SUMMARY OF SUDOANG MEETING

(2-3 December 2019)

This document summarizes the presentations and workshops that took place during the meeting at Sukarrieta last December 2019. The presentations can be downloaded at https://sudoang.eu/en/. If you wish to obtain any additional details, please contact us at https://sudoang.eu/en/contact/.

WORKSHOP: Predicting the silver biomass in the SUDOE area

The SUDOANG spatial eel database in the SUDOE area was presented during the workshop. The electrofishing data compiled during the project allowed a first estimation of densities and size structure at the sampling points of the three countries (Fig. 1.a and Fig. 1.b). The highest densities are observed in the northwest and west of France, and in the north of the Iberian Peninsula (Fig. 1.a). Regarding size structure, in France there is information on the size of individuals throughout the country, but in the Iberian Peninsula almost all the information regarding size is found in the north (Fig. 1.b).

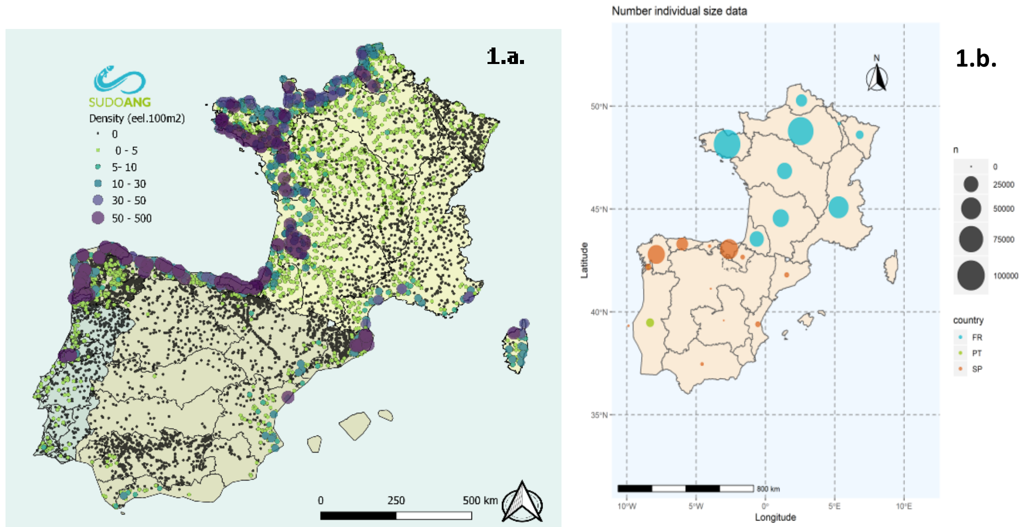


Figure 1.a. Estimation of eel density after completing the import of electrofishing data in the three countries. **Figure 1.b.** Number of individuals measured during electrofishing surveys by EMU and country.

The EDA (Eel Density Analysis) model extrapolates the abundances of the electrofishing points to obtain the eel density of the whole basin. Different attributes considered as predictors of eel abundance are needed to make that extrapolation: water surface, distance to the sea, altitude, EMU, electrofishing types, cumulated number of obstacles and height. However, information about the water surface was lacking in most of the Spanish and Portuguese rivers. To solve this problem, a new model was presented and developed within the framework of SUDOANG, to estimate the water surface area (Fig. 2).

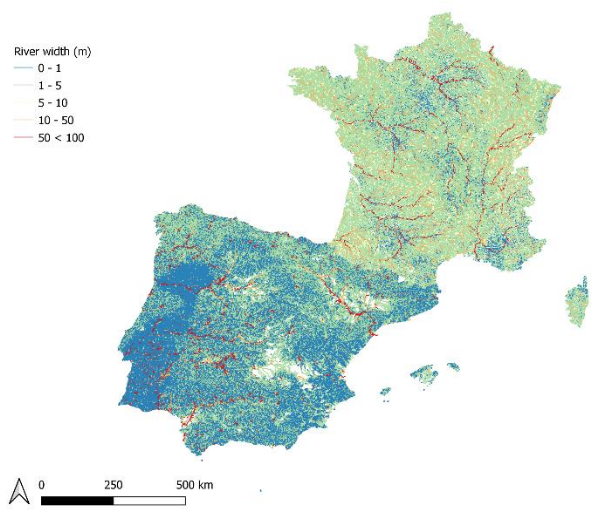


Figure. 2. The river width (in m) in the SUDOE area. In Spain and Portugal this attribute was modelled. In France, it corresponds to the river width estimated in the RHT from IRSTEA.

The first implementation of the EDA model (in which only the yellow eel density was predicted) was presented at the annual meeting in Bordeaux. A second implementation of the EDA model was presented in Sukarrieta. This second implementation contains three steps:

1. Building a delta-gamma model which calculates the density of eels

The delta-gamma model is obtained by multiplying the delta model (the probability of presence of eel) and the gamma model (density of eel when present). According to EDA, in the Iberian Peninsula, eel is abundant close to the coast but disappears abruptly due to the construction of large dams near the sea (Fig 3.a). In France densities are high close to the sea and those densities are falling steadily and progressively but the eel only disappears completely in the high peaks of central France. The residuals of this model were also presented to identify the potential problems of the values predicted (Fig. 3.b). The model predicts lower densities than those observed in northeast Spain (high positive values indicating that observed values were higher than predicted values) and higher ones in the coast of Portugal, northern Spain and along France (negative values indicating that observed values were lower than predicted values).

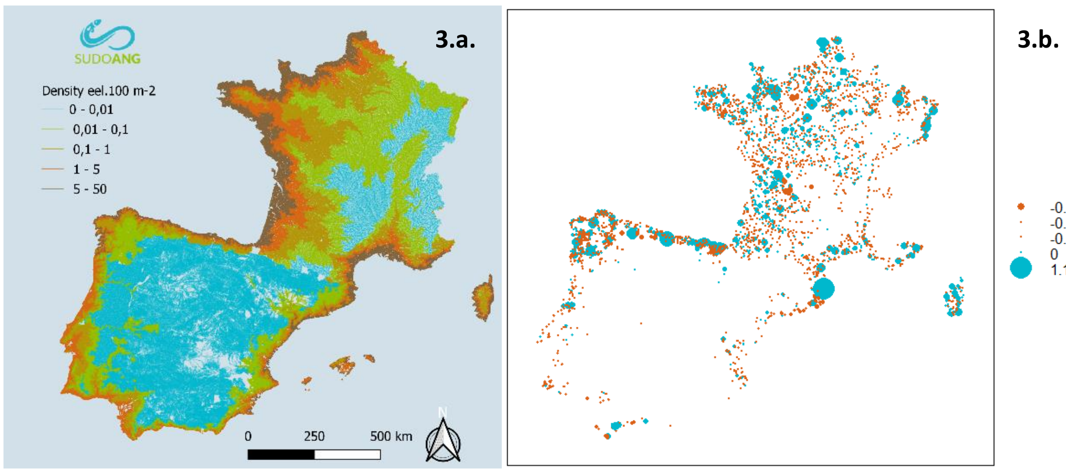


Figure 3.a. Eel density per 100 m^2 of river predicted by the EDA delta-gamma model. **Figure 3.b.** Residuals (difference between the observed values and the predicted values,) produced by EDA delta-gamma model for the estimation of eel density. analysis)

2. Building a multinomial model which calculates the size structure

First, the effect of different explanatory variables on size structure was tested. The model that best fits the data includes four explanatory variables: year, distance to the sea, cumulated height of dams (per country) and electrofishing type. The annual effect per electrofishing type (Fig. 4) and the effect of the cumulated height of dams (Fig. 5) per country estimated by the multinomial model were presented. Although in general terms, most of the eels belong to the smaller size class (<150, 150-300, 300-450 mm) in all electrofishing types (Fig. 4), the estimated proportion of each size-class changes according to the type of electrofishing (i.e: the proportion of the <150 mm size class is lower when using two pass fishery comparing to point sampling). However, the temporal trends in the proportion of each size class are similar, irrespective of the method used. The proportion of smaller sizes (<150 mm) has increased since 1990 and that of larger sizes (450-600 mm and 600-750) has decreased. The 150-300 mm size class increased its proportion until 2000, and in 2005 it started to decrease again.

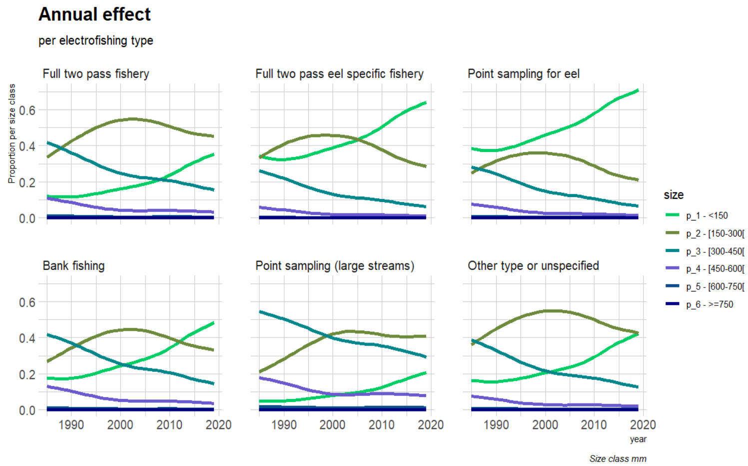
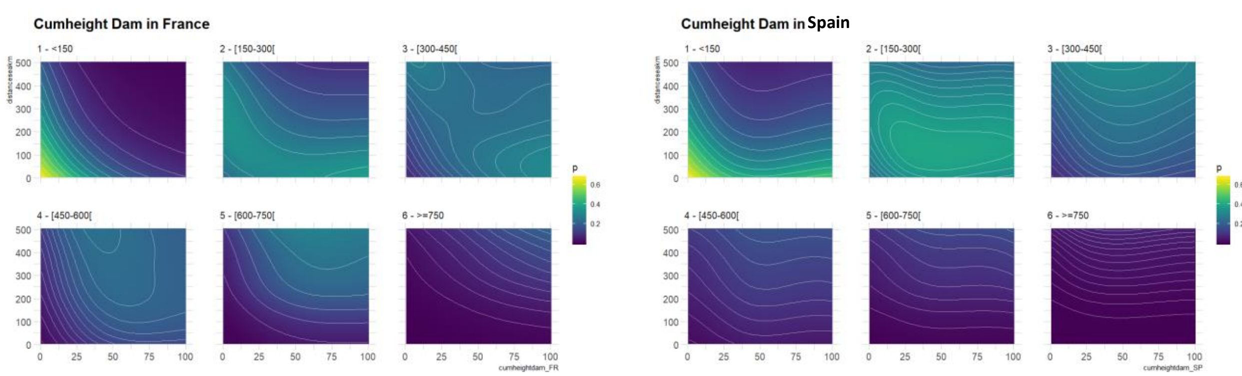


Figure. 4. Annual proportion of each size class (mm) per electrofishing type

The estimated proportion of eels included in the smaller size range (<150 mm) increases in France and Spain as the distance from the sea and the cumulated height of dams decreases (Fig. 5). The proportion of eels from larger size classes (600-750, >750 mm) is quite low in all three countries and increases with distance from the sea and the cumulated height of dams in France and Spain. In Portugal, no clear trends of size with distance to the sea or height of dams were found probably because there was less data on eel size.



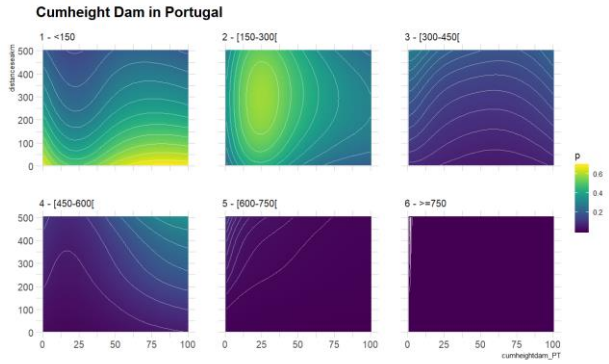


Figure 5. Eel proportion (p) in relation to the cumulated height dam (m) and distance to the sea (km) per each size class in Spain, France and Portugal estimated by the EDA multinomial model.

3. Building a silvering model

Finally, the eel densities obtained in this study need to be transformed into silver eel biomass. As the silvering percentage of the population is unknown in many sampling points, a silvering rate model will be applied. During the meeting the first step (data compilation) to build this silvering model, was presented. Different parameters related to the silvering stage have been compiled (eye diameter, length of the pectoral fin, punctuation along the lateral line, size and weight). The next step will be to build a model that relates the silvering ratios obtained with different biological and environmental parameters. Thus, it will be possible to determine the silvering percentages of the eel population in those places where no information exists.

Maps of density and size structure of yellow eel and silver eel biomass in the SUDOE area will be uploaded to the SUDOANG web page (www.sudoang.eu)

WORKSHOP: An interactive web app for validating dams and electrofishing data

A first shiny web application was developed with the purpose of obtaining the feedback from the data providers on the updated information on dams and electrofishing sampling in the SUDOE area. In particular, two aspects were identified that needed to be reviewed in order to continue with the implementation of the EDA and mortality models. First, those dams which presented inconsistencies between the estimated cumulated height and its altitude (Fig. 6.a). Second, a revision of both the probabilities of the presence/absence and densities (Fig. 6b).

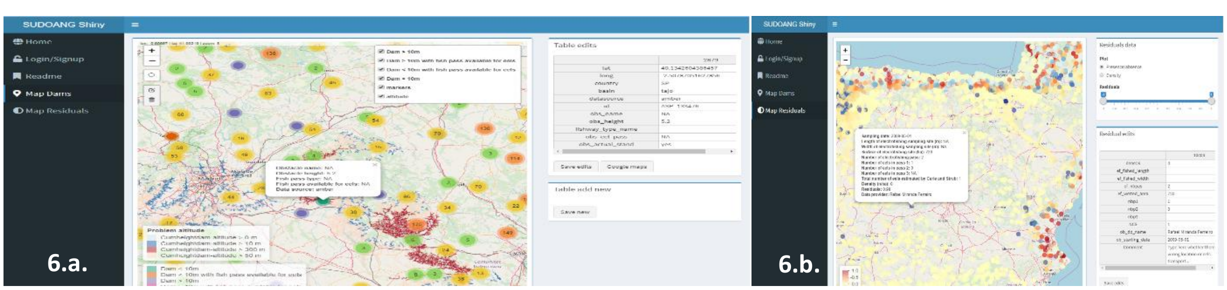


Figure 6.a. Screenshot of shinny showing the cumulated height of obstacles from the sea. **Figure 6.b.** Screenshot of shinny showing the difference between the observed values of densities and the values predicted by the EDA model.

The data providers, responsible for their validation, have been identified and a deadline has also been agreed for the delivery of the task. A guide on how to use shiny for validation has been sent to these data providers. SUDOANG envisages the creation of a toll to explore management scenarios to identify those that would be used in the simulation of silver eel escapement. During the meeting the need to build a consensus as to what spatial resolution and time frame within which to obtain them was discussed. In this sense, a shiny that provides the users the option to play with scenarios in order to give an idea of the future management module of SUDOANG shiny was introduced. Finally, the possibility of developing a web-based repository where to store all data from GT1-2-3-4-5-6 and be available for any user was presented.

WORKSHOP: It's time to make your Christmas wish list!

One of the aims of this workshop was to present recent progress in GT3. First, the results of the online questionnaire that was completed by SUDOANG partners regarding exploitation rates were presented (Fig. 7). The widespread bars indicate that the participants have different opinions about the exploitation rates in each of the basins. It is still possible to see differences among river basins; for example, participants generally believe that exploitation rates are smaller in Albufera or Ter Rivers. Secondly, the progress in the estimation of absolute recruitment in Ter, Minho and Oria Rivers was presented.

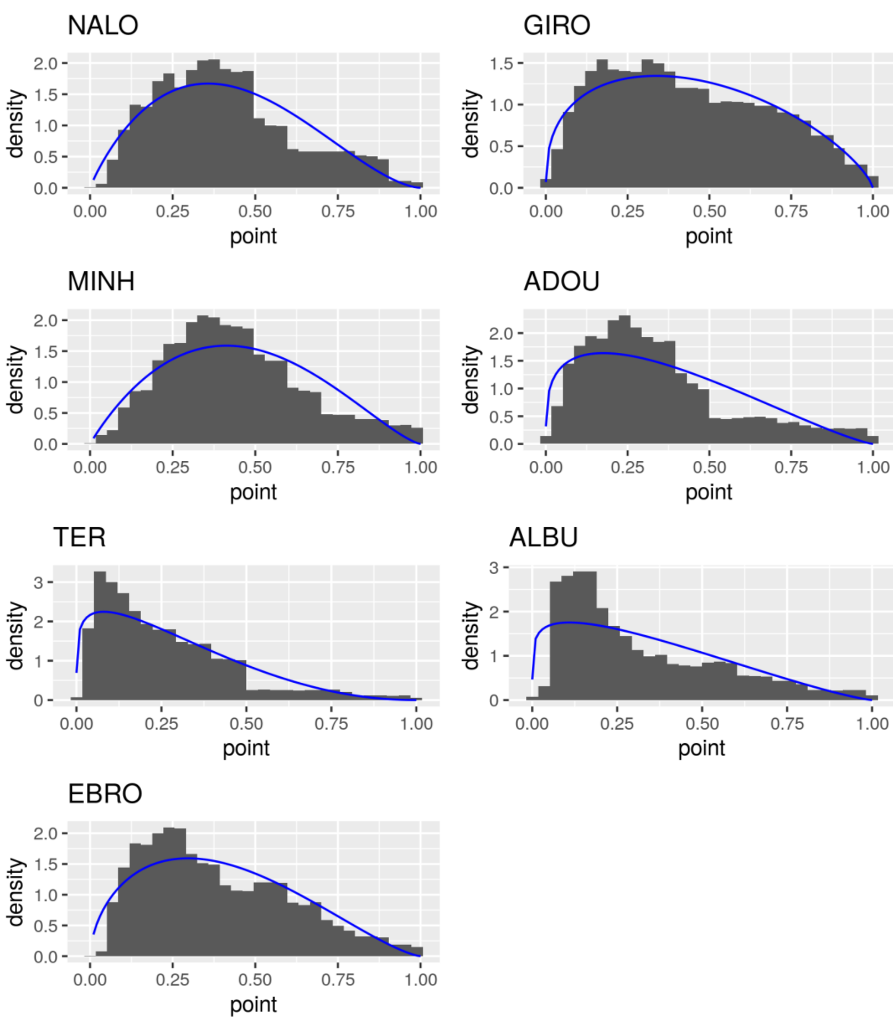


Figure 7. Results of the questionnaire about exploitation rates in the different basins. The X axis indicates the exploitation rate (from 0 to 1). The Y-axis indicates the participants opinion about the exploitation rates in each estuary. Grey bars correspond to answers of the participants; Blue lines correspond to fitted distributions that summarise the diversity of opinions.

Most importantly, the workshop aimed at collecting the points of view of participants about the most relevant indicators of recruitment. First, attendees were asked to 'draw' the type of diagrams they would like to see as a result of this GT (Fig. 8).

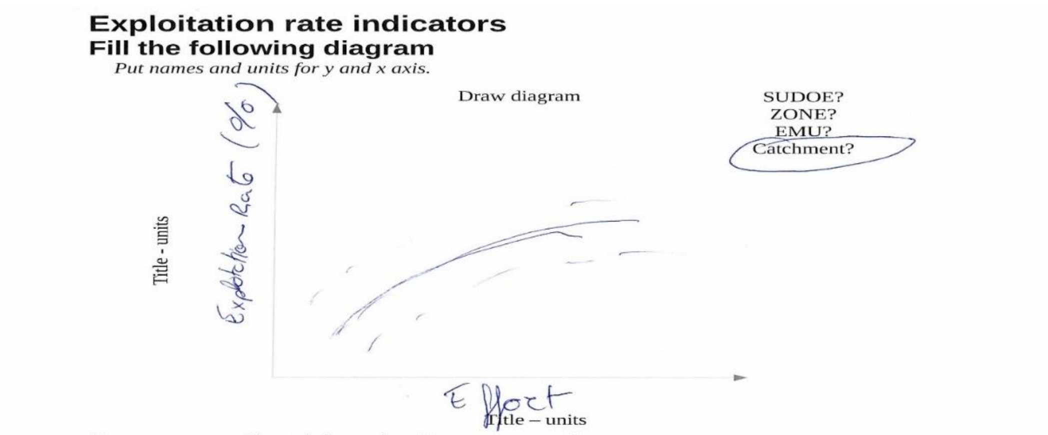


Figure 8. Example of drawings made by a participant: it shows that the participant would like to see how exploitation rates vary with fishing effort and is especially interested in seeing the results at the catchment level It also shows that the participant is aware of uncertainty around estimates (confidence intervals are drawn).

Unsurprisingly, most sudoangers expect diagrams to explore trends in recruitment and to make spatial comparisons among zones. EMUs and river basin scales were the two spatial scales of greatest interest. Regarding uncertainty, all participants agree that confidence intervals are required though few of them had drawn those intervals in the diagram. The respective benefits of relative versus absolute recruitment estimates were also discussed: while absolute recruitment simplifies the comparison of indicators among zones (catchments / EMUs, countries…) they are more sensitive to model structure than relative recruitment estimates (Fig. 9).

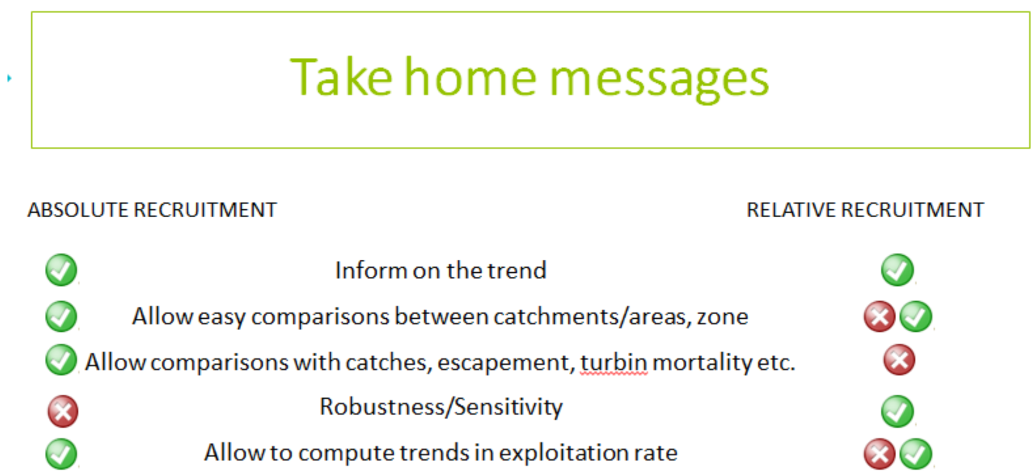


Figure 9. Pros and cons of absolute / relative estimates as presented to support the discussion during the meeting.

Finally, specific questions about exploitation rate indicators were discussed: should commercial catches (currently, we do not collect catch data in SUDOANG) be collected and/or should the end-user work with their own commercial catch data. Commercial catch per EMUs and countries are already collected by the WGEEL and are public data, so jointly with our recruitment estimates, it should be possible to display estimates of exploitation rates at these spatial scales on the shiny app. If users wish to have results at basin level, they can be offered to upload their own catch data to the app so that they can obtain estimates of exploitation rates. This solution would allow users to play with their own data without it being recorded in the app.

To conclude the workshop, a questionnaire to collect the opinions was set up (Fig. 10). The analysis of these questionnaires will allow to choose the most appropriate results to be displayed in the shiny app.

Recruitment indicators

1. *For recruitment, which spatial scale is the most important for you? (sort: 1 for the most important etc.)*

……. SUDOE scale

……. large zone scale

……. EMU scale

……. river basin scale

……. others (specify):

2. *Given what we have discussed, should we display indicators of recruitment at these spatial scales? (circle appropriate answers: 1=no way!!, 2=no, 3=no opinion, 4=yes, 5 of course!!)*

SUDOE scale:	1	2	3	4	5
large zones scale:	1	2	3	4	5
EMU scale:	1	2	3	4	5
river basin scale:	1	2	3	4	5
others (specify):…	1	2	3	4	5

Figure 10. Extract of the questionnaire used to collect participants final opinions.

WORKSHOP: Mortality and escapement estimates: how will the available data be used and how can the results be best shared?

The objective of GT2 is to quantify the impacts (i.e. induced mortalities) of hydropower plants (HPP) on downstream-migrating silver eels. EDA will produce an estimate of the silver eel stock, to which, depending on the characteristics of the HPP and hydrology, a certain mortality will be applied. Thus, the following steps are needed:

1. Obstacles and HPP technical data compilation

A manual presenting the type of data that needs to be collected and how to combine them to estimate eel mortality rates is being written and will be ready in early 2020 together with an estimate of the mortality in obstacles from the SUDOE area.

The conceptual diagram of the database on obstacles and HPP stations, included in the SUDOANG database, was presented during the workshop. The SUDOANG database structure, derived from the eel database (DBEEL) developed during the POSE project, includes information about:

- **The observation place** (Fig 11 white) includes information about the location: hydrographic (Fig 11 yellow) and environmental characteristics (Fig 11 green) are assigned to each observation place

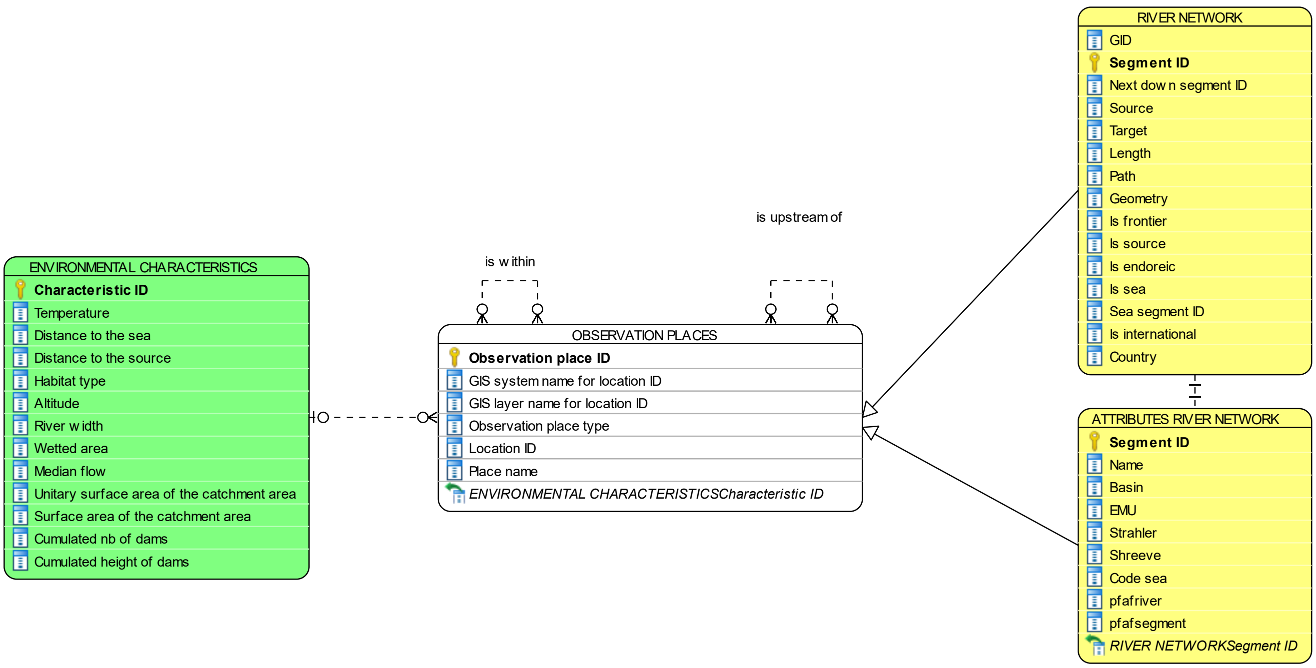


Figure 11. Conceptual diagram of the SUDOANG database.

- **The observations** (Fig. 12 white) that are assigned to an observation place. Observation includes the general characteristics of:
  - Scientific observations to determine eel abundance (Fig 12 blue)
  - The impact of pressures (Fig 12 pink), including information regarding all the parameters related to obstacles necessary to estimate eel abundance and mortality: type (dam, weir, etc.), water depth or the presence of eel pass. If the obstacles are associated with HPP, data regarding characteristics of turbines and bypass are also included.

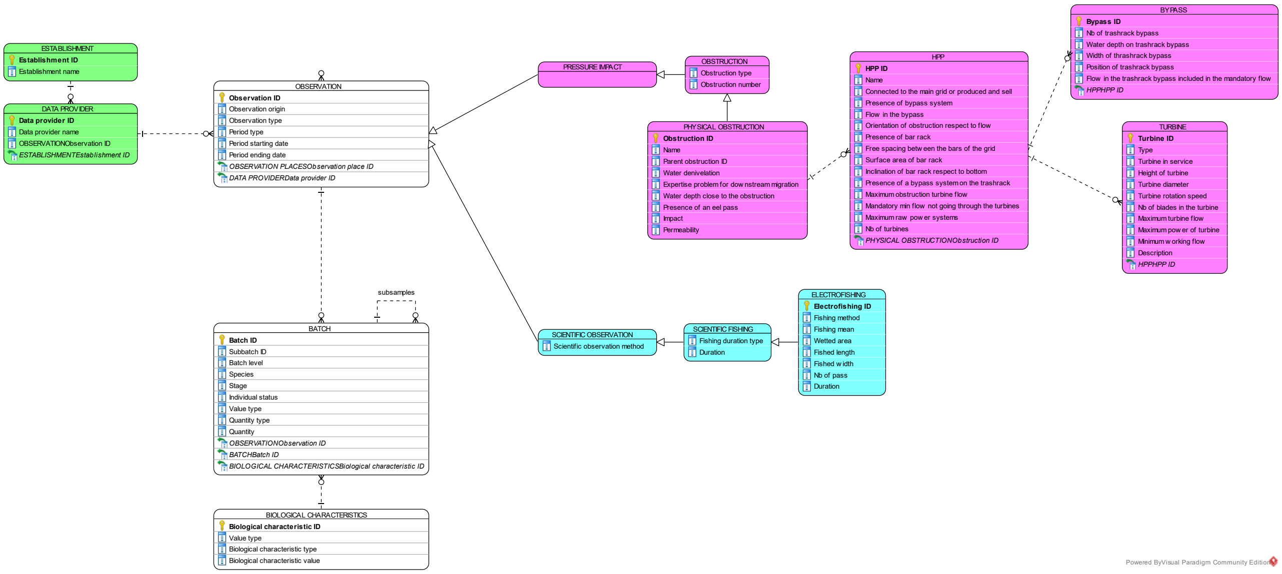


Figure 12. Conceptual diagram of the SUDOANG database.

Collection and storage of data on obstacles is now nearly finished for the three countries (Fig. 12.). For the HHP, data has already been imported in France, but in Portugal and Spain the process has not finished (Fig. 12.b).

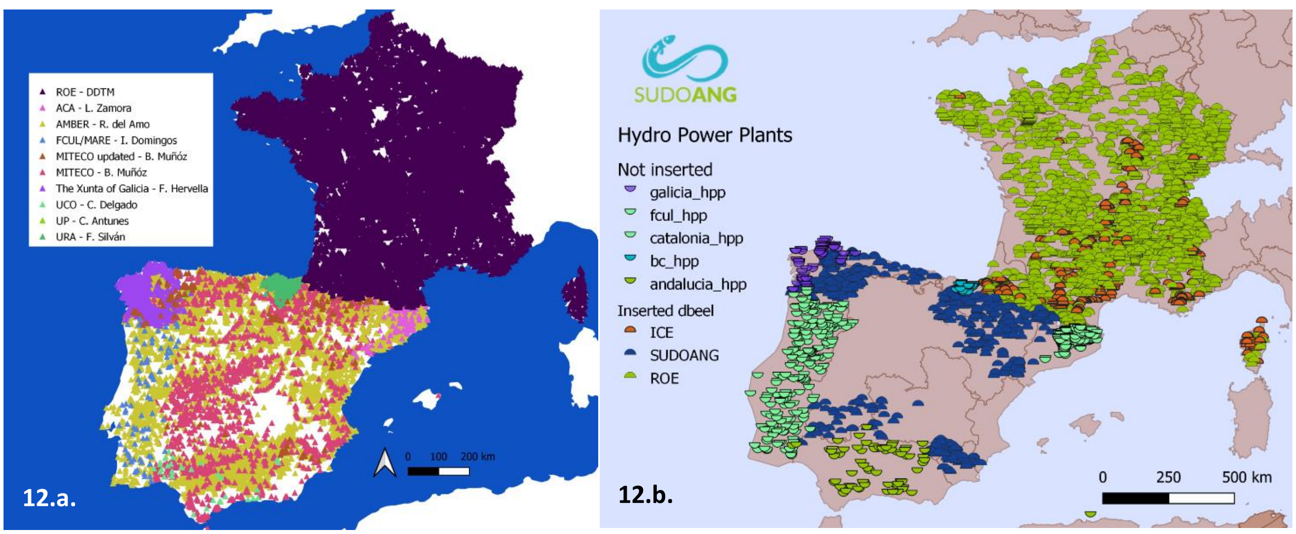


Figure 12.a. Map showing the obstacles imported into the SUDOANG database per data provider.
Figure 12.b. Hydroelectric power plants available. The legend specifies the data that have already been imported into the SUDOANG database and the remaining ones to be imported.

One of the key parameters to determine migrating silver eel mortality in the HPP is flow. This information was already available in France, but not in Portugal and Spain, so a model to estimate flow in both countries is being built.

During this workshop the results of the work carried out along with GT1, aiming to collect dam height data in France were also presented. These data come from three French databases: BDOe, ROE, ICE. Missing data were calculated from the river slope, its median flow, the obstruction type and the watershed area (Fig. 13). The same procedure will be applied to the compiled obstacles in Spain and Portugal.

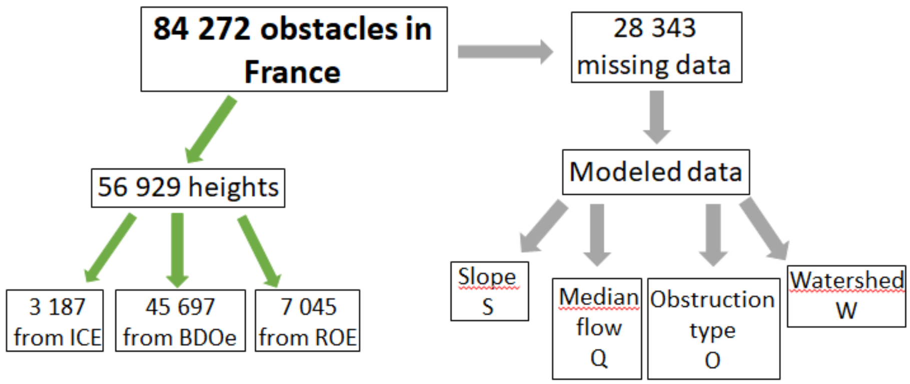


Figure 13. Left: Number of obstacles for which height data was available in France per data source. Right. Number of obstacles for which height data was not available in France and the parameters that were used to model the missing heights.

Once the height of each obstacle is known, the cumulative height of the dams is calculated taking into account the passability of the obstacle (expert judgement) and the presence or absence of an eel pass. A power transformation is then applied to the result, since the sum of the height of several small dams may be less impacting than the effect of a single dam whose height is the sum of these small dams. The cumulative height obtained is then used as the explanatory variable for eel density in the EDA model.

2. Estimation of mortality

Once data on eel biomass, hydrography and HPP characteristics are available, eel mortality can be estimated. For instance, the equation to estimate eel mortality in Kaplan (Eq. 1) and Francis (Eq. 2) turbines was presented. However, when not all the parameters of this equation are available, it is possible to have an estimate of mortality using a degraded model. All this information will be detailed in the manual to estimate mortality.

$$\text{M1}: M(\%) = 4.67 \times FL^{1.53} \times D^{-0.48} \times RS^{0,6}$$
$$\text{M2}: M(\%) = 6.59 \times FL^{1.63} \times Q^{-0.24} \times RS^{0,63}$$
$$\text{M3}: M(\%) = 12.42 \times FL^{1.36} \times Q^{-0.22} \times RS^{0,49}$$

Eq. 1. Equation for estimating eel mortality in Kaplan turbines (Gomes and Larinier, 2008). D: turbine diameter (m), RS: turbine rotation speed (rotation/min), Q: maximum turbine flow (m3/s), FL: fish length (m).

$$P = [(-17.98 + 45.62 \times H^{0.181} \times D^{-0.207} \times FL^{0.224})]^2$$

Eq. 2. Equation for estimating eel mortality in Francis turbines (Gomes and Larinier, 2000). D: turbine diameter (m), H: height of turbine (m), FL: fish length (m).

Finally, as an example of the work that will be done in other basins of SUDOANG, the calculated eel mortality for each HPP on the Gave de Pau River (South West of France) and the improvement on the cumulated survival after the upgraded of some HPP was presented (Fig. 14).

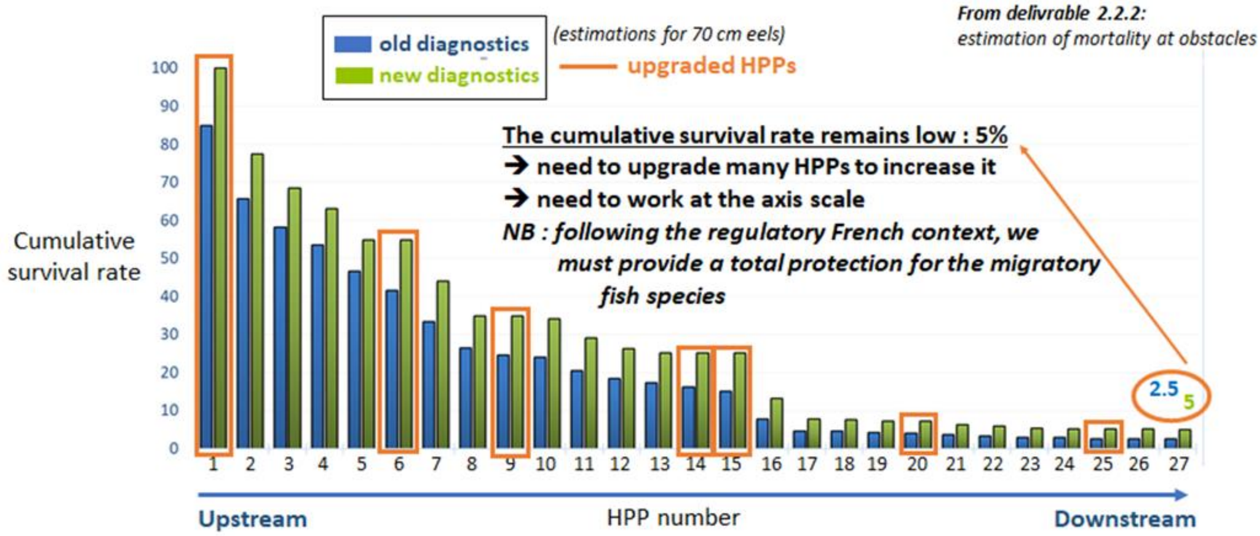


Figure 14. Estimation of the cumulative survival rate of downstream migrating eels on the Gave de Pau River (results are given for 70 cm eels).

Finally, there was a discussion about the scale at which the results of mortality should be shown. Finally, it was agreed to show the results at the river scale and in case someone would be interested in having more detailed results, he/she could ask for authorization to SUDOANG steering committee. The use of colour scale helping to identify the major obstacles was advocated.

WORKSHOP: Eel Governance Platform: Jointly designing its structure and composition

The objectives of the third workshop on **Improving the Dialogue** were to validate the mission proposals, strategic objectives and internal functions of the platform, as well as to define a proposal for its structure.

The workshop began with a brief explanation of the steps taken throughout the project, in order to understand the methodology applied for the creation of the Eel Governance Platform of the SUDOE area. On Sep2019 a survey was delivered to all the SUDOANG partners to gather their opinion on different aspects of the Governance Platform. The results of this survey, together with those from the Bordeaux workshop were used to define the mission, strategic objectives and internal functions of the platform, which were presented.

The proposed **mission statement** was the following: *Ensure the sustainability of the European eel, promoting good practices and co-responsible management between stakeholders and states, with the aim of increasing its stock and thereby contributing to improving biodiversity as a strategy to address impacts of climate change*

After deliberation and debate, there was agreement that the mission responds to the spirit of the platform, but it was decided to revise the wording to avoid very generic words. It was also decided to delete the reference to climate change.

Regarding the **strategic goals**, three main objectives were proposed according to the results of the survey:

1. *To BE RECOGNIZED as an advisory group by the stakeholders and decision makers.*
2. *To RAISE AWARENESS through campaigns, brochures and meetings.*
3. *To ADVOCATE the eel sustainability through proposals, negotiation and pressure when necessary.*

As far as the **internal functions** are concerned, four were put forward:

1. *COORDINATION of actions & management measures among partners and between different levels.*

2. HARMONIZATION of protocols, rules & methodologies.

3. INTERNAL COMMUNICATION to share knowledge, information & facilitate multilevel participation.

4. PLATFORM'S GOVERNMENT: leaders, partners, to ensure good governance.

After a brief discussion, both proposals (strategic goals and internal functions) were validated.

Finally, a proposal for the **structure of the platform** was presented and discussed (Fig. 15).

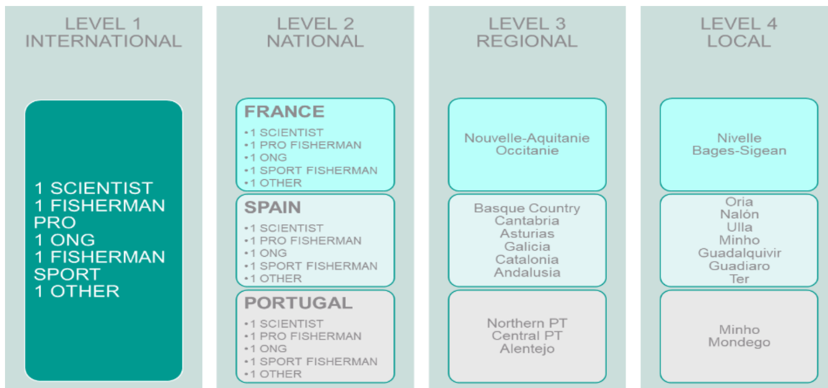


Figure 15. Proposal of the structure of the governance platform that was discussed during the Sukarrieta workshop.

The challenge was to improve this proposal, specifically with two guiding questions, in relation to the communication flows on the platform and the roles and responsibilities of its members:

- **Communication:** The attendees were divided into two groups, with representatives of the three nationalities and stakeholders (Fig. 16). They were also provided with a supporting document to help them understanding and streamlining the dynamics. After the work of each group, the results were shared.

Figure 16. SUDOANG participants discuss the communication flow of the future governance platform.

- **Roles and Responsibilities.** The roles and responsibilities of the components of the platform were discussed, based on the proposal presented. A number of specific comments were made, especially on certain differences between the three countries. It was concluded that each country could have a different structure. There was also a discussion about the responsibilities that the platform should assume, with a single voice and consensus.

A summary of the progress achieved was made during the workshop, and the next tasks to be carried out after the workshop were discussed. Fundación Fundación Lonxanet will ask, by means of online surveys or direct communications, more detailed proposals from partners and associates of SUDOANG to consolidate the elements that will contribute to the final proposal for the Eel Governance Platform.