Management problems and solutions for wetlands and floodplain habitats in the Lower Prut Floodplain Natural Park

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ABSTRACT: Lower Prut Floodplain Natural Park, located in the southern part of Prut river basin is the result of the interaction in time between human activities and nature. This protected area was envisaged as a distinct area of significant value to landscapes, as well as a region of great biological diversity. Within the boundaries of this area aspects such as maintaining a balanced interaction between society and nature, protecting the diversity of landscapes and habitats and preserving traditional land use and other activities of the local population, are encouraged. In addition, visitors are offered several recreational and touristic activities, and scientific, educational and cultural endeavours are permitted within the protected area. Tributaries from the Lower Prut basin have no facilities for riverbed schemes in their sub-basins due to the highly varying hydrological regime in terms of the discharge. However, they can be used as water sources for lacustrine units/reservoirs created as a result of land reclamation works on former marshes or for present day wetlands, but also for social and economic activities.

KEY WORDS**:** Prut, wetland, Natural Park, floodplain, management

1. Introduction

Lower Prut Floodplain Natural Park includes the entire floodplain sector located within the boundaries and under the administration of Galati County. The Park was registered with the Natural Monuments Committee as no. 19/Cj/18.02.2003. The UP V Prut Floodplain zoning maps were designed by SILVAPROIECT in 1995 (Vartolomei, 2010).

The water management in this area requires the installation of a pumping plant in the Giurgiuleşti-Oancea area, as well as several wastewater treatment plants. Their location will be determined by the migration of population from urban to the neighboring rural areas and the ensuing development of small scale industrial units in the latter (Vartolomei et al., 2011).

Based on the analysis of premises and conclusions resulted from the aforementioned problem, several proposals can be drafted in order to find a proper solution. The most important aspects are related to the technical side (i.e. the technical works required by the actual exploitation of water resources and their constant improvement, combined with the biotechnology of fish

farms) and the organisational aspect (the stakeholders and their specific objectives) (Surd et al., 2011; Pop et al., 2011).

The essence of water and environmental laws viewed as fundamental documents for each enterprise is building awareness regarding wastewater management (pollution sources, discharge values, pollutants). Therefore, the overall aim of this study is to provide a primary source of information for present and prospective stakeholders: water management and environmental protection institutions, emergency situations and labour protection offices, health and municipal services, statistical offices etc. (Vartolomei and Andrei, 2008; Pop et al., 2011).

2. Regional setting

Prut River is an allochtonous river whose headwaters are located in the Ukrainian Carpathians. From the springs to the confluence with the Danube, over a total length of 967 km, the river drains a basin of 27,450 square kilometres (according to the *Water Cadastre Atlas of Romania, Part I and Part II,* 1964). From a hydrological point of view, the Romanian sector of Prut river basin is characterized by the data presented below. The average altitude at entering the Romanian territory is about 140 m, whereas the confluence with the Danube is at 15 m (Bacauanu, 1973; Posea, 2005). The mean annual discharge is 88 cm/s, while the maximum annual discharge recorded between 1952-2010 was 4240 m/s, in 2008, in Radauti-Prut gauging station. The annual minimum discharge recorded during the same period was 7.6 m/s in 1955 (Vartolomei, 2004). The data summarizing the mean discharge within the Romanian territory between 1952-2010 are listed in Table 1 (Boboc and Melniciuc, 2007; Ujvari, 1972):

Table 1. The mean discharge characteristics during 1952-2010 in the Romanian section of Prut basin

Gauging station	**Rădăuţi-Prut**	**Ştefăneşti**	**Ungheni**	**Dorohoi**	**Todireni**	**Bădeni-Hârlău**	**Cărpinaţi-Victoria**
River	**Prut**	**Başeu**	**Prut**	**Jijia**	**Sitna**	**Bahlui**	**Jijia**
Mean discharge (m^3/s)	78,28	1,94	85,97	0,66	2,03	0,44	6,65
Gauging station	**Todireni**	**Podu Iloaie**	**Podu Iloaie**	**Iaşi**	**Iaşi**	**Murgeni**	**Fârţăneşti**
River	**Jijia**	**Bahlui**	**Bahluieţ**	**Bahlui**	**Nicolina**	**Elan**	**Covurlui**
Mean discharge (m^3/s)	2,21	1,18	1,08	3,01	0,43	0,49	0,56

Considering the lower sector of Prut river is located in the eastern part of the country, the climate is influenced by the neighbouring Carpathian Mountains (West), the hilly area of the Moldavian Plateau (East) and the Danube floodplain (South) (*Geography of Romania*, Volume I, 1983, and Volume IV , 1992). This particular context generates some changes compared to the mean temperature, precipitation and wind regimes. The mean precipitation in the three sectors of the basin (upper, middle and lower) ranges from 690 mm (in 1989), to 515 mm (in 1993) and 632,27 mm (in 1996), from the North to the South, whereas the net drainage layer ranges from 174 mm (in 1988), to 130 mm (in 1992) and 159, 42 mm (in 1996) (Bogdan, 2007; *RPR Climate*, Vol I and vol II, 1962-1966). The main human activities exerting pressure on water resources have

been identified as: the hydraulic works and floodplain protection plans, the sources of water supply for urban and rural settlements, hydropower units, agriculture, fish farms, industry and others (Bălteanu et al., 2006).

3. Aims and methods

In this document we propose, as a demonstration, three potential sites for wetland areas management and ecological restoration projects in the Lower Prut basin: *Prut floodplain* downstream of Şovarca swamp to the mouth of the Danube River; *Lake Brateş* located Northeast of Galati urban area, linked to Prut river through Ghimia channel; *Horincea river basin* (Vartolomei et al., 2011). Furthermore, we intend to present the existing natural park from the Southern part of Prut river basin as the normal and sustainable solution to the management of wetlands and floodplain habitats (Vartolomei, 2006c).

The technical works for water resources management in Prut river basin were conducted based on several aspects: covering the water amount required by human settlements, industry and other uses, controlling the destructive effects of floods, the hydropower potential of the main watercourse within the basin, protecting the quality of water sources and providing a healthy environment for the population.

Note that the differences in the terminology referring to natural areas under protection can simply be removed by using the classification system developed by IUCN whose main purpose is to organize and structure protected areas. This system comprises of six categories of protected areas with a varying degree of human intervention, ranging from non-existent (categories Ia and Ib) to very high (category V) (Vartolomei et al., 2011; Vartolomei, 2002). All categories imply similar importance and relevance to biodiversity conservation.

As regards the working methods, GIS techniques and GPS tools were employed for inventorizing and recording in the field the boundaries of all these types of protected areas, as well as for digitally integrating them with the boundaries of all protected areas according to European standards (Vartolomei, 2003, 2006a, 2006b; Andrei and Vartolomei, 2010).

4. Results about current aspects regarding the wetlands and floodplain habitats inventory

In 1998 the Romanian Waters National Company, the main manager of water resources in Romania, initiated (upon specific request from the Ministry of Waters, Forests and Environmental Protection) the preparation of inventories of wetlands and floodplain habitats nationwide, including their potential for restoration, according to the particular cases in Romania where the land restitution process to the original owners was in its second stage of implementation (Vartolomei, 2012, 2012b).

In order to determine the potential and state of conservation of wetlands within the Danube Basin, an assessment of wetlands and floodplains was conducted by an international consortium coordinated by the UNDP/GEF Assistance (according to *Transboundary Cooperation and nature conservation and wetland management for the Danube River Basin - component no. 3. Nature rehabilitation and international wetlands management in the Lower Prut river*).

Furthermore, a national inventory of wetlands and floodplains was completed including all natural wetlands, as well as wetlands whose initial state has undergone changes.

Both reports indicate Prut river basin contains a large number of wetland areas, as well as a vast potential for ecological restoration. Of the 200 wetlands inventorized throughout Prut basin (many of which are less than 1 sq km area), a total of 19 wetland areas were selected and analysed in the initial state. Some of these wetlands are still under natural conditions (10), whereas the rest were modified for agricultural use (Fig. 1) (Vartolomei, 2012, 2012b).

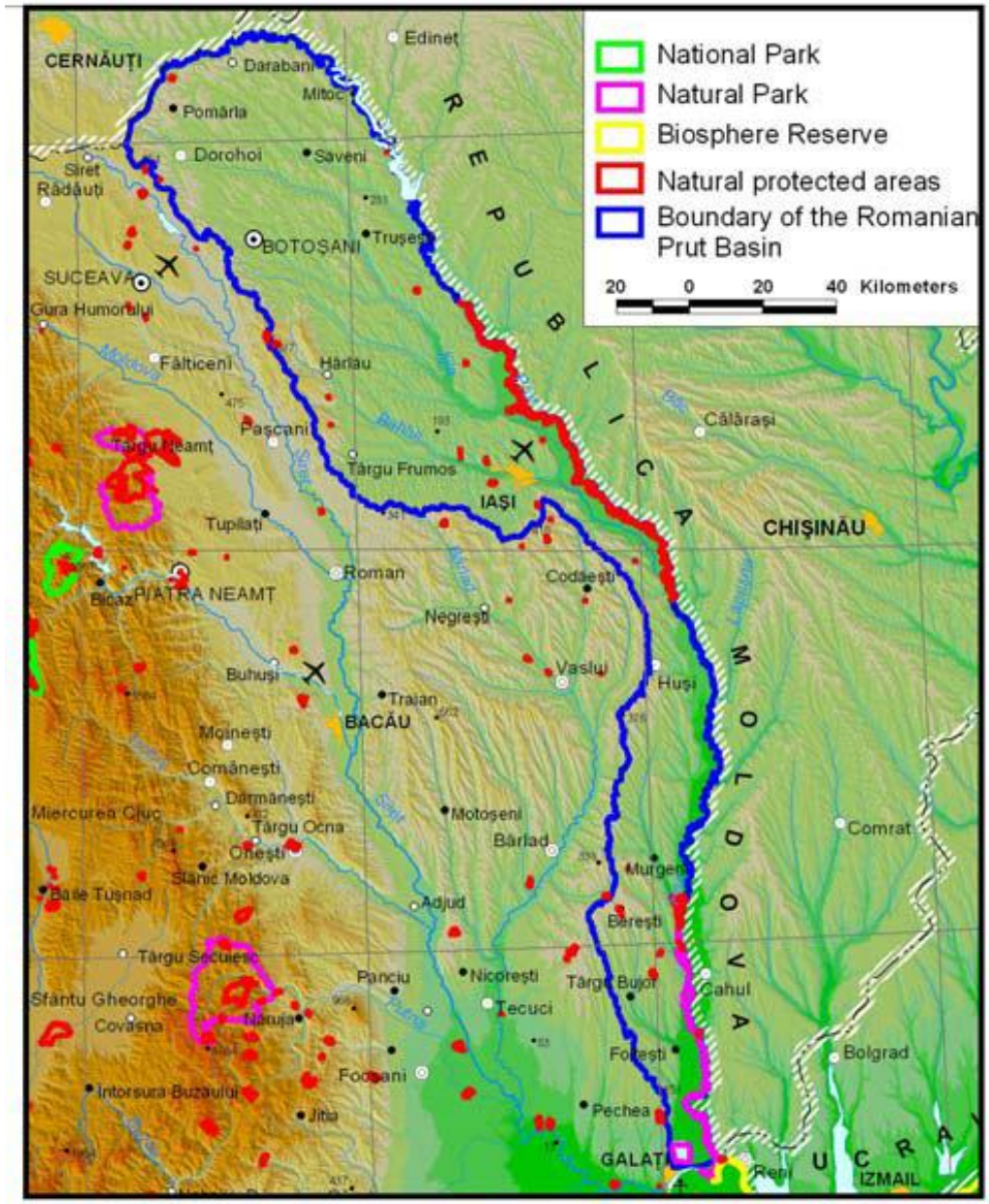

Figure 1. Natural Protected Areas in the Romanian Prut Basin (after Bălteanu et al., 2009). This figure is available in colour online at www.georeview.ro.

It is worth mentioning that some natural-state wetlands are already listed as natural protected areas by legislation. From this point of view, wetlands and floodplain restoration planning is underdeveloped and will depend on the completion of the land restitution process. In the Lower Prut basin within Galati and Vaslui counties we list the following protected areas (Vartolomei, 2002, 2007; Râclea and Vartolomei, 2006) (Table 2).

Of all the protected areas in Galaţi county, according to the habitat identification criteria, just three (i.e. Prut Ostrov/Isle, the Lower Prut Floodplain and Vlascuţa swamp/lake) are listed as including wetlands, as well (Vartolomei, 2008).

Table 2. The protected areas within Lower Prut River counties

No.	Natural Protected Area	Location (adiministrative unit)	Area (ha)
	Vaslui county		
1	Malusteni Fossil area	Malusteni	1,00
2	Nisiparia Hulubat Fossil place	Vaslui	250
3	Hill of Burcel	Miclesti	1,20
4	Tanacu – Coasta Rupturile	Tanacu	600
5	Badeana forest	Tutova	12,670
6	Harboanca forest	Stefan cel Mare	4,310
7	Balteni forest	Balteni	2,200
8	Hay meadow Glodeni	Glodeni- Negrilesti	600
	Galati county		
1	Sand dunes – Hanu Conachi	Hanul Conachi	199.3
2	Garboavele forest	Galati	220.4
3	Breana-Roscani forest	Baneasa	78.3
4	Tirighina-Barbosi Fossil place	Galati	1.0
5	Rates Fossil area	Tecuci	1.5
6	Fundeanu forest	Draguseni	110.7
7	Talasmani forest	Beresti	20.0
8	Buciumeni forest	Buciumeni, Brahesesti	71.2
9	Prut Ostrov (Prut Isle)	Ghimia Prut	56.6
10	Potcoava swamp	Branistea	49.0
11	Talabasca swamp	Tudor Vladimirescu	130.0
12	Beresti Fossil place	Beresti	49.0
13	Prut Lower Floodplain	Cavadinesti	5,480.41
14	Pochina swamp/lake	Suceveni	74.8
15	Vlascuta swamp/lake	Mascatani	41.8
16	Pogonesti forest	Suceveni	33.5

Prut Ostrov (Isle), which is in fact an island formed at the confluence point of Prut and Danube, was included in the fourth category of protected areas by the County Council in 1994. The main vegetation types were forests and wetland vegetation. As regards the main habitats within the protected area, wetland and freshwater habitats are prevalent, as well as forest habitats. The areas of the main habitat types are listed in Table 3, according to the *Transboundary Cooperation and nature conservation and wetland management for the Danube River Basin - component no. 3. Nature rehabilitation and international wetlands management in the Lower Prut river*:

Table 3. The area of the main types of habitats in Prut Ostrov

Main types	Area (ha)
Freshwater/Wetlands habitats	20.5
Forests	35.5
Total	56

The fauna includes mammals, birds, reptiles, amphibians, fish, as well as a variety of species belonging to the *Nevertebrata Fillum* (Pişota, 1972). The main activities carried out within the boundaries of this protected area fishing, unruly unregulated deforestation, hunting and various types of poaching. The impacts of fishing, hunting and poaching are currently rather low.

In the **Lower Prut floodplain** forest, pasture and wetland (floodplain and marsh) vegetation formations are prevalent. The main habitats of interest in this protected area are freshwater, wetland and marsh associations, lianas, shrubbery and forest habitats. The areas and traits of the main habitat types are listed, according to the *Transboundary Cooperation and nature conservation and wetland management for the Danube River Basin - component no. 3. Nature rehabilitation and international wetlands management in the Lower Prut river,* in Table 4 below:

Table 4. The area of the main types of habitats in the **Lower Prut floodplain**

Main types	Area (ha)
Freshwater/wetland habitats	25.5
Herbal associations/pastures and shrubbery	31.5
Forests	2,573.43
The length of Prut river on the Romanian territory	225

The floral composition of wetlands (floodplain and marshes) comprises of *Salix alba, Populus alba, Rosa canina, Satix fragila, Eqtasetum limosum, Typha angustifolia, Nymphae alba, Sagitaria sagitifolia* etc. (Pişota, 1972). The fauna includes species of birds, fish, reptiles, amphibians, insects and mammals characteristic to wetland habitats.

The Lower Prut Floodplain is an outsanding habitat for over 230 species of birds nesting, feeding and passing through this region, many of which are under the protection of international conventions. The fish fauna is composed freshwater species such as *Misgurnus Fosilis, Titca tica, Esox lucius, Cyprinu carpio, Silurus glanis* etc. Mammals are underrepresented in this area; however, we can note the occurrence of species such as *Ondra yibethica, Vulpes vulpes* (Pişota, 1972).

The main human activities within this protected area are fishing, deforestation, hunting and various types of poaching. Of these, just fishing and deforestation have a broader impact, whereas hunting is seasonal, and therefore its impact is less significant, and poaching has only been reported sporadically. Moreover, some accidental activities occurring outside of the protected area have had a negative impact on the latter, according to the *Transboundary Cooperation and nature conservation and wetland management for the Danube River Basin - component no. 3. Nature rehabilitation and international wetlands management in the Lower Prut river,* which are listed in Table 5 below:

Table 5. Types of affected environmental factors in the Lower Prut river meadow area

Impact Source	Pollutant	Affected environmental factors
Fish ponds	Waste	Water, soils
Mata/Radeanau, Sovarca	Waste	Water
Vladesti, Brates	Nutrients	Water

This protected area is regularly affected by flooding, especially during spring. The Lower Prut Floodplain Natural Reserve was the subject of a proposal submitted in 1999 by the Galati Environmental Protection Agency to the Romanian Academy and the County Council, which intended to declare the area as an official protection area within the Lower Danube Green Corridor. The latter is a project coordinated by the Danube Delta Research and Planning Institute and the Directorate for Nature Conservation and Biodiversity Protection, the Ministry of the Environment of Romania.

Currently the area is protected under Annex 1 of Law 5/2000 (Fig. 2) (Vartolomei, 2006; Vartolomei et al., 2011).

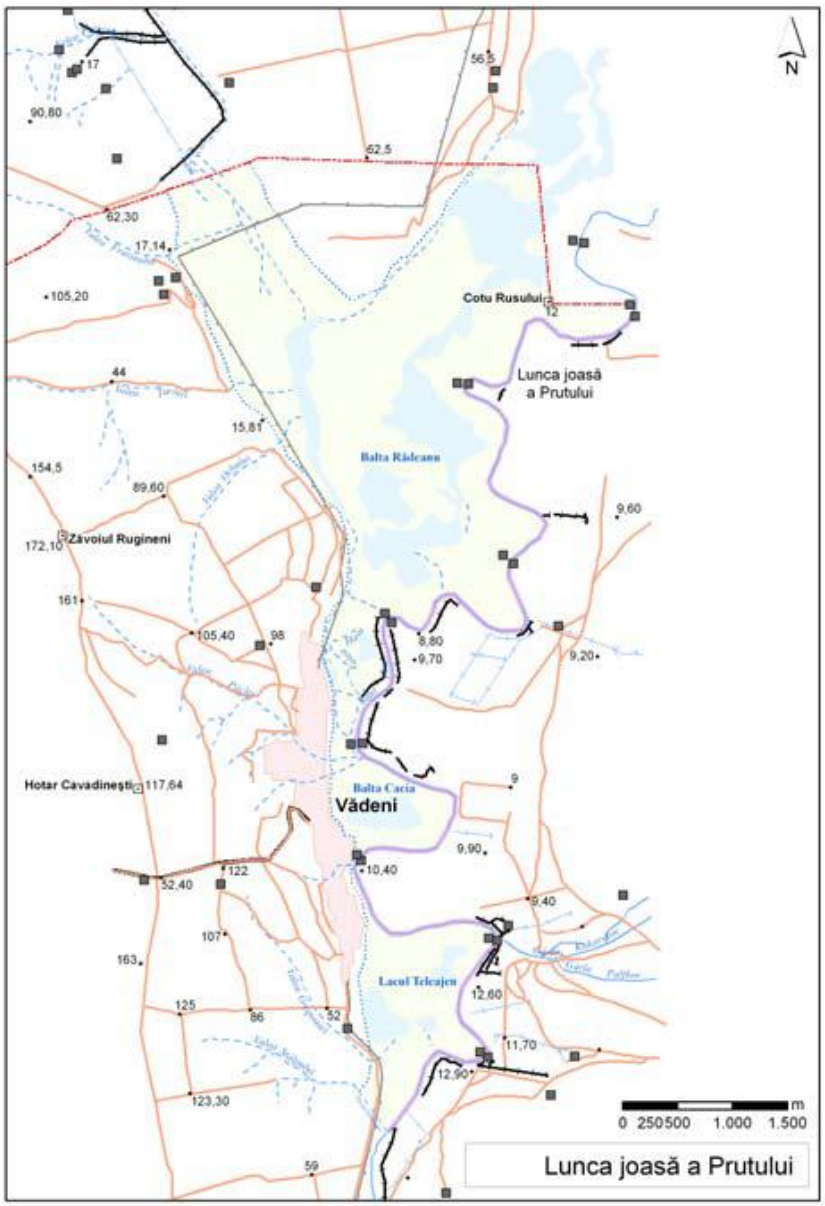

Figure 2. Lower Prut Floodplain Natural Reserve (after Bălteanu, 2009, with GIS processing). This figure is available in colour online at www.georeview.ro.

The third protected area in our list, **Vlascuta swamp**, comprises of 100% typical wetland vegetation; the flora includes species such as *Typha angustifolia, Nymphaea alba, Sagitaria sagitifolia* etc. The fauna is also typical for shallow marshes, consisting of invertebrates, amphibians, molluscs, reptiles, fish, birds and mammals associations. The main human activities are fishing, hunting and sporadical poaching. As in the previous case, a number of accidental activities occurring outside of the protected area have had a negative impact on it, according to the *Transboundary Cooperation and nature conservation and wetland management for the Danube River Basin - component no. 3. Nature rehabilitation and international wetlands management in the Lower Prut river* study. These activities are listed in Table 6 below:

Table 6. Types of affected environmental factors in Vlăşcuţa swamp area

Impact Source	Pollutant	Affected environmental factors
Crops	Fertilizers	Soils, groundwater
Mesteacanis village	Waste	Water, soils

5. Discussion about the southern sector of the Natural Park

The establishment of the Lower Prut Floodplain Natural Park in the southern part of Prut river basin is the result of the interaction in time between human activities and nature. This protected area was envisaged as a distinct area of significant value to landscapes, as well as a region of great biological diversity. Within the boundaries of this area aspects such as maintaining a balanced interaction between society and nature, protecting the diversity of landscapes and habitats and preserving traditional land use and other activities of the local population, are encouraged (Figs 4 and 5). In addition, visitors are offered several recreational and touristic activities, whereas scientific, educational and cultural endeavours are permitted within the protected area (Fig. 3) (Vartolomei, 2012b).

Figure 3. The natural potential for touristic activities in the Lower Prut Floodplain Natural Park (Source: personal photo-archive). This figure is available in colour online at www.georeview.ro.

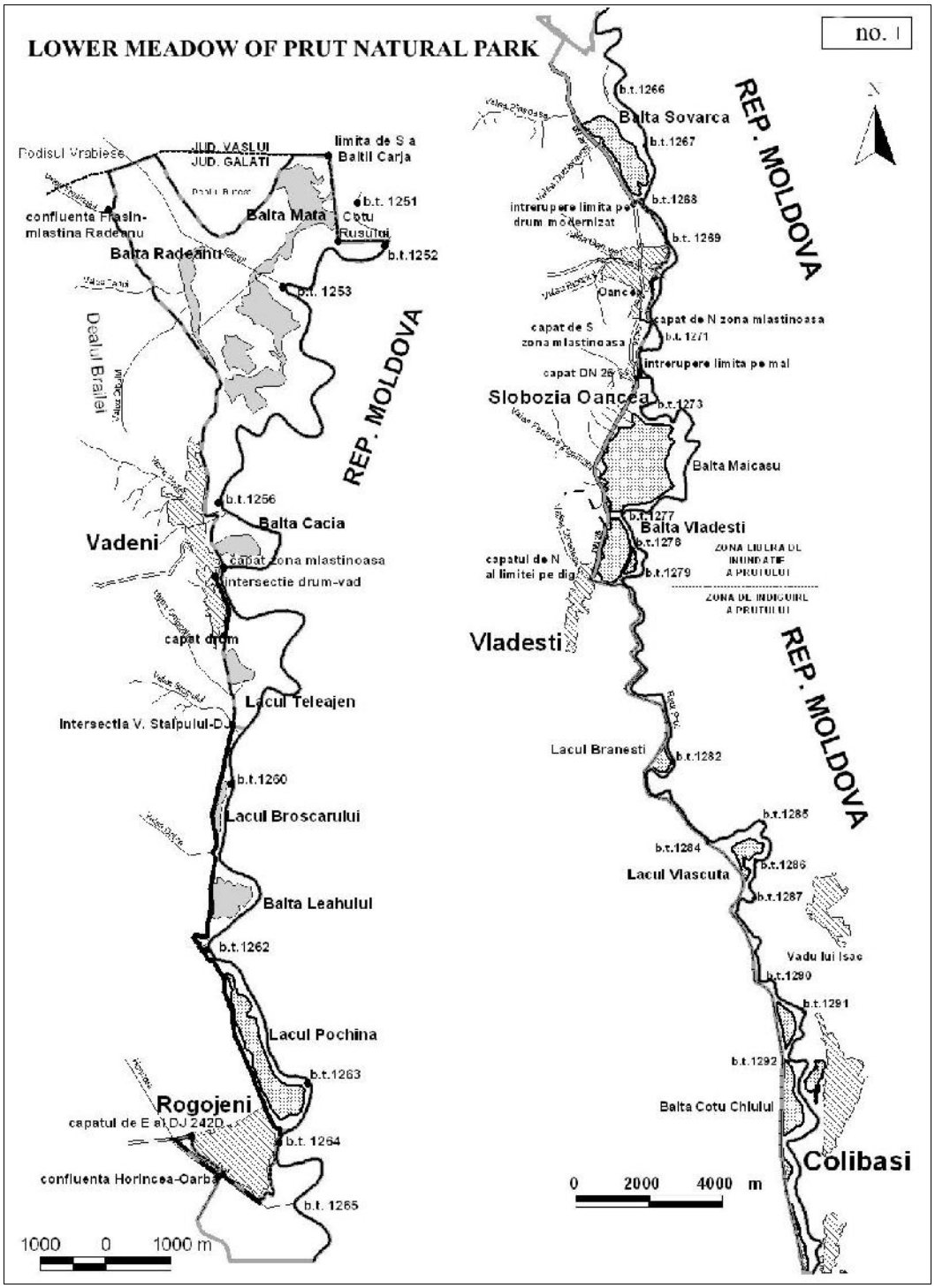

Figure 4. The Northern sector of Lower Prut Floodplain Natural Park (Digital format source: Supply contract no. 9257/16.08.2005 between Florin Vartolomei and the Regional Environmental Protection Agency Galati, Galati county - *Acquisition of digital map in vector format with limits in GIS format for Lower Prut Floodplain Natural Park*).

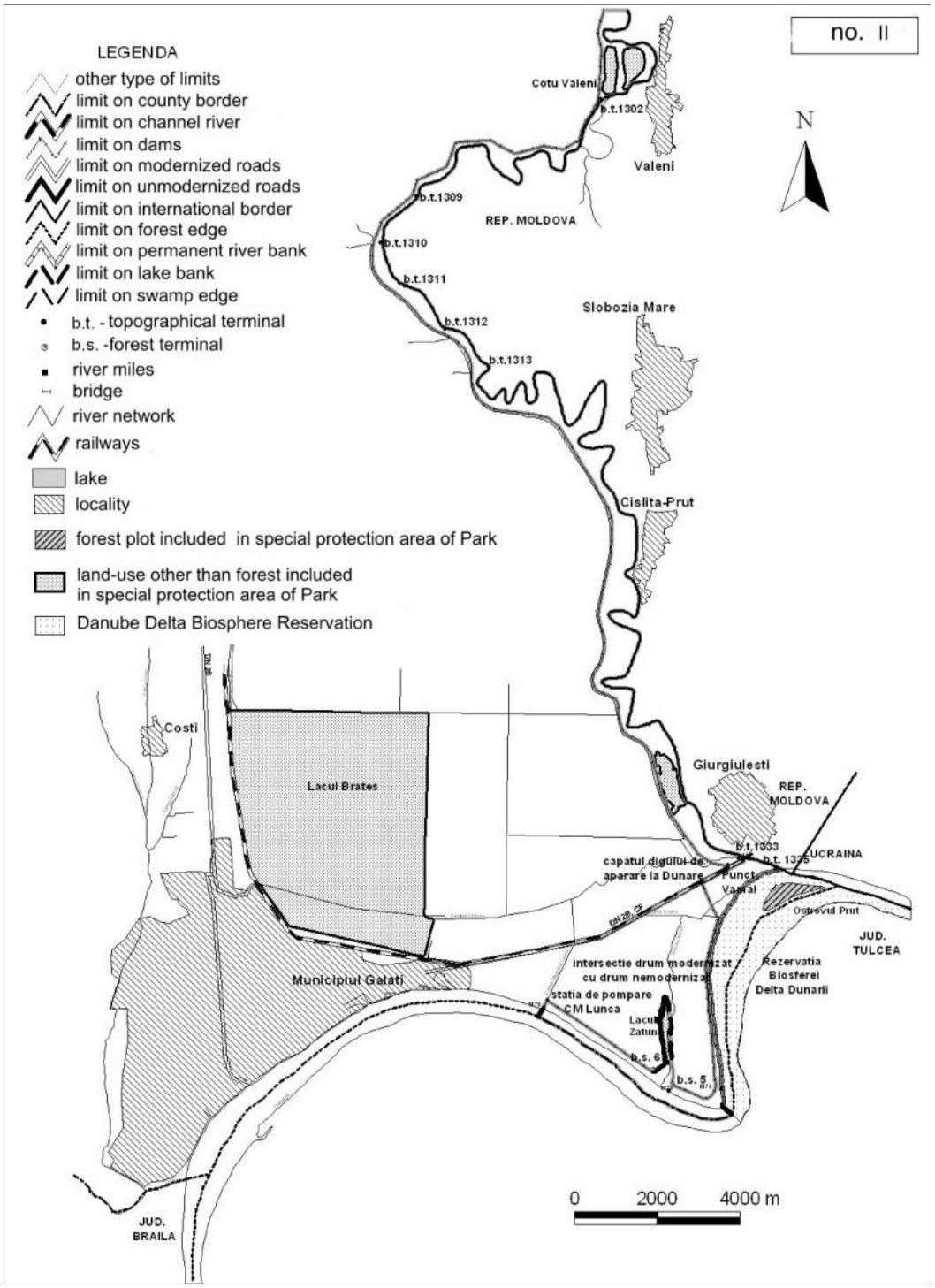

Figure 5. The Southern sector of Lower Prut Floodplain Natural Park (Digital format source: Supply contract no. 9257/16.08.2005 between Florin Vartolomei and the Regional Environmental Protection Agency Galati, Galati county - *Acquisition of digital map in vector format with limits in GIS format for Lower Prut Floodplain Natural Park*).

5.1. Ecological considerations

The Northern sector (consisting of Maţa Lacustrine Complex bordering Vaslui county) includes two lakes (the low lacustrine area, accounting for 135 ha altogether) and the higher area surrounding them (57 ha), whereas the Southern sector consists of Radeanu Lacustrine Complex (342 ha water surface and 78 ha of agricultural terrains) (Vartolomei, 2008).

Within the southern sector (i.e. Radeanu L.C.), located on the lower Elan stream (SE), there are several areas where the environment is virtually natural, untouched, wherein aquatic patches alternate with scroll bars, natural levees, marshy spots, which host numerous bird colonies throughout the year. The area which was proposed for the establishment of a special bird protection reserve amounts to 194 ha. However, due to the improper operation of the numerous hydrotechnical works in the area (caused mainly by lack of financial resources), currently just 148 fishponds are functional (Fig. 6) (Vartolomei, 2006c).

The Natural Park falls in the habitat type consisting of: natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* vegetation (habitat code 3150 according to Natura 2000 list) and lakes or reservoirs with water ranging from dark grey to blue green with variable turbidity, particularly rich in alkaline substances with pH usually above 7, and floating islets formed of *Hydrocharition* on the water surface. In the case of deep water and/or large water systems, *Hydrocharition* formations are associated with submerged vegetation consisting of large *cormophytes* such as *Magnopotamion* (Gâştescu, 1971).

Figure 6. Biodiversity in Mata-Radeanu Lake Complex (Source: personal photo-archive). This figure is available in colour online at www.georeview.ro.

The plant species characteristic for this habitat are *Lemna, Spirodella, Wolffia*, *Hydrocharis morsus-ranae*, *Stratiotes aloides, Utricularia australis and Utricularia vulgaris*, *Aldrovanda vesiculosa* (aldrovanda), *Azolla* ferns, aquatic moss species from the *Riccia* and *Ricciocarpus* genera, various submerged cormophytes, such as *Potamogeton lucens, Potamogeton praelongus, Potamogeton zizii, Potamogeton perfoliatus* etc. (Pişota, 1972).

5.2. The description of special conservation areas

The Lower Prut Floodplain Natural Park includes the entire floodplain of Prut river located within the administrative territory of Galaţi county. This park is listed by the Natural Monuments Commission under no. 19/Cj/18.02.2003. The spatial planning maps for UP V Lunca Prutului (Prut river floodplain) were designed by SILVAPROIECT in 1995 (Vartolomei, 2006b, 2006c, 2012b).

The special conservation areas in Lower Prut Floodplain Natural Park comprise:

- Lake Brateş including the piscicultural breeding grounds and the areas covered by reed and paludal vegetation etc., and Prut Ostrov as a.u. 82 from UP V Prut Floodplain of OS Galati, between forest landmarks 166 and 167;
- The leveed sector of Prut between Giurgiuleşti Customs Point (topographical landmark 1333 on Prut river, and forest landmark 23, OS Galati) and Vlădeşti (topographical landmark 1297 on Prut river), ranging from forest lot 11 to 81 A (including lakes, ponds and the reed belt);
- The floodplain of Prut river comprising Lake Pochina-Rogojeni, including the area covered by reed and paludal vegetation, and the Vădeni sector located at the confluence point of Stâlpului stream with Prut river and the Northern boundary of Galati county (with Vaslui county), between topographical landmarks 1260 and 1252 on Prut river. It includes Lake Teleajen, and ponds Cacia, Maţa and Rădeanu, as well as reed patches, agricultural terrains, pastures and borderline forests (Fig. 7);

Figure 7. Biodiversity aspect in Pochina lake area (Source: personal photo-archive). This figure is available in colour online at www.georeview.ro.

- The area located between Prut riverbanks and the thalweg, over a distance of 122.4 kilometres, between the confluence with the Danube, nearby forest landmark no. 21, OS Galati / the topographical landmark 1335 on Prut river, and the topographical landmark 1252 at Cotu Rusului, on river Prut.

6. Potential solutions for floodplain wetlands habitat management

Based on the analysis of premises and conclusions resulted from the aforementioned problem, several proposals can be drafted in order to find a proper solution. The most important aspects are related to the technical side (i.e. the technical works required by the actual exploitation of water resources and their constant improvement, combined with the biotechnology of fish farms) and the organisational aspect (the stakeholders and their specific objectives) (Vartolomei, 2012b).

6.1. Some technical aspects

Sub-basins schemes should start from the watershed line and encompass all the necessary works for soil erosion control and soil conservation, as well as for the complete removal of harmful effects generated by flood water. The resulting reservoirs can thus store the flood waves and have a complex use: agro-fishery, water supply for livestock farms, leisure. Regardless of the form of use, they must comply with the following functions:

- Avoiding downstream flooding;
- Ensuring a guaranteed minimum discharge during periods of low hydric potential;
- Ensuring the efficient use of water resources.

Based on the data presented above (i.e. the description of abiotic and biotic components, climate conditions, the hydrological regime, the soil structure, the vegetation cover, the intensity of erosion processes etc.), the first recommended steps are shaping (cutting) steep riverbanks (which would soon result in reduced erosion), expanding the banks such that their slope decreases, stabilizing the riverbed in the sectors where the water flow is faster by adding stones and boulders, and planting the banks so as to reconstruct the herbaceous vegetation, as well as the shrubbery and forests, which could thoroughly fix the banks and retain suspended material through the root mass they develop.

6.2. Some organisational issues

After assessing the structure and attributions of local and central public authorities we reckon there are two ministries, i.e. the Ministry of Agriculture and Forestry and the Ministry of Waters and Environmental Protection, two national Administrations, i.e. the Romanian Waters National Administration and the National Forest Administration - Romsilva, as well as various organs with general competences within the local authority, which are required by law to draw up priority programs for the complex recovery, use, protection and development of such areas.

6.3. Brief legislative aspects

Prut river basin Management Plan is the main instrument for the implementation of the Water Framework Directive 2000/60/UE. The Management Plan that targets this river basin aims at achieving a *"good status"* of waters in 2015, which will provide the same standard of living in terms of water quality for all EU citizens. Moreover, this Plan is subsumed to the Romanian National Management Plan, which is also enframed by the Danube River Basin Management Plan (DRBMP Plan).

Within each Romanian Waters National Administration subdivision, a Basin Committee is organized, composed of representatives from the Ministry of Waters and Environmental Protection, Ministry of Health, municipalities, prefectures, county councils, Romanian Waters National Administration, NGOs, the Office for Consumer Protection, water users etc. The Basin Committee collaborates with the Romanian Waters National Administration in implementing the national strategy and water management policy, for which purpose it must:

- Approve the framework schemes and development programs for works, installations and water management facilities;
- Approve prevention plans for accidental pollution and the removal of their effects, designed according to the local conditions;
- Approve local schemes, by establishing technical and financial priorities and integrating them into the framework schemes;
- Approve the water quality and quantity integrated management plan in the respective river basin;
- Propose the revision of water management norms and standards and, if necessary, to elaborate quality norms for the discharged water valid in the respective basin; the latter may be more strict than national regulations;
- Establish regulations for wastewater discharge, if necessary, in order to meet the established water quality standards;
- Approve the water quality classification of watercourses in the respective river basin;
- Recommend priorities for funding and compliance in order to accomplish the development programs for water management works, installations and facilities;
- Ensure public information and the required amount of time for receiving public comments, to hold public hearings on all matters proposed for approval and to provide public access to its documents.

7. Conclusions

The pressure of the steady economic development in the past 50 years in the Prut river basin and the protective measures against flooding, i.e., the building of a large dam and hydrotechnical node in the floodplain area at Stanca Costeşti, are the main causes for the transformation of typical wetland habitats along the Prut river (in the borderline area with the Republic of Moldova). Thus, the floodable area, highly suitable for fish breeding and bird nesting, became endangered, as well as the ecological integrity of the entire ecosystem of this area.

The water from Prut river basin can be used either to supply the units resulted from former ponds or ponds in their natural state, or various economic and social activities. However, the latter use require the installation of pumping and treatment plants in the Giurgiuleşti-Oancea area, as well as several wastewater treatment plants. Their location will be determined by the migration of population from urban to the neighbouring rural areas and the development of small scale rural industrial units.

The hydric potential of Prut sub-basins opens the perspective for complete sub-basins schemes within a unitary frame in accordance with the topographical, hydrological and geological particularities of the area. Such complex schemes are mandatory for several sub-basins, such as Horincea, Oancea, Bisericii and Stoenesei, located in an area with moisture deficit. For this purpose, sub-basins must be regarded as natural indivisible units.

The complete schemes for these sub-basins must start from the watershed line and include all works necessary for soil erosion control and soil conservation, and for the complete removal of the harmful effects of flood water.

The resulting reservoirs can thus store the flood waves and have a complex use: agro-fishery, water supply for livestock farms, leisure. Regardless of the form of use, they must comply with several functions, such as preventing downstream flooding, ensuring a guaranteed minimum discharge during periods of low hydric potential and the efficient use of water resources.

The possible creation of reservoirs in Horincea sub-basin can be completed in a subsequent stage with reservoirs in its lower basin, thereby ensuring effective control of the water discharge in the entire basin. The investment will be considerably higher due to the fact that in this area Horincea has a broad channel-bed, thus requiring an approximately 6 km-long dam.

Another future possibility is to transfer water from the Prut, although this will involve high costs. However, this option would become viable if the population of the area will increase and small-scale local industry will flourish.

The entire range of hydraulic works included in the schemes for Horincea, Oancea, Bisericii and Stoenesei sub-basins aimed at watercourse regulation for avoiding negative effects of floods should follow ecological planning principles in order to avoid deficiencies which commonly occur after their completion, such as: the loss of floodplains results in the increase of the water speed as a result of river channels transformation such that water can be used by the riverains only for a short period of time; the increase in the water speed generates a gradual deepening of the river channel, which in turn causes a decrease in the overall groundwater level in the area, leading to drying water wells and land desertification.

In the case of ecological water schemes, the main premise is the fact that in Prut basin, streams and rivers are waterways, water reservoirs and complex ecological areas, interacting with the neighbouring regions. Based on the data presented above, regarding the abiotic and biotic components, climate conditions, the hydrological regime, the soil structure, the vegetation cover, the intensity of erosion processes, the profiles we realized, the first recommended steps are cutting steep riverbanks, which would lead to reduced erosion, expanding the banks to decrease their slope, stabilizing the riverbed in the sectors where the water flow is faster by adding stones and boulders, and planting the banks so as to reconstruct the herbaceous vegetation, as well as the shrubbery and forests, which could thoroughly fix the banks and retain suspended material through their root mass.

As regards the fisheries functioning in the old ponds from the Lower Prut basin, these should be restructured in the future in order to provide the optimal framework for the application of competitive technologies of market economies. Restructuring fisheries requires the following general technical issues:

- A judicious sizing of farms in terms of concentrating the technological activities on smaller areas, easier to control and thus more efficient;
- The use of pressurized hydraulic systems for the water supply of these facilities;
- The mechanization of the main technological stages, fishing, feeding, maintenance;
- The introduction of superintensive recirculating fish farming.

Restructuring fisheries opens perspectives for achieving several strategic objectives in this sector, i.e. the application of the intensive farming system for valuable species required by domestic and foreign markets, the application of growth biotechnologies in climatized spaces and the mechanization and automation of fish farming technologies.

Lastly, we recommend that the existing natural ponds within Prut floodplain are preserved in their current state subsequent to being declared natural reserves. Maintaining these unaltered areas will preserve the biological balance and biodiversity of the area. Moreover, in the current context, the existence of these wetlands opens a new perspective for Prut floodplain to become part of an international circuit of protection and development.

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