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ASSESSMENT ON BIOECONOMICAL POTENTIAL FOR MEDICINAL PLANTS IN SALTY MEADOWS FROM THE ARADULUI PLAIN (W. ROMANIA)

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ABSTRACT. The paper is an investigation on current and potential value of medicinal plants growing in six saline meadows in Aradului Plain. The list of species is based on previous original studies made in 2010-2012 (Dărăban *et al*., 2012a, 2012b and unpublished data). A bibliographical investigation shows for many of them effectiveness and potential medicinal uses. Besides *Achillea millefolium* and *Chamomilla recutita* (common medicinals), *Artemisia santonicum* subsp. *santonicum* and *Limonium gmelinii* may become valuable for pharmaceutical uses. In the vicinities, we identified numerous ruderal species with high medicinal value (*Cichorium intybus, Lythrum salicaria, Mentha* sp*., Ononis spinosa* etc). The medicinal use and the conservation of studied halophilic communities (they are part of a Natura 2000 site) are not antagonistic objectives. Rediscovering local remedies from plants it is a way to involve people in conservation. Overgrazing (noticed especially in Vărșand and Socodor) is a threat for both plant diversity and their local uses.

Keywords: bioeconomical potential, Arad county, halophilic meadows, medicinal plants, Vărșand, Socodor, Pilu, Sânmartin, Grăniceri, Nădab, conservation.

INTRODUCTION

Medicinal plants growing in seminatural and natural ecosystems are a valuable resource for some reasons, at least: being not-cultivated, their production doesn't need agricultural polluting inputs; they are a cheap resource; the quality of spontaneous herbs is seldom superior to those cultivated and their consumers' acceptance is higher. In Romania, some of these medicinal plants used to be a significant drugs resource, so they have also an ethnologic and cultural value (Butură, 1979).

Flora on saline soils is known to offer support to human life, especially in littoral areas, and arid environment (Ansarinia & Jouyban, 2012); the interest in saline agriculture using crop halophytes is rapidly increasing, particularly in arid and semiarid regions (Khan & Duke, 2001), and it could be even more enhanced by climatic changes (it reiterates also the idea of domestication of medicinal halophytes – Quasim *et al.,* 2011). Seminatural and natural meadows influence positively on the quality of raw animal products (Metera *et al.,* 2010).

Continental saline vegetation in Eastern Europe and Romania was used mainly in extensive-pastoralism systems (Török *et al*., 2011, Molnár & Borhidi, 2003, Ardelean & Mohan, 2008 etc.). As other vegetation types, halophilic phytocoenosis were more or less systematically used as medicinal plants harvesting fields.

Our aim is here to screen the potential for medicinal plants of saline grasslands situated in the Aradului Plain (West-Romania), as a part of a wide-angle evaluation of plant resources in the area, based on two previous papers on flora and vegetation in Vărșand (Dărăban *et al.,* 2012a, 2012b) and on field researches made mainly by PhD student I.-N. DĂRĂBAN. The financial support was provided by the POSDRU/CPP107/DMI 1.5/S/77082 "*Burse doctorale de pregătire ecoeconomică şi bioeconomică complexă pentru siguranţa şi securitatea alimentelor şi furajelor din ecosisteme antropice".* Previous recent studies on flora and vegetation in the region (Arad County, Crişul Alb valley, Crişul Alb lower plain) were published by Ardelean (1999, 2002, 2006).

MATERIALS AND METHODS

The studied areas consist of 6 halophylic pastures situated in the vicinities of villages: Vărşand, Pilu, Nădab, Socodor, Grăniceri and Sânmartin (fig. 1). These territories belong to the *Natura 2000 Network*, as a part of the Site of Community Importance ROSCI0231 Nădab-Vărşand-Socodor (habitat for red-listed species *Lotus angustissimus* and *Trifolium ornithopodioides* – Dihoru & Negrean, 2009).

Floristic lists are the results of field researches during the period 2010-2012. Identification of species was made using Ciocârlan (2009). The nomenclature follows the on-line edition of *Flora Europaea*. The compiled list of cormophytes (more than 200 species) from all the six locations includes not only halophytes, but also glycophytes and other species from proximities, and sometimes found whithin halophilic phytocoenosis (more or less temporary and accidentally). As a matter of fact, Grigore *et al.* (2010) show the relative separation of the two categories (halophytes and glycophytes).

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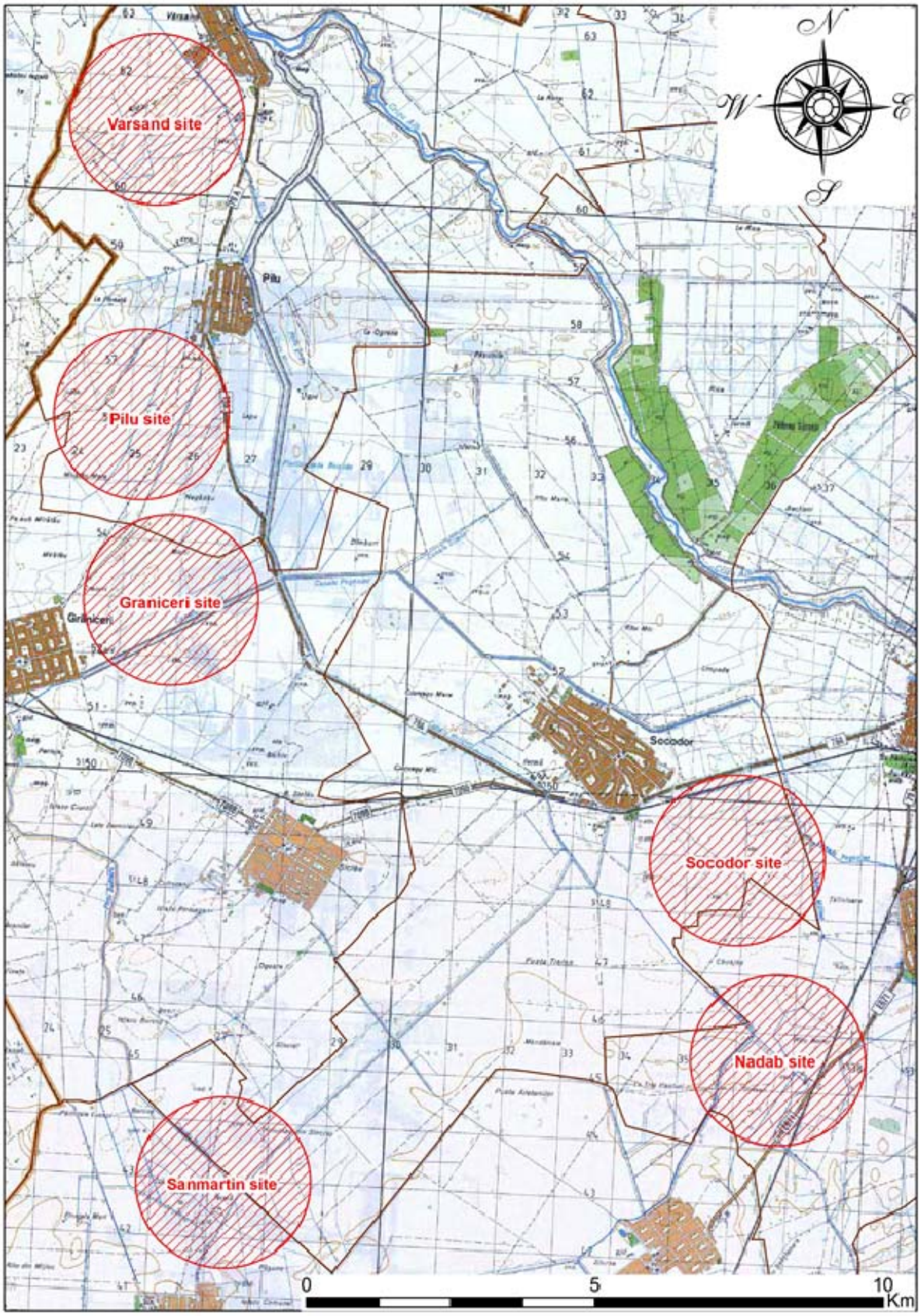

Fig. 1 The studied areas

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The choice of species we present and discuss here cater for medicinal halophytes in first instance. In order to explore the medicinal properties, potential or proven, we used principally the database *Plants for a future* (http://www.pfaf.org/user/default.aspx), cited bellow as *Pfaf*, and the Romanian literature (Ardelean *et al.,* 1997; Ardelean & Mohan, 2008; Ciulei *et al.,* 1993; Muntean *et al.,* 2007 and other authors). The content in medicinal and biologically active compounds is taken from Romanian publications, and publications on populations from neighboring countries (Hungary, Serbia, Moldavia – we assume semblable biochemical properties in neighboring populations) or other countries in the species' areals (Turkey, Iran, ...). The main bibliographic source on the Romanian ethno-medicine was Butură (1979). The considerations and recommendations on conservation are driven by our observations in the field and from experience exposed by different authors (WHO *Guidelines on the Conservation of Medicinal Plants*, 1993; Hamilton, 2004; Molnár & Borhidi, 2003; Török *et al.,* 2011 etc.).

RESULTS AND DISCUSSIONS

A). Medicinal halophytes (*lato sensu*)

Achillea millefolium L. (*Compositae*):

Common in all studied sites. In traditional medicine, aerial parts of the yarrow are used as: antidiarrhoeal, antiinflammatory, antiseptic, antispasmodic, appetizer, aromatic, astringent, carminative, cholagogue, diaphoretic, digestive, emmenagogue, odontalgic, stimulant, tonic, vasodilator, vulnerary (PfaF). It contains essential oil (0,1-0,5 %, depending of soil properties, climate and the populations genetics – Ciulei *et al.,* 1993) composed by chamazulene and sesquiterpenoid lactones. Orav *et al.* (2006) found high amounts of chamazulene in samples from Hungary, Greece and Moldavia; samples from Greece and Moldavia showed also high content of sesquiterpenes. Beside chamazulene, essential oil from *A. millefolium, A. pannonica* and *A. collina* contains monoterpenes, 1,8-cineole, camphor, borneol, pinenes (Nemeth, 2005). *Herba millefolii* (*Millefolii flos*) is a cheap natural resource of chamazulene (Awang *et al.,* 2009) and have three categories of traditional uses in herbal medicine: a) to stop minor bleeding and to treat wounds, b) to treat inflamations, especially in intestinal and female reproductive tracts, c) as a mild sedative (Gaby, 2006).

Artemisia santonicum L. subsp. *santonicum* (Waldst. & Kit.) Gams (*Compositae*):

The most common medicinal in the genus *Artemisia* is *A. absinthium*, used for centuries as antihelminthic, and for ist stimulating properties on digestive and gall-bladder function (Gaby, 2006). Aerial parts of *Artemisia santonicum* and related *Artemisia maritima* were analyzed by many authors. Turkish authors, mainly, revelead as main components of *A. santonicum* essential oil: camphor, 1,8-cineole, chamazulene, and nuciferol propionate, and its antifungal and antioxidant acivity (Kordali et al., 2005). According to *Flora Europaea*, the typical species grows in Turkey and Romania (and other European countries), whilst the subspecies *santonicum* grows only in Romania (and Bulgaria, Greece, Hungary, former Yugoslavia, Russia). By comparison, the camphor content of essential oil from Turkish samples of *Artemisia santonicum* is higher (18.2 %) than in *A. absinthium* (3.7 %) (Abad *et al.,* 2012).

Artemisia santonicum subsp. *santonicum* (Vărșand, photo: I.-N. Dărăban)

Meriçli *et al.* (1988) discovered new eudesmanolides in *Artemisia santonicum*, closely related from the point of view of the chemical structure to taurin. *Artemisia santonicum* essential oil shows an antibacterial activity over a large spectrum of species (Kordali, Kotan et al., 2005). Sengul *et al.* (2011) find that the antioxidant activity (because of total phenolic content) of *Artemisia santonicum* extract is lower than those of *Artemisia absinthium* extract. Oral administration of *aqueous* extract from panicles have hypoglycemic effect on rabbits (Korkmaz & Gürdal, 2002). Santonin, a substance extracted from some *Artemisia* species (*A. maritima* and other congeneric species growing in Russia, Central-Asia and China) it is a well-known antihelmintic. The use of santonin in over-doses can induce unpleasant somatic secondary effects and xanthopsie (visions in yellow) (Chopra *et al.,* 1960). Butură (1979) lists many traditional medicinal uses of *Artemisia* species (*A. absinthium, A. pontica, A. vulgaris, A. austriaca*) in Romania, but not of *A. santonicum.*

Chamomilla recutita (L.) Rauschert (*Compositae*)

Found in all studied sites, in variable size of populations. Western region of Romania were renowed for collecting and using chamomile (Zamfirescu & Iuracec, 1963). The active compounds in chamomile inflorescences are divided by Schilcher *et al.* (2005) in those composing the lipophilic fraction (chamazulene, bisabolol, apigenin, coumarins, methoxylated flavone aglyca, phytosterols), respectively the hydrophilic fraction (flavonoids, mucilage, phenyl carboxylic

acids, amino acids, choline). It is a common medicinal and aromatic plant, cultivated and collected from the wild. It grows with predilection on low-saline soils. Anthodia have many uses in the traditional medicine: anodyne, anti-inflammatory, antiseptic, antispasmodic, carminative, cholagogue, diaphoretic, homeopathy, nervine, stomachic, tonic, vasodilator (PfaF). The sedative properties and uses in eyes conditions were well-known in all Romania (Butură, 1979).

***Limonium gmelinii* (Willd.) Kuntze (*Plumbaginaceae*):**

It forms large patches in Vărșand and Nădab. There are no many medicinal uses reported from this species. As biologically active compounds, Korulkina *et al.* (2004) found galactose, gallic, syringic and ellagic acids, quercetin, rutin, myricetin and its glycosides (in the roots), and gallic acid, quercetin and myricetin (in the aerial parts). A new flavonol glycoside (gmelinoside I) was discovered in this species (Gadetskaya *et al.,* 2011). In a study carried out in Gyula (Hungary, few kolimeters from Vărșand), Amtman (2009) finds that this plant may become an important melliferous in dry summers, when bees don't dispose of other nectar resources; the almost unifloral honey resulted had an interesting sour-bitter taste, that can be appreciated by some consumers.

Limonium gmelinii (Vărșand, photo: I.-N. Dărăban)

***Plantago maritima* L. (*Plantaginaceae*):**

Small populations, with sparse individuals, in Vărșand and Nădab. There are no bibliographic references on the medicinal traditional use of the sea plantain in Romania. In other european countries, leaves are known to be laxative (PfaF). Beara *et al.* (2009) reveal that *Plantago maritima* as a possible source of natural antioxidant.

B) Other medicinal species

Carduus nutans L. (*Compositae*):

As a result of overgrazing and disregard of pasture and cultivated parcel edges keeping, it forms large populations in all 6 locations. In the traditional medicine, it is a blood purifier, febrifuge (PfaF). Flavones based on apigenin and luteolin were isolated from *C. nutans* and *C. acanthoides* (Bain & Desrochers, 1988).

Centaurea solstitialis L., (*Compositae*):

Sporadic in the studied sites. Flowers are lithontripic (PfaF); they contains sesquiterpenes (solstitialin A, repin, subluteolide, acroptilin) and lactones (solstitiolides, episolstitiolide) (Merrill & Stevens, 1985). Freshy spiny flowers (anthodia) are used in Turkey for the treatment of peptic ulcers (Yesilada *et al.,* 2004)

Cichorium intybus L. (*Compositae*):

Large populations were found in ruderal habitats surrounding studied halophilic communities. From cichory, aerial parts without lignified (herba) stems and roots are used. Herba contains protein, fat, carbohydrate, fiber, Calcium, Iron, Vitamin A, Thiamine (B1), Riboflavin (B2), Niacin, B6, C (PfaF). In *Radix Cichorii* there are inulin, phytosterols, flavones. Both aerial and subterranean parts act against sthomac and liver conditions (Constantinescu & Agopian, 1962). In other countries traditional medicine, they are used for their properties as: appetizer, cholagogue, depurative, diuretic, hypoglycemic, tonic (PfaF). Extracts from roots were found by Mares *et al.* (2005) effective against *Trichophyton tonsurans* var. *sulphureum*, a fungus causing anthropohilic dermatite.

Conium maculatum L. (*Umbelliferae*):

Hemlock grows in patches, on soils portions with high nitrates contents (resulting from animal concentrations), sporadically in all 6 sites. In spite of its reputation as toxic for humans and animals, there are some uses in traditional medicine of some countries: analgesic, antirheumatic, antispasmodic, cancer, emetic, galactofuge, homeopathy, sedative (PfaF). Biologically active compounds in *Conium maculatum* are alkaloids, flavonoids, coumarin, polyacetylenes, vitamins, non-volatile oils, steroids (Radulovič & Đorđevič, 2011).

Daucus carota L. subsp. *carota* (*Umbelliferae*):

Common and frequent especially in ruderal habitats. It is a traditional drug used as: anthelmintic, carminative, contraceptive, deobstruent, diuretic, emmenagogue, galactogogue, ophtalmic, stimulant (PfaF). In modern herbal medicine, the plant is used in urinary, carminative, antispasmodic ant antireumatic themes (Tobyn *et al.,* 2000).

Eryngium campestre L. (*Umbelliferae*):

The massive presence of these species indicates lack of pastures management. In some countries, roots are edible (Muntean *et al.,* 2007, PfaF). Traditional medicine list as plat actions: antispasmodic, aromatic, diaphoretic, diuretic, expectorant, galactofuge, stimulant (PfaF). Roots and aerial parts were used in Turkey as folk remedy for the treatment of various inflamatory disorders (Küpeli *et al.,* 2006).

Gypsophila muralis L. (*Caryophyllaceae*):

Small plant, found in scarse populations in all studied sites; also, it appears as weed in neighbouring cultivated parcels. Roots contains saponins and prosaponins, like other species from the genus *Gypsophila* (especially *G. paniculata*), responsible for anti-inflamatory effects (Hanafy *et al.,* 2007, Paris & Dilemann, 1960).

Lythrum salicaria L. (*Lythraceae*):

Grows in humid microhabitats and canals in Vărșand, Nădab, Pilu. The traditional use of aerial parts is reported from Moldavia and Transilvania (Butură, 1979). In other countries, this drug is known as: antibiotic, antidiarrhoeal, astringent, hypoglycaemic, styptic, vulnerary (PfaF). In Turkey, this species is used against diarrhea, chronic intestinal catarrh, hemorrhoids, eczema, varicose veins, bleeding of the gums (Tunalier *et al*., 2007). Hypoglicemic activity of several extracts of *L. salicaria* was prouved on rabbits (Tores & Suarez, 1980), rats and mice (Lamela *et al.,* 1986).

Malva neglecta Wallr., *Malva sylvestris* L. (*Malvaceae*):

Folia Malvae neglectae and *Folia & Flores Malvae silvestris* contains mucilages (Ciulei *et al.,* 1993; Constantinescu & Agopian, 1962 etc.) and they are: anti-inflammatory, antiphlogistic, astringent, demulcent, diuretic, emollient, expectorant, laxative, used in poultices, as purgative (PfaF)

Ononis spinosa L. (= *Ononis vulgaris* Rouy *pro parte*), (*Leguminosae*):

Found in all sites, in fringy portions of meadows, with sub-saline soils. *Radix Odonidis* is an expectorant, depurative and diuretic traditional drug (Constantinescu & Agopian, 1962; Butură, 1979). Dhanamani *et al.* (2011) report a study (Lellau & Liebezeif, 2003) presenting the extract of *Ononis spinosa* (as well as extracts of *Trifolium fragiferum* and *Trifolium repens*) as antitumoral.

Plantago lanceolata L. (*Plantaginaceae*):

Found sporadically in *Festuca pseudovina*-dominant communities and more abundant on sub-saline old-ruderal surfaces. *Folia Plantaginis* are: antibacterial, astringent, demulcent, expectorant, haemostatic, laxative, ophthalmic (PfaF). Congeneric *P. major* L. can also be used as medicinal drug with similar action (Ianovici *et al.,* 2010).

Medicinal uses (traditional and modern) are also reported for other species we identified: *Aster tripolium* L. (*Compositae*)*, Atriplex patula* L. (*Chenopodiaceae*), *Atriplex tatarica* L. (*Chenopodiaceae*), *Beckmannia eruciformis* (L.) Host. (*Gramineae*), *Capsella bursa-pastoris* (L.) Medik. (*Cruciferae*), *Cynodon dactylon* (L.) Pers. (*Gramineae*), *Erophila verna* (L.) Chevall. (*Cruciferae*), *Lactuca saligna* L. (*Compositae*), *Lepidium perfoliatum* L. (*Cruciferae*), *Lepidium ruderale* L. (*Cruciferae*), *Lotus corniculatus* L. (*Leguminosae*), *Medicago lupulina* L. (*Leguminosae*), *Mentha longifolia* (L.) Huds. (*Labiatae*), *Mentha pulegium* L. (*Labiatae*), *Ononis arvensis* L. (*Leguminosae*), *Polygonum aviculare* L. (*Polygonaceae*), *Polygonum lapathifolium* L. (*Polygonaceae*), *Potentilla reptans* L. (*Rosaceae*), *Rumex conglomeratus* Murray (*Polygonaceae*), *Rumex dentatus* L. (*Polygonaceae*), *Sisymbrium officinale* (*L.*) Scop. (*Cruciferae*), *Teucrium scordium* L. (*Labiatae*), *Trifolium repens* L. (*Leguminosae*), *Verbena officinalis* L. (*Verbenaceae*), *Veronica arvensis* L. (*Scrophulariaceae*), *Xanthium spinosum* L. (*Compositae*) etc.

C). Considerations on conservation

Conservation of the studied saline grasslands should be guided by the objective of keeping the traditional uses (extensive grazing, firstly), but the revival of traditional medicine based on plants could lend to a higher involvement of local communities in a more effective conservation. The role of ethnomedicine in conservation is highlighted by Schoop-Guth & Fremuth (2001, in Hamilton, 2004): „Probably, the single most important ‚role' for medicinal plants in biological and ecological conservation stems from the foundation that they provide for the involvement of people in conservation of natural habitats.". In this respect, creating ethno-medicinal plants garden is a conservative measure, recommended by Ansarinia & Jouyban (2012), that could help. The high content in essential oils of some species (*Chamomila recutita*, *Artemisia* sp., *Achillea* sp.) allow the rediscovery of other traditional uses (e.g. perfuming the home-made soap, insects repellents etc.). *Ex situ* conservation of medicinal halophytes is difficult because of the soil properties (salinity) required by these plants.

Recommendations about collecting these plants should take into account the conservative value of the whole ecosystem (Natura 2000 site), and natural yearly variations in populations' coverage due mainly to salinity fluctuations (Tóth, 2010, on *Artemisia* saline puszta). Industrial or large scale harvesting should be clearly avoided.

The overgrazing diminishes the potential for medicinal plants production in two ways: reducing populations of some species, and decreasing the quality of the herba (huge quantities of excreta); it creates also good conditions for spreading of species as *Eryngium campestre*, *Cirsium arvense* and *Cirsium lanceolatun*, *Carduus nutans*, *Cynodon dactylon* and *Onopordum acanthium*.

Collecting and storing seeds in seed banks is a compulsory measure, in order to save material for genetic and biochemical future studies, at least for comparison with other populations.

CONCLUSIONS

Almost all the species found in the six location have or may have medicinal uses. Few is published about the ethnomedicine of halophytes in the studied area, as well about these populations' contents in biologically active compounds.

Given their pharmaceutical uses in Romania and in other European countries, the most valuable species are: *Achillea millefolium, Matricaria* recutita and *Mentha* sp.

Artemisia santonicum subsp. *santonicum* and *Limonium gmelinii* seem to be promising species for biochemical and pharmaceutical research.

Overgrazing is a mitigating factor on medicinal plant value (especially in Vărşand and Socodor). An investigation on local ethnomedicine could create the conditions of people involvement in conservation.

A large number of ruderal species growing in proximities of analyzed areas are also medicinal.

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