About an Integrated Adaptive Management of Protected Natural Areas. Case study: Tourism Management with the Help of Unmanned Aerial Vehicles (UAVs) – an Efficient Instrument in the Help of in the National Park “Balta Mică a Brăilei” (BmB-NP)

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Abstract: - Protected areas are large nature areal over land, water, ice, to keep in their natural status without direct human intrusion. Tourism in such areas is an important aspect, with benefic effects for both their sustainability and for educating the younger generations. The UAVs (Unmanned Aerial Vehicles) are an adequate tool for a better management of large surfaces, without the direct presence of human beings inside the protected areas. The “Balta mică a Brăilei” National Park (BmB-NP) is an example of such proposed adaptive and integrated management.

Key-Words: - tourism management, protected areas, unmanned aerial vehicles, ecological vehicle, legal status

1 INTRODUCTION
Even it is placed in the center of a large white spot on the touristic map of Romania, (from Călărași in south up to Vaslui in north), without outstanding traditions in the hospitality industry, Brăila county has an exception potential in this field, which may be valorized in three axes of a sustainable tourism:
1. Cultural tourism in Brăila county;
   a. Braila city is an European model for the interethnic coexistence in Balkans,
   b. historical and architectural attractions;
   c. an outstanding economic development supported by the fact that Brăila was the main cereals pole from the Central and Eastern part of Europe before the World War 2;
2. Balnear tourism in Brăila county is sustained by the large sapropelic mud reserve in Europa (in Lacu Sărat, Câineni Băi, Movila Miresii and Balta Albă resorts);
3. Ecologic Tourism in the National Park “Balta Mică a Brăilei” (BmB-NP) will be researched as a civil application of the use of UAVs in monitoring the tourism in a protected area. In chapter 4, the authors present 30 favorable arguments in using UAVs in the frame of an integrated adaptive management for such protected natural areas.

2 UAVs nowadays
UAVs are Unmanned Aerial Vehicles remotely piloted, initially developed by militaries, but with more diverse and wide-ranged applications, including the civil field.

The civil applications of the UAVs rely on their possibility to accomplish missions with a great diversity. Besides the measurement of the environmental parameters and monitoring of the nature reserves as a non-polluting UAV (e.g. MEDIAS) could accomplish, the civil UAVs shall be able to carry out a large variety of missions such as: Fire and Rescue, Government, Energy Sector, Agriculture, Forestry and Fisheries, Communications and Broadcasting, Earth Observation and Remote Sensing.

3 MEDIAS Project - an ecological aerial vehicle for the environmental monitoring

3.1 The design characteristics
In 2008, in Romania, an academic consortium, with researchers from Galați, Iași and Bacău universities, coordinated by the author, obtained, for the researches on Coandă effect, a national grant from...
CNMP, for the surveillance and protection of the natural environment, using an ecological Coandă UAV [2]. According the contract, this new UAV, named MEDIAS, had to be in the same time a modern and a nonpolluting aerial vehicle, easy to maneuver and safe to the environment and people.

![MEDIAS components](image)

**Fig. 1. MEDIAS components [2]**

1 - curved upper surface; 2 - steering flaps; 3 - toroidal He chamber; 4 - counter-rotating fins; 5 - inner exhaust profiled cap; 6 - propeller’s shaft; 7 - electrical motor and batteries; 8 - propeller; 9 – propeller duct

As a main characteristic, MEDIAS with his adequate shape, uses the Coandă Effect (I) for lift and maneuverability. An air flow created by an electrically driven propeller (II) flows over the upper surfaces of a curved radial canopy and changes the pressure field above and under the vehicle, creating more lift and improving the stability of the flight.

A toroidal Helium optionally added inflatable chamber (III) is increasing the buoyancy and functionality of the MEDIAS VTOL UAV design and is increasing also the UAV’s mission autonomy. This high propulsion efficiency will be obtained because, besides using Coandă effect, the vehicle has an innovative design, MEDIAS being a hybrid between the following:

I. An aerial vehicle - propelled and steered by Coandă effect and vertical air jets,
II. An aerial platform - which ensures its sustentation by using a propeller, preferably ducted, for a greater efficiency,
III. An aerostat - preferably filled with Helium - which improves some of the flight parameters.

### 3.2 The main characteristics

The main characteristics of the MEDIAS ecological UAV are:

- Rotating wing, with a central propeller, with the use of vertical reactive jets, amplified with the help of Coandă effect, around the symmetrical profiled canopy.
- The central propeller is driven by an electric brushless engine, and the energy is stored in a pair of Li-Po accumulators.
- Size: Diameter – 1...1.5 m; Mass – 7...10 kg.
- Payload weight (for scientific equipment and monitoring devices): 3...5 kg.
- Cruise speed: 0...35 km/h; Max speed: 35 km/h.
- Service altitude: 0...500 m; Max. altitude: 1000 m.
- Remote control range (and for data transmission): 40…50 km.
- Autonomy: 1...6 h

### 4 INTEGRATED AND ADAPTIVE MANAGEMENT IN “BALTA MICA A BRAILEI” NATURAL PARK

“Balta Mica a Brailei” Natural Park (BmB-NP) stands for one last sample of the former Danube pools. Across an area of only 241 km², BmB-NP preserves 10% of the former Interior Delta (the former pools of Braila and Ialomita), which, by the 6th decade of the last century used to occupy 2.413 km² (Antipa, 1910 []) of wet compact area across the Danube Inferior Course between Silistra and Braila.

#### 4.1 Localization

BmB-NP stretches over a section of 62 km of Danube Inferior Course (Picture 3.1). Of the entire Danube length, 80 km of the left bank (3% of the total length and 7% of the Romanian route) border Braila County on the East (Moisei, 2003 [5]). What is remarkable is that on Braila County territory, Danube Meadow reaches a width of 25 km, which is the highest across the entire European course of the Danube.
River (Clonaru, 1967). There are no human settlements on PN – BmB territory.

4.2 Hydrology
The hydrographic network in BmB-NP consists of 7 Danube Arms, with a length of the water course of 149 km, which is the equivalent of a length of 61,3 km² lotic ecosystems and a number of 52 interior lakes and pools totaling an area with glossy waters of 44.3 km² lentic ecosystems.

4.3 Geomorphology
The action of flood waters, by the latter’s solid component, has generated over centuries of evolution, a necklace of 7 main islands, under a flood regime, with a cumulated area of 151.8 sq. km. These islands area varies between 242.4 ha - Harapu Island, and 9.726.6 ha – Small Island of Braia Island (InB). In addition to these main islands, in Balta Mica a Brailei (BmB) there are four other smaller peaks of 20 ha, with a total area of 56.2 ha.

The fact that BmB-NP is the park with biggest length in Romania, that there are no human settlements within BmB-NP, that one may find an intense fragmentation of the land environment in the water environment (sometimes weather – related conditions such as – icebergs or fog – do not allow for Danube crossing), as well as the monitoring of the spectacular dynamics of the meadow micro – relief, but also the annual alternations between the water environment and the land one stand for the first 5 arguments in favor of introducing UAVs in BmB-NP management.

4.4 Biodiversity Magnitude.
Secondly after the Danube Delta Biosphere Reserve (which in a world top of biodiversity magnitude in those protected areas holds the third position after the Great Barrier Reef and Galapagos Islands), BmB-NP holds the highest bio diversity of the 29 national and natural parks in Romania. Of 208 bird species (52% of Romanian ornithofauna) as inventoried in the park unitary database, 68 are on the 1st Axis of Birds Directive and other 123 species are protected by other international laws. In terms of the “Directive on Habitats, Flora and Fauna” of the 19 types of habitats, as identified in Balta Mica a Brailei, 9 are of priority being registered on the 1st Axis of the aforementioned Directive and of the 74 species of mammals, reptiles, amphibians and fish, 23 may be found on the special lists of species of the same European Directive.

4.5 Legal Status
BmB-NP enjoys a three – sided legal status:

i. At the national level: it is declared a natural park (by virtue of Law no. 5/2000) ;

ii. At the global level: it is declared to be a Ramsar site (a wetland of an international relevance – as of June 2001) ;

iii. At the European level: it is declared to be a “Nature 2000 site”, as of December 2007, both as an Area of Birds and Fauna Protection (ROSPA0005), and as a Site of Community Importance (ROSCI0006).
The acknowledgement at both the European and the global level stands for the 6th argument in favor of introducing UAVs in BmB-NP.

4.6 Management Plan

The first edition of BmB-NP Management Plan has been drawn up during the period between 1999 and 2002 by Bucharest University by means of the project LIFE 99 NAT/RO/006400, it has been endorsed by the Romanian Academy (no. 265 of November the 21st 2002 and approved, by virtue of the Order of the Minister of the Environment no. 1456 of August the 14th 2003. Nowadays, the second edition of the management plan is in force, as approved by virtue of Government Decision HG no. 538 din 18 May 2011 - published in “Monitorul Oficial” no. 498 din 13 July 2011 and also elaborated by means of project: LIFE 06 NAT/RO/000172.

At the same time, the management plan has also an adaptive character since it is thus conceived as to enable a periodical harmonization (every 10 years) both in relation to the dynamics of the complexes of water and land ecosystems from Danube Meadow (the area where the natural capital registers the most intense and even dramatic evolution in Romania), as well as in terms of the social – economical and cultural developments (particularly from the legal perspective in this period of correlation with the communitarian legislation).

The topics of the management plan are the following:

1. Biodiversity knowledge is achieved by scientific research, by monitoring some of the key systemic components (7th argument) and periodical surveying (observing) in stationary the status of the said eco – systems complexes (8th argument);

2. The ecological education, information and awareness means promoting the value of biodiversity in BmB-NP based upon one well – substantiated communication strategy, by means of which one has identified 5 main target groups within the category of receptors: local communities, pupils and students, users of those services and resources, as provided by the park’s natural capital, tourists and audio – visual media; in the approach used for the case study in chapter 4 one focuses on tourists’ information and awareness;

3. The relations with local communities – local communities, which, by the time of embankments held a vast positive managerial background, since, while being aware of not exhausting their renewable resources, they used to carry out traditional activities within the limits of the support capacity of the said land and water ecosystem complexes, have got nowadays at that point when they tend to harass the park biodiversity by: fish poaching (9th argument), semi – wild pasturage (10th argument), forestry crimes (11th argument);

4. The management of a sustainable use of renewable resources, as provided by the natural capital in BmB-NP, is divided in:

   The use of those resources, as provided by the wood vegetation by means of forest exploitations (12th argument) and the management of the woods’ renewing activity (13th argument);
The use of water resources, by means of commercial fishing (14th argument), traditional fishing (15th argument) and recreational - sportive fishing (16th argument);
The use of those resources, as belonging to the land flora by means of pastoral activities (17th argument);
(18th argument);
(19th argument).

5. The management of a sustainable use of the services provided by the natural capital in BmB-NP, may be:
The use by means of TOURISM of those services, as provided by BmB-NP, shall be given a broad presentation in the case study from chapter 5 (20th argument);
Sustainable navigation on the Danube (21st argument).

6. Reconstruction and ecological rehabilitation in BmB-NP, with the 2 components which may be found in BmB-NP:
Ecological reconstruction of the former alluvial forest (22nd argument),
Ecological rehabilitation of lentic water ecosystems (23rd argument);

Fig. 5 BmB-NP zoning from the perspective of recreation and tourism

7. The management of species and habitats of a Community Interest in BmB-NP, the study of such habitats and populations, alongside the observation of the outcomes of the management measures, as envisaged, may be much more efficient by help of UAVs since there is no need for the intrinsic presence of the human factor, which, usually disturbs (alters) the natural behavior (24th argument);

8. The management of Force Majeure events, such as:

Historical floods (in the recent decade, based upon weather changes which have also been felt in the Danube Basin as well, 2 such historical floods have been registered: namely in 2006 and in 2010) (25th argument),
Epizooties (some of them very serious indeed – such as the avian flu) (26th argument),
Ice bridges during winter floods (27th argument),
Fires (28th argument),
Major pollutions (such as the case of cyanide waves in 2006 and in 2010) (29th argument);

9. The constructions in BmB-NP – although on the current park territory there have been 9 villages which have been relocated following the 1970 floods, at present one allows for the achievement of some investments for touristic purposes, only in the area of sustainable development of human activities; the anthropization of the other areas, by building hotels, touristic chalets, eco – touristic pensions and the establishment of several holiday villages, causes the deterioration of the dynamic balance of the extremely fragile natural capital in this protected natural area (30th argument).

The aforementioned presentation of a number of 30 arguments in favor of using UAVs as an efficient instrument in the PN – BmB integrated and adaptive management comes to prove beyond any reasonable doubt whatsoever, that establishing a constant stationary network of UAVs in BmB-NP, is not only necessary, but also especially opportune.

5 Tourism Management with the help of UAVs in BmB-NP - Case Study

The eco – touristic potential for the buffer areas (the 7 big islands in BmB-NP) and for the full protection areas, has been calculated at approximately 8,500 visitors each year for an average period of 5 days and a volume of 42,500 touristic days (Vădineanu and the others, 2004 [6]). Concurrently with the inclusion of the three areas of sustainable development of human activities in BmB-NP (the embankment – bank areas of Northern Baragan Field, of IMB and of Dobrogea), as frequently visited by 90% of sportive fishermen (who, in 2007 have stood for 73,6% of the overall visitors), we estimate the touristic potential of BmB-NP to be 25 thousand visitors each year (16,500 tourists / year in
the Area of Sustainable Development of Human Activities + 8,500 tourists / year in the 7 Areas of Sustainable Management).

When developing a sustainable tourism in BmB-NP, one requires the adoption of a management which shall simultaneously combine the following (Dumbrăveanu, 2005 [4]): The ecologic support capacity; Economic support capacity; Social support capacity; Psychological support capacity.

In the case of those full protection areas, the Scientific Council has approved in the meeting from November the 10th 2005 an ecologic support capacity for the tourism activity of 15 tourists per day in the Full Protection Area Fundu Mare and of 25 visitors / day in the Full Protection Area Egreta, and subsequently, of 20 tourists / day in the Full Protection Area Cucova. Due to the fact that, upon the endorsement of the second edition from February, of the Management Plan, the eco-tourism in BmB-NP is poorly developed (7.6% in 2007 of the potential of 25 thousand, being deemed as the best year by the Administration of BmB-NP when 1.903 visitors in BmB-NP have been monitored), the other three support capacities (economic, social and psychological) may be very difficult to estimate. The economic, social and psychological support capacities shall be calculated upon the following review of the Management Plan.

The types of tourism which may be carried out in BmB-NP are:

- Eco-tourism (sports fishing also included here),
- Agro-tourism,
- Scientific tourism
- Educational tourism.

The forms of tourism allowed in BmB-NP are:

- Nautical tourism, as practiced both individually (by kayak), as well as in group (by oared boats),
- Equestrian tourism,
- Cycle-tourism,
- Pedestrian tourism.

According to BmB-NP Visiting Strategy, as submitted in January the 25th 2010 with the Intermediate Body in Galati, by means of the finance petition at POS-1, in BmB-NP tourists’ access is regulated under the chart from picture no. 3.1 and the map represented in Fig. 5 as follows:

i. “Tourist Zone I” corresponds to the 2 strictly protected areas;

ii. “Tourist Zone II” corresponds to the 7 sustainable management areas + the 8 full protection areas

iii. “Tourist Zone III” corresponds to the area for sustainable development of human activities.

BmB-NP visiting may be done only under the conditions stipulated within the Park Regulation.

6 Conclusions

1. UAVs are a non-intrusive tool in the monitoring of protected areas, especially the large ones, as this avoids the direct presence of man.

2. The ecological characteristics are a “must” when choosing or designing an environmental monitoring UAV.

3. Through its location, the BmB-NP is an adequate example of using modern tools in the frame of an adaptive integrated management of a protected area.

References

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