAT	Weir -d	1	0,01%
PREGRADA	Barier	2065	15,66%
PRELJEV	Spillway	38	0,29%
PROPUST	Culvert	5058	38,36%
RHE	Reversibile hydrowower plant	2	0,02%
STEPENICA	Step	3848	29,18%
USTAVA	Weir	380	2,88%
		13187	100,00%

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The completeness of the attribute information varies for different types of obstacles/water structures. All have information about the location and name of the watercourse (either as a name or as a numerical designation of the water body from the HV database).

A potential problem when entering the AMBER database is represented by the category "barriers", which includes a total of 17% of obstacles (if gaps are removed, then even 28%), which has no defined characteristics and cannot be classified into any of the groups of the AMBER database.

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