Deliverable 2.1.2. Conceptual and physical model of database

GT2. Estimation of mortality in obstacles

December 2019

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INTRODUCTION

In order to carry out a thorough eel assessment in the SUDOE area, a standardization of data collection and assessment methods among the different states is necessary. SUDOANG is working in a coordinated way among GT's and managers to collect all the dispersed information about:

- the abundance,
- the distribution and the biometric characteristics of the eel,
- the environmental characteristics of the basins,
- the impacts of ecological discontinuities on the eels.

The development of the templates has enabled the collection of information (deliverable 1.1.1.), which was already presented and delivered during the kick of meeting. In addition, all data providers have submitted the information available in their area.

DATA MODELLING

Due to the type of data and the needs of the project, the data modelling designed to see how the data will be stored in the database is inherited from the database for eel (DBEEL), developed during the POSE project, which aimed at the current and potential estimation of silver eel in the Baltic, Atlantic and Mediterranean regions. DBEEL provides a practical and cost-effective solution for the management and exchange of information about the species. Its structure can be adopted at different spatial scales, supporting coordinated eel assessment and management.

Because of these advantages, the SUDOANG database maintains the same structure, based on a main network defined by:

- The observation place that refers to the hydrographic network, where all the environmental characteristics of the hydrographic network of the SUDOE area are collected. Due to this structure, other elements such as basins or lakes can also be stored.
- The observations corresponding to the general characteristics of:
    - scientific observations: in our case, electrofishing samples,
    - the impact of pressures: such as physical obstacles or dams, which may have hydroelectric power plants associated with their respective turbines.
- The batch or set of individuals grouped by taxon and life stage, which are sampled during the observation.

- The biological characteristics that characterize each batch, such as age, sex, length or weight.

This structure is observed in the conceptual model (Figure 1), which is also described in a data dictionary produced in deliverable 1.3.2 on the eel database. This conceptual model defines what the data base contains in order to organise and define the concepts and the rules of all the compiled information.

The objective of this deliverable is to explain the conceptual and physical model of data on barriers to migration and particularly to hydroelectric power plant turbines associated with dams. The general model of the SUDOANG database is described in detail in deliverable 1.3.2 on the eel database.

CONCEPTUAL MODEL OF DATABASE ON OBTACLES TO MIGRATION

Data on obstacles to migration and particularly on hydroelectric power plant turbines associated with dams are considered as observations in the conceptual model of the SUDOANG database (Figure 1). The structure of this part of the database is also inherited from the French ROE (Référentiel des Obstacles à l'Ecoulement), BDOe (Base de Données sur les Obstacles à l'écoulement) and ICE (Information sur la Continuité Écologique) databases. These correspond to standardized databases on flow barriers and ecological continuity in France. Figure 2 shows only the conceptual model of the obstacles to migration and the relationships with the possible hydropower plants associated.

As observations, the establishment responsible for providing the data and the person in charge are indicated for each obstacle. These are imported into the database as pressure impacts, indicating the type and number of obstacles (in the case of several associated obstacles, for example). The type of obstacle defines the category of the obstacle, within the SUDOANG project all obstacles are physical obstructions as they are barriers to migration. But this attribute allows to import other obstructions like chemicals, for example. New categories have been included within the physical obstructions (Table 1).

Identifier (no_id)	Code (no_code)	Type (no_name)
218	UN	Unknown
219	PU	Physical obstruction (Unknown)
220	CH	Chemical obstruction
291	DA	Dam
292	WE	Weir
293	RR	Rock ramp
294	CU	Culvert
295	FO	Ford

296	BR	Bridge
297	OT	Other
298	DI	Dike
299	GR	Grid

Table 1. Type of obstruction included in the SUDOANG database

These physical obstructions are characterized by different attributes:

- The name (character).
- Indicate if the obstacle is associated with a major one (numeric).
- The difference in water level (numeric, in meters).
- Indicate if there is a problem during downstream migration (expert advice) (logical).
- The water Depth near the obstacle (downstream) (numeric, in meters).
- The presence of an eel pass (logical).
- The type of impact (expert advice). Different levels of impact have been considered (Table 2). Two blocks of impact levels exist, when the code (no_code) is numerical (0 - 5) it refers to any data obtained, and when the code (no_code) is categorical (LO, ME, HI, LI, SO, MA, TO) it refers only to data from France.
- The permeability evaluation method (charcacter).

Identifier (no_id)	Code (no_code)	Type (no_name)
208	NA	Unknown
209	0	Unobtrusive and/or no barrier
210	1	Passable without apparent difficulty
211	2	Passable with some risk of delay
212	3	Difficult to pass
213	4	Very difficult to pass
214	5	Impassable
267	LO	Low (scale with three categories)
268	ME	Medium (scale with three categories)
269	HI	High (scale with three categories)
287	LI	Barrier passable with Limited Impact (source ICE)
288	SO	Partial barrier with Some Impact (source ICE)
289	MA	Partial barrier with Major Impact (source ICE)
290	TO	Total barrier (source ICE)

Table 2. Type of impact. Expert advice is needed to indicate the level of impact

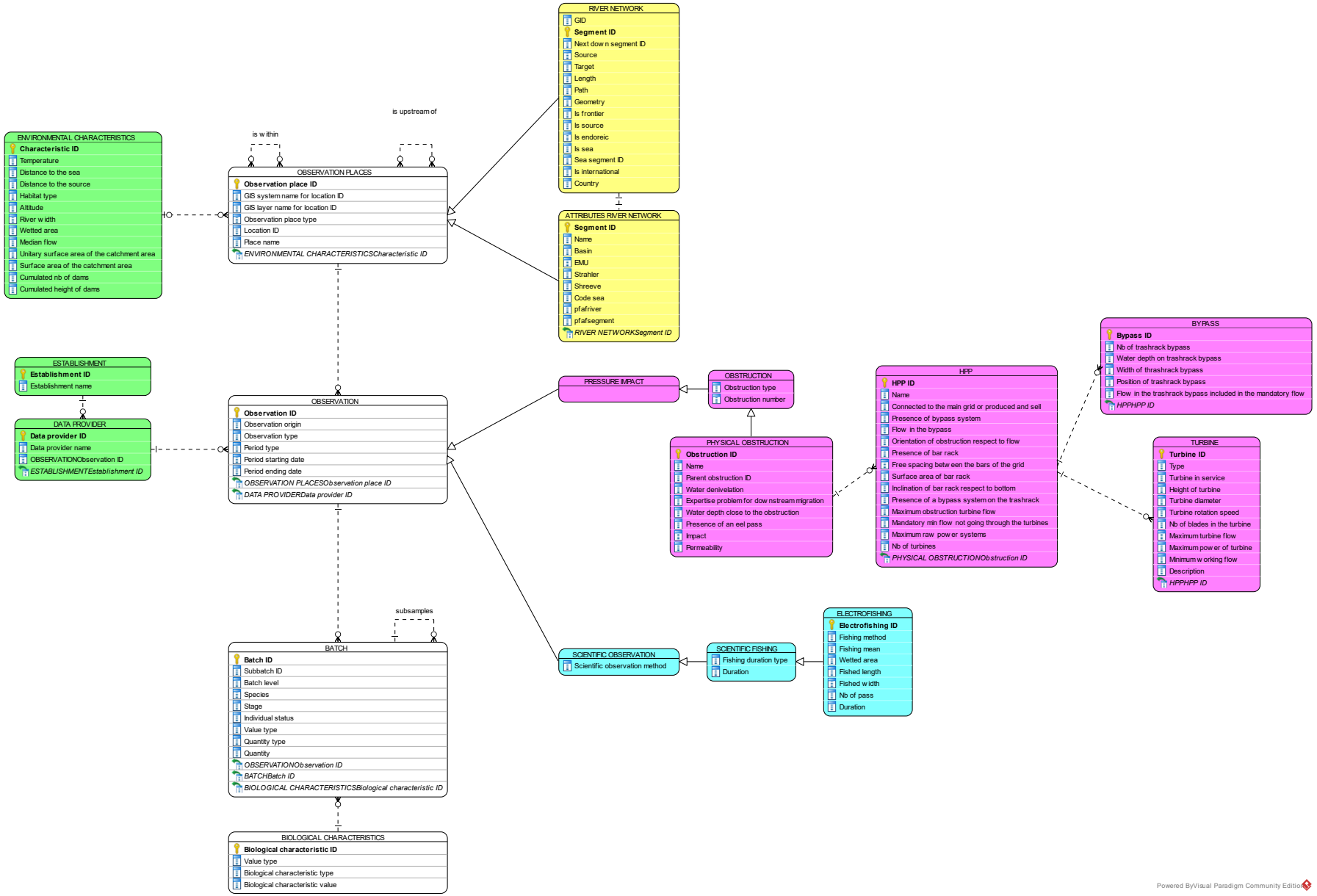

Figure 1. Conceptual model of the SUDOANG database, inherited from the DBEEL database

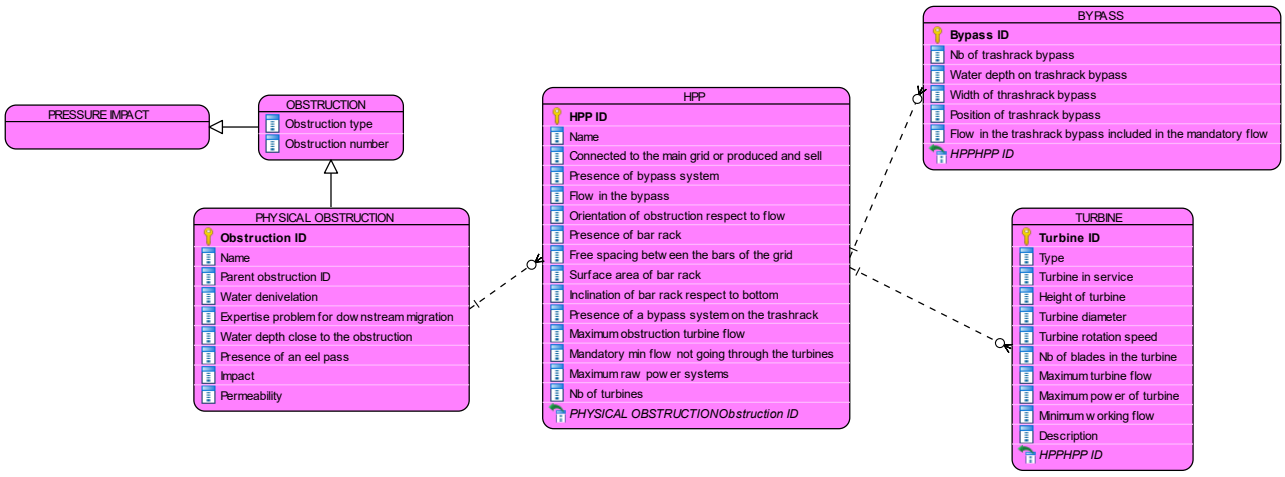

Figure 2. Conceptual model of the database on obstacles and hydroelectric power plants (HPP) associated

If the obstacle is a dam, it may have one or more associated hydroelectric power plants (ratio 1 to n) (Figure 2). The hydroelectric power plants (HPP) are characterized by the following attributes:

- The name (character).
- Indicate if the HPP is connected to the main grid or produced and sell (numeric: main grid = 1; production = 2).
- Indicate the presence of bypass system (logical).
- The flow in the bypass (numeric, in m^3/s).
- The orientation of dam respect to the flow. The dam orientation explains one part of the potential mortality at hydropower sites. Eels encounter higher probabilities to escape over the dam if it is perpendicular to the main flow, and lower probabilities if the dam is low angled with the main flow, as in this case it "guides" eels to the power plant location. Different orientations have been considered (Table 3).

Identifier (no_id)	Code (no_code)	Type (no_name)
238	1	[70-90°]
239	2	[50-70°[
240	3	[30-50°[
241	4	<30°

Table 3. Orientation levels of the dam with respect to the flow

- Indicate the presence of bar rack (logical).
- The free spacing between the bars of the grid (numeric, in mm).
- The surface area of the bar rack (numeric, in m^2).
- The inclination of bar rack respect to the bottom (numeric, in degrees).
- Indicate the presence of a bypass system on the trashrack (logical).

- The maximum dam turbine flow (numeric, in m^3/s).
- The mandatory minimum flow not going through the turbines (numeric, in m^3/s).
- The maximum raw power systems (numeric, in kw).
- The number of turbines (numeric).

If there is a bypass system in the trashrack (hpp_presence_bypass = TRUE), the following attributes are indicated (Figure 2):

- The number of trashrack bypass system (numeric).
- The water depth on the trashrack (numeric, in meters).
- The width of the trashrack (numeric, in meters).
- The position of the trashrack (character).
- The flow in the trashrack bypass induced in the mandatory flow (numeric, in m^3/s).

The ratio between the hydropower plant and the bypass system is 1 to n because hydropower plants can have one or more bypass systems associated.

On the other hand, the hydroelectric power plant may have one or more turbines (ratio 1 to n), which are indicated in the table of hydroelectric power plants (hpp_number_turbines). These turbines are in turn characterized by the following attributes (Figure 2):

- The type of turbine that is indicated in Table 4. This attribute is important because each type of turbine has a different impact on eel mortality.

Identifier (no_id)	Type (no_name)
242	Horizontal axis Kaplan (bulb)
243	Other (please specify)
244	Double Francis (spiral case)
245	Francis unspecified
246	Turbine with fixed blade propeller and vertical axis
247	Kaplan not specified
248	Pelton
249	Reversible
250	Kaplan (model of S-turbine)
251	Turbine with fixed blade propeller and horizontal axis
252	Unknown
253	Vertical axis Kaplan
254	Francis without volute
255	Francis (spiral case)
256	Banki-Michell (cross-flow)
257	VLH
258	Archimedean screw turbine
259	Water wheel turbine (aqualienne)
260	Water wheel turbine (others)

261	Propeller unspecified

Table 4. Type of turbines

- Indicate if the turbine is in service (logical).
- The height of turbine (numeric, in meters).
- The turbine diameter (numeric, in meters).
- The turbine rotation speed (numeric, in rotation/min).
- The number of blades in the turbine (numeric).
- The maximum turbine flow (numeric, in m^3/s).
- The maximum power of turbine (numeric, in kw).
- The minimum working flow (numeric, in m^3/s).
- Description (character).

PHYSICAL MODEL OF DATABASE ON OBSTACLES TO MIGRATION

The physical model of database describes the database specific implementation (Figure 3). For this purpose, (i) all tables are specified, which in the conceptual model are considered as entities (impact pressure, obstruction, physical obstruction, HPP, bypass and turbines). (ii) The attributes of the conceptual model are transformed into columns specifying code, data type and unit of measurement. (iii) Finally, the relationships described in the conceptual model are identified by primary and foreign keys in this new model. Therefore, all the attributes indicated in the conceptual model are observed in the Figure 3.

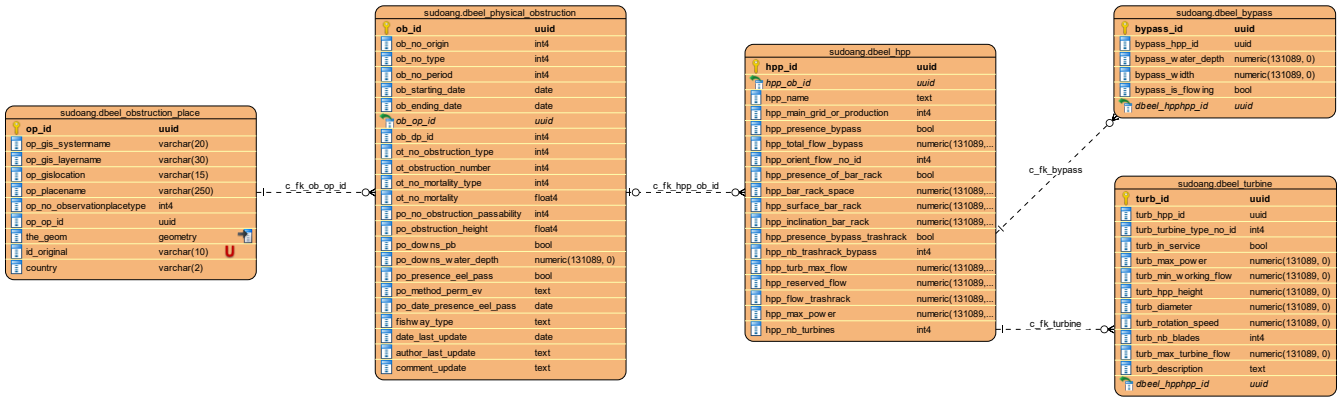

Figure 3. The physical database model on obstacles to migration