

## Assessment of vegetal resources in Danube Delta, Romania

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**Abstract.** This paper summarizes a review of plant resources within the Danube Delta. The material shows the areas of interest in terms of rational exploitation of plant species from the spontaneous, subspontaneous and cultivated flora. It is also a review of meliferous and medicinal plant species of interest. An assessment was made over the pratological value of the investigated area.

**Key Words:** Vegetal resources, meadows, pastures, plant species.

**Rezumat.** Această lucrare prezintă succint o trecere în revistă a resurselor vegetale de pe teritoriul Deltei Dunării. Materialul prezintă zonele de interes din perspectiva exploatarea rațională a speciilor vegetale întâlnite în flora spontană, subspontană și cultivată. S-a făcut deasemeni o trecere în revistă a speciilor de interes apicol și medicinal. Totodată s-a făcut și o evaluare pratologică a zonei investigate.

**Cuvinte cheie:** Resurse vegetale, lunci, pășuni, specii de plante.

**Introduction.** In present days, natural meadows within Danube Delta occupy a surface of 22.490 ha, most of which are locality pastures that occupy 21.260 ha (Gâstescu & Știucă 2008).

Due to irrational use of these natural resources, especially to abusive grazing, exceeding the support capacity, meadows are classified into the category of those with low support capacity. The phenomenon of meadows degradation is induced due to both defective management and other factor namely the decrease of vegetation diversity, weed proliferation and the installation of anthropic species vegetation, the introduction of adventive, nitrophyle and zoochore species (Popescu et al 1997; Mölder & Schneider 2011; Bostan et al 2000).

Natural meadows within Danube Delta are the main deltaic ecosystems which provide the trophic support for wild equines, being used not only for grazing, but also for mowing (Figure 4). The necessary hay for the cold season is often supplemented by means of mowing in the green reed which subsequently is dried and appropriately stored (Chifu et al 1993).

Most of the natural meadows within Danube Delta have a high potential for recovery due to the proximity of hydric factor. However, it is recommended to keep it under control when invasive/anthropic species zoochor disseminated occur to the detriment of valuable species of gramineous plants which naturally grow in the deltaic environment. The high number of species in the grasslands ecosystems reveals an indicator of health and good functioning of natural meadows ecosystems, and the presence in a great number of species with high fodder value, conveys value and high support capacity for animal charge (Hanganu et al 2002).

**Material and Method.** The relevee method has been employed in the field (according to coverage – percentage method), gramineous, leguminous, Cyperaceae and diverse species having been recorded on an established surface (100 m<sup>2</sup>) meant to reflect the average characteristics of the investigated areas. A certain amount of green mass has also been collected from several sample points floristically as homogeneous as possible, ranging 1 sqm with a view to report it to a surface of 1 hectares (ha). Subsequently, the results have been synthesized into a synthetic table for meadows evaluation, presented below (Table 4). In order to have an overall view upon the entire territory of Letea Sandune and thus facilitating decision making with concern to management measures and sustainable administration of meadows.

Field recorded data are processed by employing professional methodology with regard to meadows exploitation, the following synthetic indicators having been established (Hanganu 2002):

- grazing value (G.v.);
- humidity index (H);
- actual production (A.p.).

The *grazing value* (G.v.) represents the basic synthetic indicator for the agronomic evaluation of meadow vegetation, including the main elements concerning not only the floristic composition (gramineous and leguminous plants, Juncaceae-Cyperaceae and other plant species), but also the fodder value (the quality specific index) of the component species (Bărbulescu & Burcea 1980; Hanganu 2002).

The *humidity index* (H) represents both species needs for soil humidity and the degree of water supply of a certain station. Its variation interval lies between minimum values = H1 – xerophytes and maximum = H5 – hydrophytes.

The *actual production* (A.p.) is the indicator established by mowed and weighed samples from surfaces ranging between 1-10 sqm and it is expressed in “green-mass tons per hectare” – (g.m.t./ha) (Bărbulescu & Burcea 1980; Hanganu 2002).

The results of the three synthetic indicators are expressed in points given to each indicator and the evaluation grade for the vegetation is obtained by summing them up, on the basis of which the meadows are included into one of the classes and categories established for each district separately. The final goal is to establish the charge – big-cow unit per hectare (B.C.U./ha) in order to concretely know how many animals may graze to the surface capacity.

## Results and Discussion

**The estimation of medicinal herb resources on the territory of Danube Delta Biosphere Reserve (D.D.B.R.).** In order to estimate the potential of medicinal herb resource, research has been carried out on the entire territory of D.D.B.R. during the optimum period of vegetation.

A number of 95 plant species from the delta spontaneous flora have been taken into consideration (presented in Table 3) (Ciocărlan 2009) being given that they are used for medicinal purpose, not only in natural form, but they are also pharmaceutically processed.

As far as spreading is regarded, the species of medicinal interest occupy important areas within the territory of D.D.B.R., 97% out of the total of 98 medicinal species being very frequent, frequent and sporadic, and only a percentage of 3% are considered to be rare (Hanganu 2002; Ciocărlan 2009).

All information was synthesized in a centralized data basis presented in the present study by means of the synthesized tables which include information related to medicinal herbs and their harvest amount in each D.D.B.R.’s district.

For each species, there have been mentioned either the local or common name (with the purpose that they should be identified by those who gather and use medicinal herbs), the blossom period (with the purpose that they should be gathered at optimum time – for the species from which flowers and aerial part are used) and the spreading

degree (which draws attention on a particular species' perpetuation threshold, especially for the rare and sporadic ones) (Mohan & Avram 1989; Palade 1999).

For those who plan to harvest and use medicinal herbs, there have been set the component parts of the plants that contain maximum of active substances known as drugs in the field of phytopharmacy (flowers, leaves, roots, rhizomes, seeds and fruit, buds, bark or the entire plant) (Palade 1999) (see Table 2). Also the harvest amount for each district and its cantons have been set for gatherers.

In the table 1 and the map in figure 4 offer an overall picture of medicinal herb resource both from the perspective of the localization of species of medicinal interest and of the harvest potential for each area.

Table 1

Synthesized centralization of medicinal herb resource on the territory of D.D.B.R.

District	Cantons with harvest potential of medicinal herbs	Surface [ha]	Number of medicinal herb species	Total of harvest amount (kg m.v.)
A - TULCEA	8, 15, 16	505.07	28	3030
B - PARDINA	1, 2, 3, 5	2203.01	28	2641
C - CHILIA VECHE	1, 2, 3	1692.66	29	2692
D - SULINA	1, 2, 3, 4, 5, 6, 7, 10, 11	4720.49	23	2855
E - CRIȘAN	1, 3, 4, 5, 6, 7, 8, 9	1168.91	28	3144
F - CARAORMAN	2, 3, 4, 5, 6, 7	1912.95	30	3964
G - SF. GHEORGHE	1, 2, 5, 6, 7, 8	5364.36	29	3933
H - UZLINA	1, 2, 4, 6	1540.94	27	3330
I - MALIUC	1, 2, 3, 4, 7, 8	1126.25	31	4935
J - SARICHIOI	5, 6	81.82	27	1580
K - JURILOVCA	3	70.89	22	1005
L - MIHAI VITEAZU	4, 5, 6, 7, 8, 9, 10	4051	28	4314
<b>TOTAL</b>		<b>24441.35</b>	<b>95</b>	<b>37423</b>

In order that both balance and regeneration ensurance and sustainable management of medicinal herbs on the territory of D.D.B.R. should be mentained, a series of measures need to be put into force:

- To abide by the optimum periods of harvesting the plants throughout the entire year, by the right periods during an entire day (for the maximum of content in active substances) and by meteorologic conditions;
- To not harvest all the specimens, being considered that 1/3 of the component plants should remain in the territory;
- To selectively harvest, especially for the plants that grow as a bush – sparing 1/3 of the entire number of individuals of a bush;
- To not totally harvest the inflorescences (in the case of flowers harvesting) for the species which spread themselves by seeds;
- The bark and buds should be harvested from cut-down willow and poplar trees within forest exploitation sites;
- To only harvest the well known species, thus being avoided the risk to get into contact with toxic plants and to know first – aid measures in case of intoxication.

At present, this type of resource does not represent special interest for locals, who should represent its main capitalizers in order to get benefits from both the richness and diversity of medicinal herbs species and the market demand.

In order to reach this aim, the initialization of specific programmes or local population aware projects would be benefic, with the view of making the locals aware of

medicinal herbs resource valorization. This way, local wealthfare and profits for the state budget can be ensured.

Table 2

The list of studied plants within D.D.B.R.

No.	Species name	Blossom period (month)	The used part of the plant								Spreading degree
			Flowers	Leaves	Roots	Seeds	Buds	Bark	Entire plant		
1	2	4	5	6	7	8	9	10	11	12	
1	<i>Achillea millefolium</i> L.	VII - VIII	*						*	sporadic	
2	<i>Achillea setacea</i> L.	VI - VIII	*						*	sporadic	
3	<i>Agrimonia eupatoria</i> L.	VII - IX							*	sporadic	
4	<i>Agropyron repens</i> (L.) Beauv.	VI - VII			*					frequent	
5	<i>Alisma plantago-aquatica</i> L.	VII - VIII			*					frequent	
6	<i>Althaea officinalis</i> L.	VII - IX	*	*	*					sporadic	
7	<i>Anthemis ruthenica</i> Bieb.	VI - VII	*						*	sporadic	
8	<i>Apium graveolens</i> L.	VII - VIII		*					*	frequent	
9	<i>Arctium lappa</i> L.	VII - VIII			*					sporadic	
10	<i>Artemisia absinthum</i> L.	VII - IX							*	sporadic	
11	<i>Artemisia annua</i> L.	VII - IX							*	frequent	
12	<i>Artemisia austriaca</i> Jacq.	VII - IX							*	sporadic	
13	<i>Artemisia campestris</i> L.	VII - X							*	sporadic	
14	<i>Artemisia pontica</i> L.	VII - IX							*	frequent	
15	<i>Artemisia vulgaris</i> L.	VII - IX							*	frequent	
16	<i>Atriplex tatarica</i> L.	VII - X							*	very frequent	
17	<i>Capsella bursa-pastoris</i> (L) Medic.	IV - XI							*	frequent	
18	<i>Cardaria draba</i> L.	V - VI							*	sporadic	
19	<i>Carduus nutans</i> L.	VI - VIII	*		*				*	sporadic	
20	<i>Centaurium erythraea</i> L.	VII - IX							*	rare	
21	<i>Centaurium pulchellum</i> (Sw.)	VII - IX							*	frequent	
22	<i>Cichorium intybus</i> L.	VII - IX			*					sporadic	
23	<i>Convolvulus arvensis</i> L.	V - IX							*	frequent	
24	<i>Coronilla varia</i> L.	VI -VIII	*						*	sporadic	
25	<i>Cynanchum vincetoxicum</i> (L.) Pers.	V - VIII			*					frequent	
26	<i>Cynoglossum officinale</i> L.	V - VII							*	sporadic	
27	<i>Daucus carota</i> L.	VII - IX	*		*					very frequent	
28	<i>Echium vulgare</i> L.	VI -VIII	*		*				*	sporadic	
29	<i>Epilobium palustre</i> L.	VI - VIII	*	*	*				*	sporadic	
30	<i>Epilobium parviflorum</i> Schreb.	VI - VIII	*						*	sporadic	
31	<i>Equisetum arvense</i> L.	III - V							*	sporadic	
32	<i>Erodium cicutarium</i> (L.) L'Her.	IV - X							*	frequent	
33	<i>Eryngium campestre</i> L.	VII - VIII			*				*	sporadic	
34	<i>Eryngium maritimum</i> L.	VI - VIII			*					sporadic	
35	<i>Eupatorium cannabinum</i> L.	VII - IX			*				*	frequent	
36	<i>Euphorbia lucida</i> Wet. K.	V - VIII							*	frequent	
37	<i>Galega officinalis</i> L.	VII - VIII	*	*					*	sporadic	
38	<i>Galium aparine</i> L.	V - IX							*	frequent	
39	<i>Galium mollugo</i> L.	VI - IX							*	sporadic	
40	<i>Glechoma hederacea</i> L.	IV - V		*					*	sporadic	
41	<i>Glycyrrhiza echinata</i> L.	VI - VII			*					sporadic	
42	<i>Hippophae rhamnoides</i> L.	IV - V				*				frequent	

43	<i>Inula britannica</i> L.	VII - IX	*	*		*	sporadic
44	<i>Inula salicina</i> L.	VI - IX	*	*		*	frequent
45	<i>Iris pseudacorus</i> L.	V - VIII			*		frequent
46	<i>Linaria vulgaris</i> Mill.	VI - IX	*			*	sporadic
47	<i>Lotus tenuis</i> W. et K.	V - VIII	*			*	sporadic
48	<i>Lysimachia nummularia</i> L.	V - VII				*	frequent
49	<i>Lysimachia vulgaris</i> L.	VI - VII				*	frequent
50	<i>Lythrum salicaria</i> L.	VI - IX	*			*	frequent
51	<i>Lythrum virgatum</i> L.	VI - IX	*			*	sporadic
52	<i>Malva neglecta</i> Wallr.	VI - IX			*		sporadic
53	<i>Marrubium vulgare</i> L.	VI - IX				*	frequent
54	<i>Matricaria chamomilla</i> L.	V - VI	*			*	sporadic
55	<i>Melilotus alba</i> L.	VI - IX	*			*	frequent
56	<i>Melilotus officinalis</i> Lam.	VI - IX	*			*	sporadic
57	<i>Mentha aquatica</i> L.	VI - VIII			*	*	frequent
58	<i>Mentha arvensis</i> L.	VI - X			*	*	sporadic
59	<i>Mentha pulegium</i> L.	VII - IX	*	*		*	frequent
60	<i>Oenanthe aquatica</i> (L.) Poir.	VI - VIII	*			*	frequent
61	<i>Ononis arvensis</i> L.	VI - VIII			*	*	sporadic
62	<i>Ononis spinosa</i> L.	VI - VIII			*		frequent
63	<i>Plantago lanceolata</i> L.	V - VIII		*	*	*	sporadic
64	<i>Plantago major</i> L.	VI - VIII		*	*	*	frequent
65	<i>Plantago media</i> L.	VI - VIII		*	*	*	sporadic
66	<i>Polygonum aviculare</i> L.	VI - X				*	sporadic
67	<i>Polygonum hydropiper</i> L.	VII - IX				*	very frequent
68	<i>Populus nigra</i> L.	III - V				*	frequent
69	<i>Potentilla erecta</i> (L.)	V - VIII				*	rare
70	<i>Potentilla reptans</i> (L.)	VI - VIII				*	very frequent
71	<i>Prunus spinosa</i> L.	IV - V	*		*		sporadic
72	<i>Pulicaria dysenterica</i> (L.) Bernh.	VII - IX	*			*	frequent
73	<i>Rubus caesius</i> L.	V - VI		*			frequent
74	<i>Rumex crispus</i> L.	VII - VIII		*	*	*	sporadic
75	<i>Salix alba</i> L.	IV - V		*		*	frequent
76	<i>Saponaria officinalis</i> L.	VI - IX			*		rare
77	<i>Senecio vernalis</i> (Wet. K.)	V - VIII				*	frequent
78	<i>Simphytum officinale</i> L.	V - VIII		*	*	*	frequent
79	<i>Sisymbrium officinale</i> (L.) Scop.	V - IX				*	sporadic
80	<i>Solanum dulcamara</i> L.	VI - VIII	*	*		*	frequent
81	<i>Tamarix ramosissima</i> L.	VI - VIII	*		*	*	very frequent
82	<i>Tanacetum vulgare</i> L.	VII - X	*			*	frequent
83	<i>Taraxacum officinale</i> L.	IV - VI		*	*	*	frequent
84	<i>Teucrium chamaedrys</i> L.	VI - VIII				*	frecventă
85	<i>Trifolium campestre</i> Schreb.	V - IX	*			*	sporadic
86	<i>Trigonella procumbens</i> L.	VI - VII				*	sporadic
87	<i>Tussilago farfara</i> L.	III - V	*	*			sporadic
88	<i>Typha latifolia</i> L.	VII - VIII			*		frequent
89	<i>Urtica dioica</i> L.	VI - IX		*	*		frequent
90	<i>Verbascum banaticum</i> L.	VI - VIII	*	*			sporadic
91	<i>Verbascum blataria</i> L.	VI - VII	*				sporadic
92	<i>Verbascum phlomoides</i> L.	VI - VII	*				sporadic
93	<i>Verbena officinalis</i> L.	VI - VIII				*	sporadic
94	<i>Viscum album</i> L.	III - V		*			sporadic
95	<i>Xanthium spinosum</i> L.	VII - X				*	sporadic

**The estimation of melliferous resource (basis) in D.D.B.R.** On the territory of D.D.B.R., in addition to the other vegetal resources (forests, meadows, medicinal herbs and reed), the melliferous resource (or basis) takes up an important place (Mag et al 2006).

Field research, carried out during the optimum period of vegetation, has led to identification of 64 plant species that are nectariferous, nectaropollen and pollen producers (presented in Table 3) and provide a diverse melliferous basis.

Due to the fact that D.D.B.R territory is isolated from polluting agents, the melliferous flora in Danube Delta provides nectar and pollen without polluting substances, therefore this honey is an ecologic product.

The melliferous basis of D.D.B.R. includes herbaceous plant species, trees and shrubs with variable apiarian share (Cîrnu 1980) (see Figure 2).

The diversity of plant species, shrubs and trees whose blossom periods start in March and end in September covers the entire harvesting season for bees. The "poliflower" honey thus produced is high quality (see Figure 1).

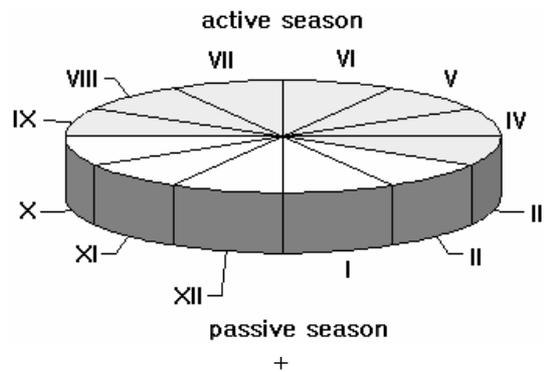


Figure 1. The harvest periods (months) provided by D.D.B.R' melliferous basis.

The long period from March till the second decade of October (sometimes) ensures favourable conditions for the bee families. This way they are not disturbed by repeated manipulation and transportation that could cause the so-called damaging "stress". It could lead to the fact that a series of individuals should not easily adapt to the new apiarian dwelling place where the apiary is placed.

When analysing the blossom periods of vegetal species (Ciocârlan 2009) which represent the Danube delta's melliferous basis, a maximum of favourable harvest can be marked between June and August and it corresponds to an approximate potential of 75% out of the melliferous species total (Figure 3).

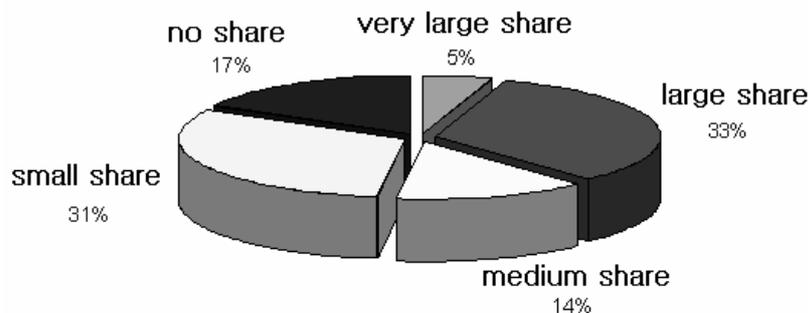


Figure 2. Apiarian share of the melliferous basis on the territory of D.D.B.R.

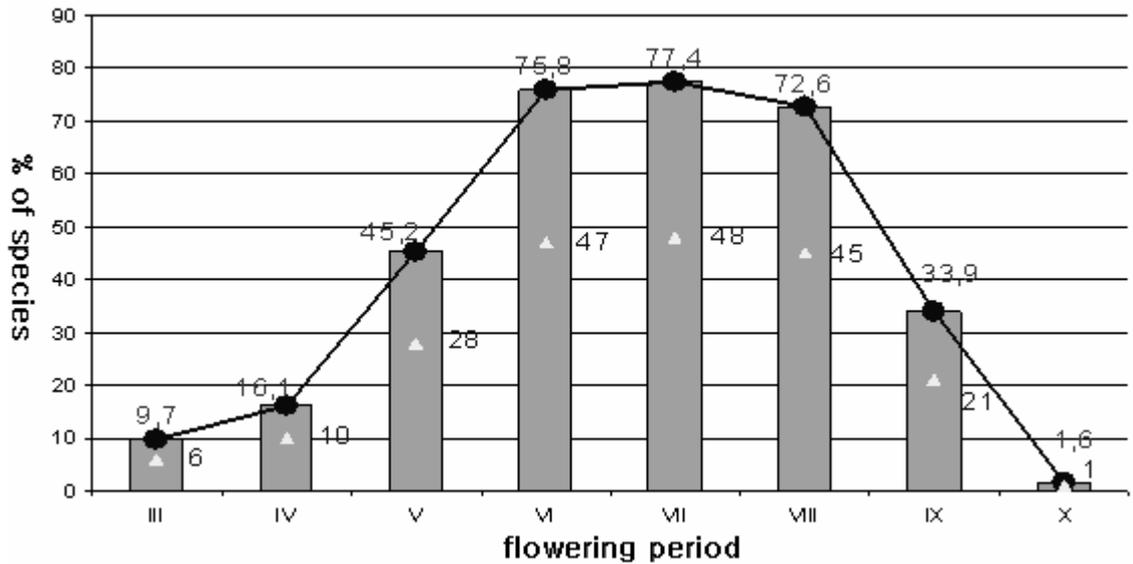


Figure 3. The percentage (respectively the number) out of the melliferous species total that blossom on the territory of D.D.B.R. during the active season.

Considering the apiarian share (see Figure 2), the delta's melliferous basis includes species whose apiarian share is relatively high; 52% represents the melliferous flora.

For the D.D.B.R.'s territory, the melliferous flora's productivity has been estimated by a global evaluation (Cîrnu 1980) that considered the surfaces of forests, meadows, pastures and reed areas as follows:

Willow forests.....20 kg/ha  
 Natural meadows in Danube Delta.....50 kg/ha  
 Delta pastures.....5 kg/ha  
 Reed manna (cane).....20 kg/ha

In order to find out the number of bee families ( $F$ ) which can be economically supported within an analysed perimetre (Harnaj et al 1983), the following formula is employed:  $F = M / m$ , where:

- $M$  represents one third out of the total honey production, and
- $m$  is the necessary nutrients (honey) for a bee family for one year.

There are necessary 130 kg of honey to economically support a bee family, divided as follows:

- 30 kg of honey production
- 91 kg of food for the bee family
- 9 kg of food for the teem.

For an apiary with 100 bee families with an economic support of 130 kg/year, according to the place where the apiarian dwelling place is set, there are necessary the next surfaces in order that 13 000 kg of honey/year should be collected. An example is the apiary on dwelling place I, a specific situation for the areas adherent to routes 6, 7, 8.

Willow forests.....50 ha x 20 kg/ha = 1 000 kg honey  
 Natural meadows.....200 ha x 50 kg/ha = 10 000 kg honey  
 Delta pastures.....200 ha x 5 kg/ha = 1 000 kg honey  
 Reed manna(cane).....50 ha x 20 kg/ha = 1 000 kg honey  
 TOTAL = 13 000 kg honey/100 bee families;

Or the apiary on dwelling place II, specific situation for the areas adherent to routes 2, 3, 4.

Willow forests.....200 ha x 20 kg/ha = 4 000 kg honey  
Natural meadows..... 100 ha x 50 kg/ha = 5 000 kg honey  
Reed manna(cane).....200 ha x 20 kg/ha = 4 000 kg honey  
TOTAL = 13 000 kg honey/100 bee families;

Or the apiary on dwelling place III, specific situation for the areas adherent to routes 1, 5.

Willow forests.....100 ha x 20 kg/ha = 2 000 kg honey  
Delta pastures.....1000 ha x 5 kg/ha = 5 000 kg honey  
Reed manna(cane)..... 300 ha x 20 kg/ha = 6 000 kg honey  
TOTAL = 13 000 kg honey/100 bee families;

The place where the dwelling place of the apiary should be carefully monitored in order that the following should be met (Hanganu 2002):

- the distance between the apiary and the melliferous flora basis should not exceed 1-1.5 km (economic flight ray); more than 2 km flights are not economic;
- the estimation of the territory's melliferous basis need to be made on the account of knowing particular production characteristics of nectaro-pollen plants within D.D.B.R.

However, the valorization of D.D.B.R.'s flora from apiarian perspective is conditioned by a series of limitations:

- the uneven distribution of the melliferous resource;
- the various hydrography of Danube Delta (channels, lakes with the water surface larger than 1 ha which diminish the harvest flights' profitability);
- land accessibility on country roads;
- fluvial transportation costs that sometimes overcome road transportation costs etc.

With the view to support those who wish to practise pasture apiculture on the territory of D.D.B.R., a number of 8 apiarian routes are suggested in order to carry out their activity in conditions of maximum profitability.

*Apiarian route no. 1* – Tulcea- Somova, Parcheș, Isaccea, Rachelu, Luncavița, I.C. Brătianu area. In this case, the access is only possible by automobiles. Delta flora around lakes and deltas situated between Danube and Tulcea-Galați highway can be capitalized. The melliferous flora outside territory of D.D.B.R., situated south of the abovementioned highway (Telița area, the monasteries of Saun and Cocoș, Nifon area etc) can also be taken advantage of.

*Apiarian route no. 2* - Tulcea-Nufăru, Ilgani de jos, Rusca, Litcov, Băltenii de jos, Murighiol, Canal Dunavăț, Canal Dranov area.

This route follows Tulcea – Nufăru highway and afterwards it divides into 2 branches:

- a side that requires ferry-crossing to Ilgani de jos and goes on to Rusca, Litcov channel, Băltenii de jos where the melliferous potential of farming crops, forest plantations and delta flora along Litcov channel can be turned into the best account;
- the second branch goes along Tulcea – Dunavăț highway, as far as Murighiol, then it follows the Danube's bank and goes along Dunavăț channel with a sub-branch along Dranov channel where naval transportation is required. Thus the apiarian potential agricultural crops situated along Tulcea – Dunavăț highway, forest plantations and delta flora around Dunavăț and Dranov channels are to be capitalized.

*Apiarian route no. 3* – Branch Sf. Gheorghe KM54 la KM10, Perivolovca stream area.

Naval transportation is required for this route. Delta flora, both natural and planted forests and the meadows in the area of Perivolovca stream and along Branch Sf. Gheorghe from KM54 to KM10 (in this case reed manna can be capitalized, too as the area provides important reed surfaces) can be capitalized.

*Apiarian route no. 4 - Partizani, Vultur, Gorgova, Crişan, Caraorman on the right bank of Sulina Branch and Ilganii de sus, Maliuc – on the left side.*

This route starts from Partizani locality area and includes a branch along the right bank of Sulina channel and it continues in the area of Caraorman channel and a second branch that requires the cross on the right side of Sulina channel towards the localities of Ilganii de sus and Maliuc.

The melliferous potential of this area is mainly represented by the delta flora, both natural and planted forests and meadows situated along Sulina channel and the agricultural crops around Partizani locality.

*Apiarian route no. 5 - Stipoc Channel, Băclăneşti, Iacubova Channel and the agricultural enclosure of Pardina Chilia Veche.*

As in the case of route no. 3, the access to this area requires naval transportation given that the route lies in the area of Stipoc and Iacubova channels.

The main percentage of the melliferous potential is represented by the agricultural crops in the south agricultural enclosure Pardina as well as in the meadows in the area of Stipoc, and the delta flora that is situated along Iacubova, Stipoc channels and Băclăneşti lake.

*Apiarian route no. 6 – the area of Pătlăgeanca, Sălceni, Ceatalchioi, Plaur and canalul Mila 36, Sireasa Channel in agricultural enclosure of Sireasa.*

The access in this case is mixed, both auto and naval. In order to get to Pătlăgeanca locality, Danube must be crossed and then choose between auto transportation on country road starting from Pătlăgeanca towards Sălceni, Ceatalchioi, Plauru, and naval transportation on Mila 36, Sireasa channels and a part of Chilia Branch.

As the previous one, this area mostly turns into account the agricultural crops within Sireasa enclosure and around Tudor Vladimirescu locality, as well as the delta flora, meadows and forests in the confinement areas of Mila 36 and Sireasa channels.

*Apiarian route no.7 – the area of Pardina, Tatanir, Tătaru Channel as far as Chilia Veche and the agricultural enclosure of Pardina Tatanir, Ostroavele Babina and Cernovca.*

This route starts from the area of Pardina locality and continues along the northern part of the agricultural enclosure of Pardina-Tatanir as far as the area of Chilia Veche locality, including a branch which capitalizes the melliferous potential of Babina and Cernovca islets. Both naval and auto transportation is available in these areas.

Considering the melliferous potential, there are mainly turned into account the agricultural crops within Pardina – Tatanir enclosure, a series of locust-tree forests planted in the area of Tătaru, the delta flora and the natural meadows on the territory of Babina and Cernovca islets.

*Apiarian route no.8 – the area of Mila 23 – Old Danube - Eracle Channel- Iacob Stream – Obretin area and Ceamurlia.*

This route is situated in the central area of Danube Delta. In order to get here naval transportation is required. It thoroughly includes the loops of "The Big M" formed by the old course of Sulina branch, the area of Eracle channel and Iacob's stream.

The melliferous potential of the area is mainly provided by the delta flora and the natural forests situated along the branches of old Danube as well as the meadows both around Mila 23 locality and the territory of the fish enclosure of Ceamurlia.

## Potential resource of D.D.B.R. meadows

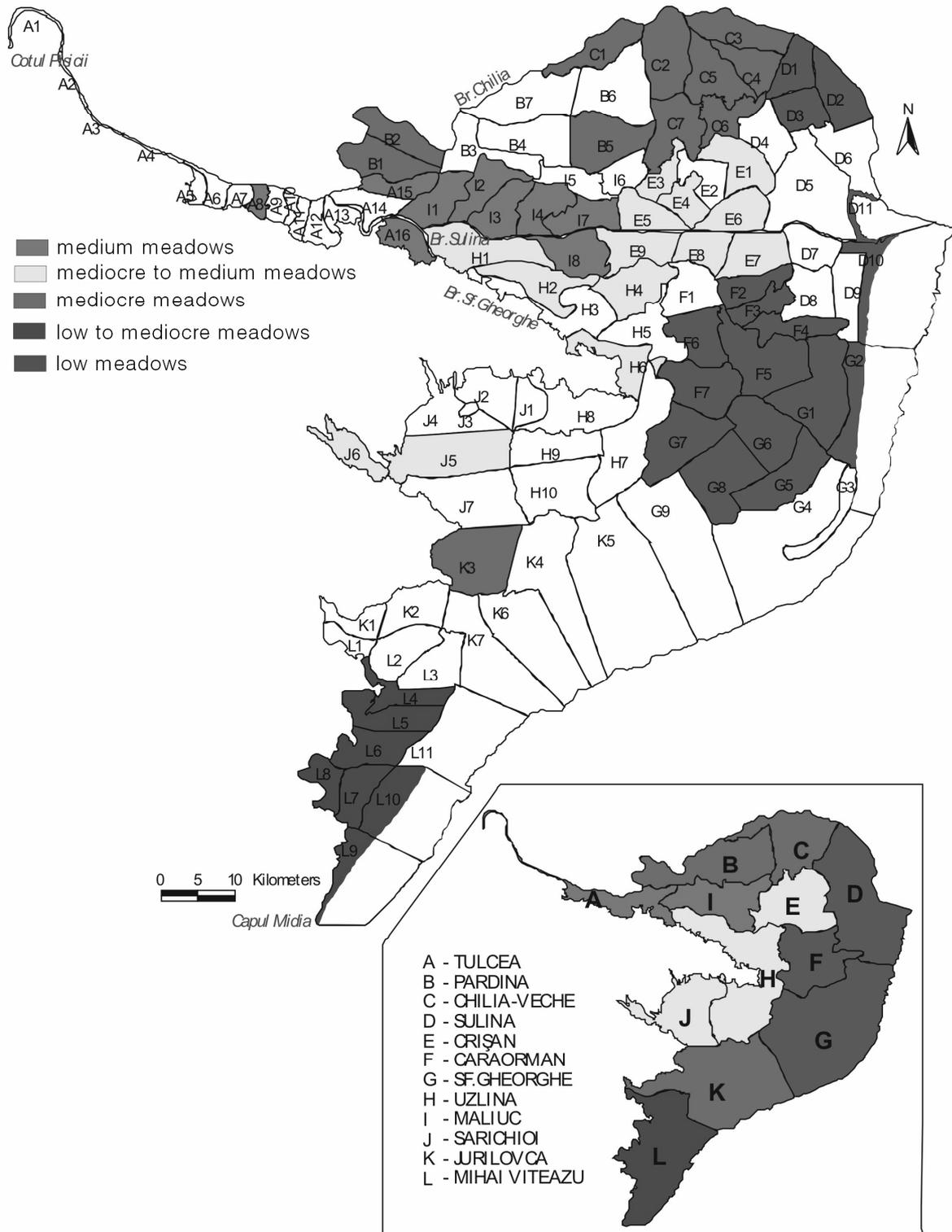


Figure 4. The spatial location of the meadow classes identified on the D.D.B.R.'s territory at the level of 2003.

Table 3

## The melliferous resource within D.D.B.R.

Nr.	Species name	Flowering period	Spreading degree	Biological data*			Honey production	Economic use	
							D.D.B.R.	Kg / ha	at national level
1.	2.	4.	5.	6.			7.	8.	9.
1	<i>Sambucus ebulus</i> L.	VII - VIII	sporadic	pr.	n	p	30 - 40	low	low
2	<i>Arctium lappa</i> L.	VII - VIII	sporadic	bn.	n	p	300 - 350	low	high
3	<i>Stachys palustris</i> L.	VI - IX	frequent	pr.	n	p	100 - 180	medium	high
4	<i>Mentha pulegium</i> L.	VII - IX	frequent	pr.	n	p	100	medium	very high
5	<i>Stachys palustris</i> L.	V - VIII	sporadic	an	n	p	120 - 150	low	low
6	<i>Oenanthe aquatica</i> (L.) Poir.	VI - VIII	sporadic	pr.	n	p	80 - 100	low	high
7	<i>Viburnum opulus</i> L.	V - VI	rare	Phn	n	p	25 - 40	low	no use
8	<i>Hippophae rhamnoides</i> L.	IV - V	frequent	Phn	n	p	25 - 50	medium	high
9	<i>Lycium barbarum</i> L.	VI - IX	rare	Phn	n	p	20 - 50	low	no use
10	<i>Tamarix ramosissima</i> L.	VI - VIII	frequent	Phn	n	p	25	low	low
11	<i>Ballota nigra</i> L.	V - VIII	sporadic	pr.	n	p	20 - 60	low	no use
12	<i>Nepeta cataria</i> L.	V - VII	rare	pr.	n	p	100 - 140	medium	high
13	<i>Cichorium intybus</i> L.	VII - IX	sporadic	pr.	n	p	100	low	high
14	<i>Eupatorium cannabinum</i> L.	VII - IX	frequent	pr.	n	p	150 - 200	low	no use
15	<i>Clematis vitalba</i> L.	VI - VIII	sporadic	Phn	n	p	-	low	no use
16	<i>Berberis vulgaris</i> L.	V - VI	sporadic	Phn	n	p	30	medium	high
17	<i>Teucrium chamaedrys</i> L.	VI - VIII	frequent	pr.	n	p	150 - 230	low	high
18	<i>Fraxinus excelsior</i> L.	V	sporadic	Ph	p	m	H = 20	low	high
19	<i>Rorippa amphibia</i> (L.) Bess.	V - VIII	very frequent	pr.	n	p	30 - 50	medium	high
20	<i>Lotus corniculatus</i> L.	V - IX	rare	pr.	n	p	15 - 30	low	high
21	<i>Lotus glaber</i> Mill.	V - VIII	sporadic	pr.	n	p	15 - 30	low	high
22	<i>Mentha aquatica</i> L.	VI - VIII	frequent	pr.	n	p	220	high	very high
23	<i>Anchusa officinalis</i> L.	V - VII	very rare	bn.	n	p	50 - 100	medium	no use
24	<i>Medicago falcata</i> L.	V - IX	sporadic	pr.	n	p	30	low	low
25	<i>Verbascum nigrum</i> L.	VI - VII	sporadic	bn.	n	p	-	low	low
26	<i>Vicia cracca</i> L.	VI - VIII	sporadic	an.	n	p	30 - 100	medium	low

27	<i>Daucus carota</i> L.	VII - IX	very frequent	pr.	n	p	20 - 30	low	high	
28	<i>Rubus caesius</i> L.	V - VI	frequent	Phn	n	p	30 - 50	medium	high	
29	<i>Sinapis arvensis</i> L.	V - VIII	sporadic	an.	n	p	40	medium	medium	
30	<i>Malva sylvestris</i> L.	VI - IX	rare	pr.	n	p	30 - 50	no use	no use	
31	<i>Althaea officinalis</i> L.	VII - IX	sporadic	pr.	n	p	50 - 100	low	low	
32	<i>Cirsium arvense</i> (L.) Scop.	VI - VIII	frequent	bn.	n	p	100	low	low	
33	<i>Taraxacum officinale</i> L.	IV - VI	frequent	pr.	n	p	200	medium	low	
34	<i>Taraxacum bessarabicum</i> (Hornem.) Hand.-Mazz.	VII - IX	frequent	pr.	n	p	200	medium	low	
35	<i>Populus nigra</i> L.	III - V	frequent	Ph	p	m	c	H = 20	medium	high
36	<i>Tussilago farfara</i> L.	III - V	sporadic	pr.	n	p	-	no use	low	
37	<i>Brassica rapa</i> L.	IV - VIII	frequent	an.	n	p	30 - 40	low	low	
38	<i>Lythrum salicaria</i> L.	VI - IX	frequent	pr.	n	p	200	medium	medium	
39	<i>Equinops sphaerocephalus</i> L.	VII - VIII	very rare	pr.	n	p	100 - 130	no use	no use	
40	<i>Salix alba</i> L.	IV - V	frequent	Ph	p	m	c	100 - 150	high	very high
41	<i>Salix caprea</i> L.	III - IV	sporadic	Phn	n	p	m	150 - 200	high	high
42	<i>Salix babylonica</i> L.	III - IV	sporadic	Ph	n	p	m	100	low	low
43	<i>Robinia pseudacacia</i> L.	V - VI	sporadic	Ph	n	m	1000	very high	low	
44	<i>Amorpha fruticosa</i> L.	V - VI	frequent	Phn	n	p	50	medium	medium	
45	<i>Salvia nemorosa</i> L.	VI - VIII	rare	pr.	n	p	300	medium	no use	
46	<i>Eleagnus angustifolia</i> L.	VI	sporadic	Phn	n	p	100	medium	medium	
47	<i>Eryngium campestre</i> L.	VII - VIII	sporadic	pr.	n		100	medium	high	
48	<i>Veronica</i> sp.	V - IX	sporadic	pr.	n	p	40	no use	no use	
49	<i>Carduus</i> sp.	VI - VIII	sporadic	pr.	n	p	30 - 40	low	mare	
50	<i>Melilotus alba</i> L.	VI - IX	frequent	bn.	n	p	200 - 500	medium	medium	
51	<i>Melilotus officinalis</i> Lam.	VI - IX	sporadic	an.	n	p	130 - 300	medium	medium	
52	<i>Trifolium repens</i> L.	V - X	sporadic	pr.	n	p	100 - 250	high	low	
53	<i>Trifolium fragiferum</i> L.	VI - IX	frequent	pr.	n	p	100	medium	high	
54	<i>Medicago lupulina</i> L.	V - IX	frequent	pr.	n	p	40	no use	low	
55	<i>Simphytum officinale</i> L.	V - VIII	frequent	pr.	n	p	130 - 220	medium	medium	
56	<i>Ajuga chamepytis</i> (L.) Schreb.	V - VIII	sporadic	an.	n	p	100 - 200	low	low	
57	<i>Astragalus glycyphyllos</i> L.	V - VI	sporadic	pr.	n	p	20 - 60	medium	low	
58	<i>Lycopus europaeus</i> L.	VI - VIII	frequent	pr.	n	p	50 - 200	medium	high	

59	<i>Lamium purpureum</i> L.	III - IX	sporadic	pr.	n	p	50 - 90	medium	medium
60	<i>Dipsacus</i> sp.	VI - VIII	rare	pr.	n	p	20 - 60	medium	low
61	<i>Marrubium vulgare</i> L.	VI - IX	frequent	pr.	n	p	50 - 60	medium	medium
62	<i>Salix cinerea</i> L.	III - IV	very frequent	Phn	n	p	100 - 150	low	high
63	<i>Hibiscus trionum</i> L.	VI - IX	very rare	an.	n	p	50	low	no use
64	<i>Epilobium hirsutum</i> L.	VI - VIII	sporadic	pr.	n	p	40 - 60	low	low

\* Ph=tree Phn=arbust an=annual bn=bienal pr=perene ct=cultivated n=nectar p=polen m=manna H=honeydew c=cley, propolis

### **The estimation of the natural meadows productivity on the territory of D.D.B.R.**

The relevé method was employed in the field (for covering – the percentage method), recording graminaceae, leguminous, Cyperaceae and other species on a chosen sample surface (100 sqm) (Bărbulescu & Burcea 1980). It is collected the quantity of green mass in several sample points as homogeneous as possible from floristic point of view, of 1sqm, in order to get an average as significant as possible statistically with the view to refer it to a surface of 1 ha. The subsequent results were synthesized in synthetic estimation tables of the meadows at the level of district in order to get an overall picture of the entire D.D.B.R. territory. It also facilitates decision making as far as sustainable management and administration is concerned.

The field data is processed by means of specific methodology for the exploitation of meadows resulting into the following synthetic indices:

- pasture value (P.v.);
- humidity (H);
- actual production (A.p.).

*Pasture value* (P.v.) represents the basic synthetic index for the agronomic evaluation of meadows vegetation including the main elements concerning both the floristic composition (graminaceae, leguminous, Juncaceae-Cyperaceae and other plant species) and fodder value (specific quality index) of the component species.

*Humidity index* (H) represents both the species requirement for soil humidity and the water supply degree of a particular station. Its variation interval is situated between minimum values =H1 – xerophyte and maximum=H5 – hydrophyte.

*Actual production* (A.p) is the index determined by mown and weighed samples on surfaces between 1 – 10 sqm and it is expressed in «green mass tons/ha» - (g.m.t/ha). The results of the three synthetic indices are expressed in points given to each index separately, then the evaluation note for vegetation is obtained by adding them up. On its basis the meadows are included into one of the classes and categories set for each district. The final goal is to determine the charge–big cow unit per hectare (B.C.U./ha) in order to accurately know how many animals can graze compared to the surface capacity.

**Floristic description and meadow evaluation on the territory of D.D.B.R. The meadow areas description on the territory of D.D.B.R. according to their productivity.** Analyzing the 12 evaluation records for the 12 districts, the synthetic table (Table 5) was carried out, thus 5 evaluation categories (classes) having been identified according to the following gradient:

- medium meadows,
- mediocre-to-medium meadows,
- mediocre meadows,
- poor-to-mediocre meadows,
- poor meadows.

On the whole, D.D.B.R.'s meadows are described as mediocre, with an average productivity of 15.1 t/ha g.m. and a support capacity of approximate B.C.U./ha (Table 4).

From the point of view of expansion, mediocre-to-medium meadows are predominant 27%, while medium and mediocre categories have approximately equal values 22% and 23%, the poor and poor-to-mediocre meadows have percentages lower than 18% poor, 10% poor-to-mediocre.

Introducing a map with the spatial distribution of meadow classes has been considered opportune, with the view to identifying these types of meadows in the field and implementing appropriate management measures (see Figure 4).

Table 4

## The description of D.D.B.R.'s meadows

District	Cantons with meadows	Surface [ha]	Class	Meadows features	Average production [t/ha]	*U.V.M. / ha
A - TULCEA	8, 15, 16	505.07	VI	medium	20	0.81-1.00
B - PARDINA	1, 2, 3, 5	836.35	VII	mediocre	14	0.61-0.80
C - CHILIA VECHE	1, 2, 3	1692.66	VII	mediocre	15	0.61-0.80
D - SULINA	1, 2, 3, 4, 5, 6, 7, 10, 11	4312.78	VIII	low	12	0.41-0.60
E - CRIȘAN	1, 3, 4, 5, 6, 7, 8, 9	1168.91	VI VII	mediocre to medium	18	0.61-1.00
F - CARAORMAN	2, 3, 4, 5, 6, 7	1912.95	VIII	low	11	0.41-0.60
G - SF. GHEORGHE	1, 2, 5, 6, 7, 8	5364.36	VIII	low	12	0.41-0.60
H - UZLINA	1, 2, 4, 6	1540.94	VI VII	mediocre to medium	20	0.61-1.00
I - MALIUC	1, 2, 3, 4, 7, 8	1126.25	VI	medium	23	0.81-1.00
J - SARICHIOI	5, 6	81.82	VI VII	mediocre to medium	15.5	0.61-1.00
K - JURILOVCA	3	70.89	VII	mediocre	17	0.61-0.80
L - MIHAI VITEAZU	4, 5, 6, 7, 8, 9, 10	4051	VII VIII	low to mediocre	19	0.41 - 0.80
TOTAL		22663.9		mediocre	15.1	0.7

**Conclusions.** To sum up, it can be asserted that the territory of D.D.B.R. provides a valuable melliferous potential; those who consider to capitalize it have to bear in mind both the advantages and disadvantages aforementioned and to choose, according to the given possibilities, the areas with maximum economic profitability.

The experience of apiculturists with long activity in Danube Delta reveals that the advantages of apiculture in the area are neatly superior to disadvantages. This activity ensures favourable both production and financial results.

Compared to the last years, when the level of precipitations decreased, the situation this year has been favourable to the development of species which constitute the fodder basis.

Subsequent to evaluation, there was observed that many surfaces have grown from inferior classes such as those degraded into meadows with higher productivity and qualitatively improved as well.

However, it is to be marked that this situation may only be maintained under the conditions of complying with the charge of animals. Any overrun of the number of animals that graze on these meadows will have repercussions by the overgrazing phenomenon.

**Acknowledgements.** This study was supported partially by the project POS-DRU/88/1.5/S/52946 co-funded by the European Social Fund through the Sectoral Operational Programme - Human Resources and Development 2007-2013.

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Received: 25 August 2012. Accepted: 05 September 2012. Published online: 29 September 2012.

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How to cite this article:

Covaliov S., Doroftei M., Negrea B. M., 2012 Assessment of vegetal resources in Danube Delta, Romania. *AAB Bioflux* 4(2):57-72.