RESTORATION OF THE AQUATIC AND TERRESTRIAL ECOSYSTEM COMPLEX OF FUNDU MARE ISLAND, ROMANIA

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Restoration of the Aquatic and Terrestrial Ecosystem Complex of Fundu Mare Island

Outlook

I. The Small Wetland of Braila - the background and status of the RFM project

II. Experiences and results of the UAV-based surveys.

Project partners (after May 1st 2016)

- **Dunarea de Jos University of Galati UDJG** (RO)
- **SINTEF-Energy Research** (NO)
- **Norwegian Institute for Nature (NINA)** (NO)
- **Norwegian University of Science and Technology (NTNU)** (NO)
- **SWB NP Administration** (RO), which coordinates now this project on the **last remains** of an **ancient Inner Delta**

Restoration of the Aquatic and Terrestrial Ecosystem Complex of Fundu Mare Island

Is a currently ongoing **restoration project** which **aims at**:

- investigating ecosystem improvement in various restoratio scenarios,
- implementing adequate measures.

It got **international funding through EEA Grants**

We will focus hereby on the first results of the observations based on UAV aerial surveys and on hydrological measurements and reports.

The project will suggest and implement a series of measures aimed at maintaining a higher level of water in Fundu Mare Island's lakes even in less favorable times.

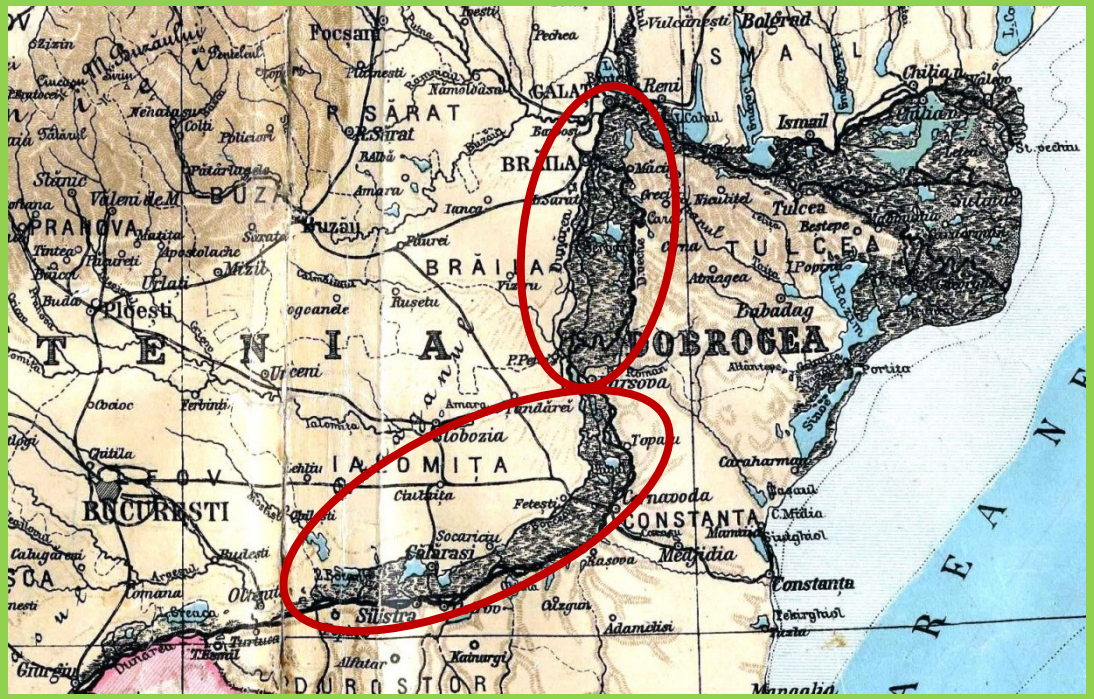
Lower Danube Inner Delta

Danube River is the **world's most international** river basin.

- Draws water from **19 nation states**
- Passes through 10 **countries** and 4 **capitals**.

Lower Danube Inner Delta

Lower Danube – illustrated in a 100 years old map



Danube River still has a second delta, besides the well-known maritime Danube Delta.

It's about an inner delta, who covered – once – a stretch of approx. 120 km of the Lower Danube length.

Lower Danube Inner Delta

Lower Danube – illustrated in a 100 years old map

But…
over 85% of this unique wetland, characterized by an outstanding biodiversity... was dammed and transformed in polders.

As a consequence, the level of the Danube River during floods raised, endangering the life of men and their traditional settlements and habitat.

Lower Danube Inner Delta

Danube River System:

- has a river reach of 840 km between Black Sea and the Iron Gate II dam,
- has been heavily affected by human activities.

As in many other wetlands in Europe,

the loss of biodiversity in SWB is the result of the:

- pressure exercised by human activities, (as damming, transports),
- water pollution
- over-exploitation of resources (hunting and fishing)

Small Wetland of Braila (SWB)

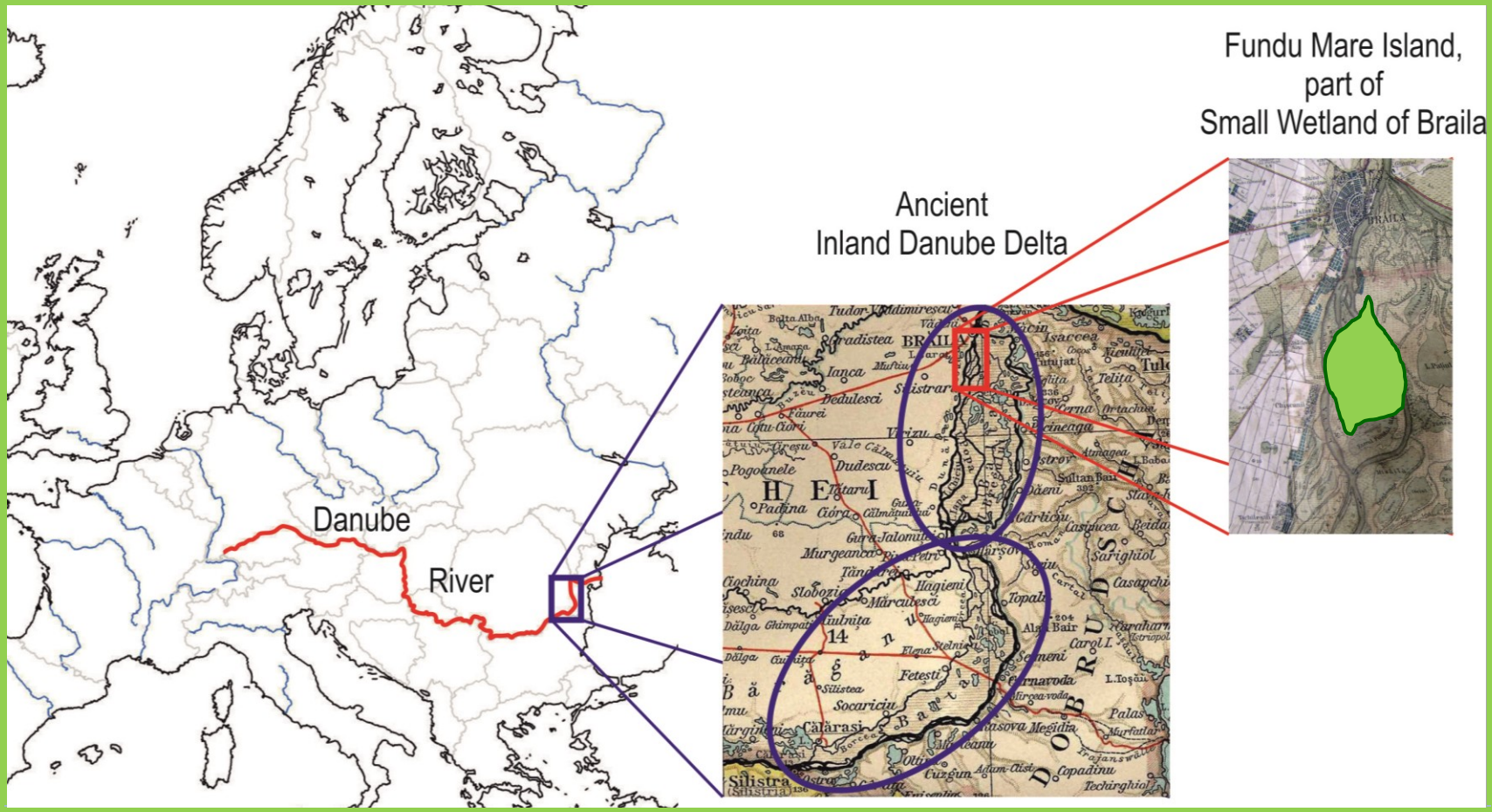
Comprising 7 small islands (total surface area of 150 km^2), **Small Wetland of Braila** (**SWB**) contains a representative sample of habitats characteristic of **floodplains**, as well as an **ancient inland delta**.

SWB is an internationally important bird protection area (**RAMSAR site 1074**), due to:

- The **quality** of its **habitats**
- Its **location** along **the migration routes** between the nesting areas (**N. of Europe**) and the South wintering areas (**Africa**)

Fundu Mare Island

- is located in the **northern part of the SWB**



Issues who need urgent measures

Fundu Mare Island has gone through a profound change regarding:

- its hydrological regime,
- climate, and
- social conditions.

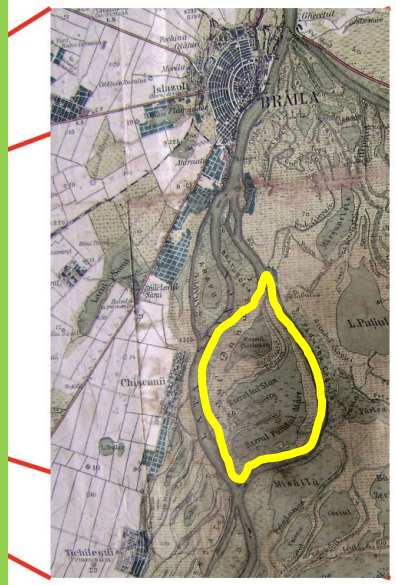
Such changes had **negative consequences** for both:

- aquatic biota,
- human life.

Extent of aquatic habitats has been severely diminished,

Periods number and length for fish reproduction are reduced.

Fundu Mare Island, part of Small Wetland of Braila



Issues who need urgent measures

- The extent of the aquatic habitats is significantly diminished,
- The sedimentation process is much higher than the washing mud process.

Proposed directions for the future restoration measures (what we should do)

- Increase the flood area and aquatic habitats,
- Offer the possibility to maintain a high enough level of water in lakes even in less favorable times,
- Select the appropriate control methods for a long-term impact of the estimated restoration measures.

Proposed measures to address these issues

1. Building one or more weirs on water access channels, to help controlling the level of the wetland's lake complex,
2. Deforestation of the willows encroachment, since their presence accelerate the evaporation losses of the aquatic habitats,
3. Partial hydrological rehabilitation works of Fundu Mare Island, including the desilting of certain channels.

Project main activities

1. Collect data from field measurements, including with a help from modern tools as UAV, USV.
2. Design hydrological rehabilitation models based upon the measurements and monitoring data.
3. Create hydrodynamic simulations for different flow situations, restoration scenarios and vegetation growing stages, in order to identify potential restoration measures.
4. Modelling of hydrological rehabilitation measures and evaluating the impact of these measures on alluvial and biological processes .
5. Identify the optimal solution of ecological restoration.
6. *Design of the project engineering for the final chosen solution.*

II. Experiences and results of the UAV-based surveys

Mission Planner screen capture – flights over the Fundu Mare Island southern part – October 2015

Aerial data collection using unmanned aircraft systems (UAS)

- The greatest advantage provided by using UAVs is the advantage of a high productivity, in terms of maintaining as high as possible the accuracy of data.

- This working method is therefore favorable to fully cover, in a significant shorter time than classic methods the researched area of Fundu Mare Island. (2000 ha!)

Aerial data collection using unmanned aircraft systems (UAS)

- Within the present project, the aerial imaging activities were carried so far out by using a SenseFly eBee, a professional survey-grade mapping UAV (Unmanned Aerial Vehicle).

- Images were captured when the UAV flew in the vicinity of the desired GPS coordinates.

- The mean precision in getting the land surface elevations was approximately 9-10 cm.

Aerial data collection using unmanned aircraft systems (UAS)

- The method enables the production of ortho-photo and digital elevation models (DEM), with an horizontal accuracy down to 3 cm, when combined with the insertion in the field of a certain number of Ground Control Points (GCP).
- The data were processed by means of a software tool, using a number of workstations working in cluster.
- Moreover, this method is non-intrusive, altitude of the flights being typically somewhere around 100 m.

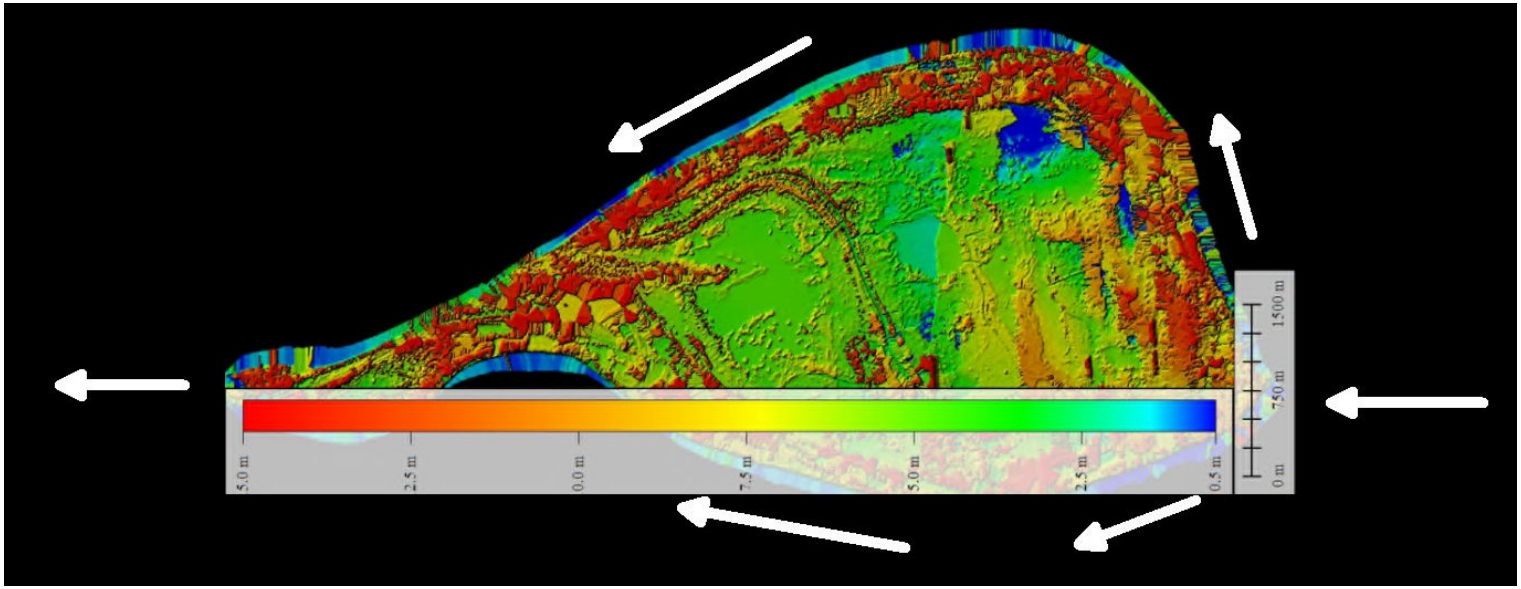
Aerial data collection using UAS

In addition to their relevance for the 3D modeling of the wetland, these detailed aerial photos offer additional info, such as:

- Vegetation (certain analysis may be made based on the height profile, leaf color and area distribution),
- Extent of lakes or flooded areas,
- Location of birds or medium-size animals in open areas.

DEM (Digital Elevation Model)

The Automn map, gathered 7669 aerial images, having a significant degree of superposing (of approx. 70% on the flight direction and 50% laterally), in conjunction with a number of approx. 35 ground control points, generated a 12.5 GB geotagged ortho-rectified photo-mosaic, as a raw material for the DEM.



Aerial data collection in wetlands using UAS - proper methods -

Discussion after two seasons of flights (autumn, winter)

The **detected limitations** of the unmanned data acquisition process came from the following :

- **Speed** of the flights **was not adapted** to a such complex habitat, with a mixture of land/water and with a very dense vegetation (speed was more adequate for plains or rural areas, with a lower density of the features),
- The **height** of the flights was also higher.

Chosen parameters were favorable to **a higher productivity**, needed for a such large area, but the paid price was **a lower accuracy** of the collected data.

Aerial data collection in wetlands using UAS - proper methods -

Discussion after two seasons of flights

One of the **known practical solution to improve the reliability** of the unmanned data acquisition process is to add a certain number of GCPs (Ground Control Points).

- Their final **number** **was not adapted** to the extent of the habitat and to its specific characteristics (mixture of land/water, very dense vegetation). We managed to place in the field less of 50 such GCP (for almost 2000ha!)

Aerial data collection in wetlands using UAS - proper methods -

Discussion after two seasons of flights

Another known issue of the aerial imagery, as the one also used by our unmanned flying vehicles is the lack of precision when dealing with surfaces covered by a monotonous pattern, as for snow, sand and - especially - water.

This comes from the software algorithms, which are using spots or significant landscape details to find (using trigonometry) their relative horizontal and vertical position. It means that for such “dull” surfaces may appear jumps in elevation, especially for their borders, next to “normal” land areas.

Aerial data collection in wetlands using UAS - proper methods -

Discussion after two seasons of flights

Other valid solutions are to significantly increase the number of the CGPs in the area and, in the same time, to improve the reading of their location.

- A future practical & efficient solution could be to use an special adapted multirotor UAV, to place more CGP.

The benefit of having a high productivity when acquiring field data with the help of the UAVs proved to be less important than the precision of the 3D map.

- In such circumstances, data acquisition should focus more on the significant features of the wetland: lakes, channels, levees, extent of different vegetation areas.

Aerial data collection in wetlands using UAS - proper methods -

Discussion after two seasons of flights

In order to implement the other viable solution needed to address the detected, i.e. to improve the reading of the GCPs location, it means that the future GPS mounted on board should be of a higher class of precision, as RTK GPS type is nowadays.

- This will be done in the next seasons of measurements, when we will have the possibility to perform an upgrade to the actual GPS tools we use with our UAVs.

Conclusions

- Within the restoration project, we used remote sensing techniques and hydrological measurements, in order to get a number of high-resolution data sets.
- It is therefore necessary to correlate multiple data sets (hydrology, soil, land configuration) and to study existing ecological relationships in order to identify optimal measures which lead to an increased flood area and offer the possibility of maintaining a high level of water in lakes even in less favorable times.
- The adaptive management already implemented by the SWB Park Administration will be improved based on the analysis, results and conclusions we will gather from the on-going project, in the next 5 years.

ACKNOWLEDGMENTS

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Large ecosystems restoration scheme


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THANK YOU!
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