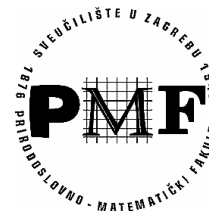




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ANALYSIS OF A POTENTIAL NETWORK OF THE IPA - Croatia

2.1 draft report

by

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1. Executive summary

Investigation of the flora of Croatia, in global retrospect, has a long history and well tradition. The best investigated group is vascular plants, and the worst ones, mosses and fungi. Respecting all groups, especially vascular plants, the diversity in state is very high, using objective methods of measuring spatial plant diversity. Despite relatively long tradition some leading difficulties in SSM methodology application in Croatia are detected, connected with insufficiency of several types of requested data:

1. complete lack of the newer data on taxa distribution for some floristic groups (mosses), or data large imperfectness (fungi, lichenes, algae)
2. lack of habitats maps in appropriate resolution or scale (manufacture in the course of, but not available for the purpose of this report development)
3. unsatisfactory presence of taxa from national lists on European and world lists which should be used for the purpose of application of the criteria A(i) i A(ii)

Mostly connected with previous statement, usability of IPA Selection Criteria in Croatia is not complete: criteria A(i) is inappropriate, A(ii), A(iv), B, C(i), C(ii) is available partially and A(iii) is available. Potential European datasets is also accessible in different mode.

Number of taxa of vascular flora suffice different IPA criteria are 15 for A(i), 62 for A(ii), 4 for A(iii), 33 for A(iv), 236 for B, none for C (i and ii), all according to the in moment available informations accumulated in CROFlora database. Using copiously GIS and related database, the geographical distribution of IPA localities according to the different criteria are defined. Each criteria and related sites are discuss separately.

With all mentioned limitations on mind, a preliminary list of 88 IPA sites could be produced. Most of them is justifiable according to not only one criteria. Principal amount of sites are connected with geological phenomenon of karst, i.e. karstic ecosystem along Dinaric mountain range (including islands), and with so called, extrazonal karst area in continental part of Croatia. Minor number of sites is connected with particular types of localities, mostly connected with wet habitats (meadows, bogs, marshes), elements of stepa, and inland sand and salt habitat. Potentially an IPA could be very small and designated to protect a single species or small area of a specific habitat, or it could incorporate a large area with many different IPA species, or habitats, or areas of richness and diversity. Also, several potential crossborder IPAs could be detected (with Slovenia and Bosnia and Herzegovina). In planning conservation actions, the most effort should be directed towards areas and localities outside already protected areas (national parks, and parks of nature).

Using information from new red data book, major threats are detected. Assessment shows that even 62% of all causes of threats of vascular flora in Croatia is connected with habitat loss or degradation human influenced. Additional 24% are indirect consequence of different causes. From the total of 29 possible causes of habitat loss or degradation primarily by human impact, 8 causes of habitat loss in 90% of all cases. Two anthropogenic functions are causes of habitat loss in almost half of all cases. The first and most important influence is influence on inland waters, draining of mires and similar habitats and influence on inland waters banks (31%). The second important human activity is shifting agriculture (18%), mostly change the habitats that is instantly visible. Threatened taxa are most presented in group of habitats no. 3 (1st CORINE level) – habitats of scrub and ley (37%) (Tab. 13). Follows group of habitats bogs and swamps (17%), and after that agricultural and artificial area, woods, and all others, each present with less than 10% in total.

The assessment of potential sites was made on existing data and the point about many of the data being very old was forcefully made. It is clear that the major fieldwork is needed to verify the data records and to assess potential sites more thoroughly.

2. Overview of the situation of IPAs in the Croatia

2.1. Flora investigation in Croatia

Investigation of the flora of Croatia, in global retrospect, has a long history and well tradition. Strong influence of middle Europe, world botanical centre by the end of 18. century and particularly during 19. century have, as a consequence, relatively early accumulation of botanical data assembled by the foreigner authors as well as domestic one. Independent institutes, higher schools, universities and specialised departments inside faculties, with better and better contouring staff, become bearer of botanical investigation in Croatia.

The flora of Adriatic sea, macro-phyto-benthos has been investigated almost 250 years (the first data from DONATIA about adriatic endemic algae, *Fucus virsoides* J. Agardh). Many botanist, whose taxonomic contributions describe sporadic taxa or taxa distribution on major or smaller adriatic parts (NACCARI, AGARDH, ERCEGOVIĆ, VOUK, LINARDIĆ, ŠPAN, ANTOLIĆ, ZAVODNIK, etc.) come latter on. Oceanographic institutes (Rovinj, Split, Dubrovnik) are the centres of such activities. However, the mapping of the marine macroflora was never done. The data are sporadic, spatially foul distributed, depending of the particular person or institution interest. Currently, only one expert for macrophytobentos work actively.

The first published data about inland water algae on Croatian area date at the beginning of the century (BRUNNTHALER, CAR). In the period that follow the sequence of papers was published, contain the floristic-taxonomic data of the pioneer of algology in sixties (KRMPOTIĆ, PEVALEK, VOUK, JURILJ i dr.), and than the papers about ecological aspects of algal development (PEVALEK, PAVLETIĆ, MARČENKO i dr.). The development of biocenology and multidisciplinary in investigation access influence also on technology of investigation of aquatic habitats (PLENKOVIĆ, MEŠTROV, HABDIJA i dr.). Mapping of algal flora according to the some standard methodology was never done, and currently in Croatia actively work four specialists.

Lichenes has been investigated on the Croatian area from middle of 19. century. In the beginning only the area close to the border of west neighbours was investigated (MASSALONGO, KÖRBER), but latter, particularly at the beginning of the 20. century, much wider (Bosna, Hercegovina, Dalmacija etc., especially ZAHLBRUCKNER). However, leading lichenologist was FRAN KUŠAN, who gave the biggest contribution with serial papers about proficiency of lichenoflora in Croatia. In the last period, homely lichenologists almost do not exist, and floristic and taxonomic evaluation of autochthonous lichens is again subject of interest of foreign botanist (i.e. CHRISTENSEN, MURATI). In the last 50 years, nevertheless, nobody work on lichenes in Croatia, so this is one of the least investigated group. In the last five years only one professionally undertaking botanist is active.

Mycology in Croatia revitalized at the middle of 19. century by work of Stjepan SCHULTZERA. But, as difference from the investigation of other plant groups, in mycology there are no continuity in investigation. Despite oddness richness in *Mycota* kingdom, at the first half of 20 century in Croatia no professional mycologist work, and beside small number of popular and skilled papers, there are no significant knowledge shifts. Merely in sixties of 20 century Milica TORTIĆ gave the significant contributions by multitude scientific papers, novelty described taxa, and valuable collections. No less for endeavor of few enthusiasts, interruption in continuity visible on the beginning of the 20 century, is repeated again today. Namely, no scientific or other institution has no undertake biologist who work on fungi. Thus, the fungi is one of the less known group of organism in Croatia.

The first notice on mosses investigation in Croatia was limited on seashore, and has been recorded at the beginning of 19. century (WEISS). On the second half of the same century prominent author is KLINGRAEFF with check list of 120 mosses from the Zagreb countryside, and SCHULTZERA with similar paper, but for the Slavonija area. Between several

author in declining years, particularly importance have Ivo HORVAT and Zlatko PAVLETIĆ with libertine work about brioflora from the european stanpoint. Today, unfortunately, briology in Croatia is wholly extinct as a sfientific filed of work. There are no active briologists in last decades.

Opposite to the previous taxonomic groups, investigation of vascular flora in Croatia, has long, copious and sustained development. In the different political boundaries, contribution was done by the many foreign and domestic authors. The prime paper are old more than 300 years. Early development of faculties and professional botanists, glance off in accomulation of significant amount of botanical and floristic data, rich collections and published papers and books. Nevertheless, the last and only work with title *Flora Croatica* has been written almost 130 year ago (SCHLOSSER & VUKOTINOVIĆ 1869). The new paper on inventarisisation of croatian flora partially fill up thi gap and with other contribution makes vascular flora the best investigated group of plant in Croatia (NIKOLIĆ 1994, 1997, 2000, 2002).

2.2. Floristic richnes

Data collected for the purpose of the development of the National strategy on Biodiversity and Landscape Conservation (MARTINIĆ 200), for the first time enable thoroughly synopsis of florstici diversity of Croatian flora and gaps in investigations level. (Tab. 1). Inside flora subgroup the fungi is placed (despite is independent kingdom *Mycota*).

Table 1. Sumarni podaci o raznolikosti flore Hrvatske (podaci o brojnosti vrsta na svjetskoj razini prema MRŠIĆ 1997 i SCHÄFER 1995)

Group	Croatia					World	
	known	known (%)	suspected	suspect. (%)	level of knowledge(%)	known	suspect.
<i>Algae</i>	2597	22,95	3717	12,61	69,87	40000	400000
<i>Bryophytes</i>	638	5,64	700	2,38	91,14	22690	
<i>Fungi</i>	3235	28,59	20000	67,87	16,18	80000	1500000
<i>Lichenesi</i>	900	7,95	1069	3,63	84,19	20000	
<i>Pteridophyta</i>	75	0,66	75	0,25	100,00	12000	
<i>Gymnospermae</i>	46	0,41	46	0,16	100,00	600	
<i>Angiospermae</i>	3825	33,80	3861	13,10	99,07	250000	320000
Total	11316	100,00	29468	100,00	*	382300	

In Croatia total of 11.316 taxa was registered from the total number of 30.000 supposed taxa (lover limit). This number is not final one, because still for some groups no approximatively number could be established (i.e. microphytobentos).

Assessment of most diverse groups in great scale depend of level of investigation,so the overall picture os elements is not realistic. According to the current data vascular flora is the richness (including ferns and seed plants) with 3.946 species (35%), followed by fungi with 3.235 noted species (29%), and than algae (23%), lichenes (8%) and mosses (6%) (Fig. 1).

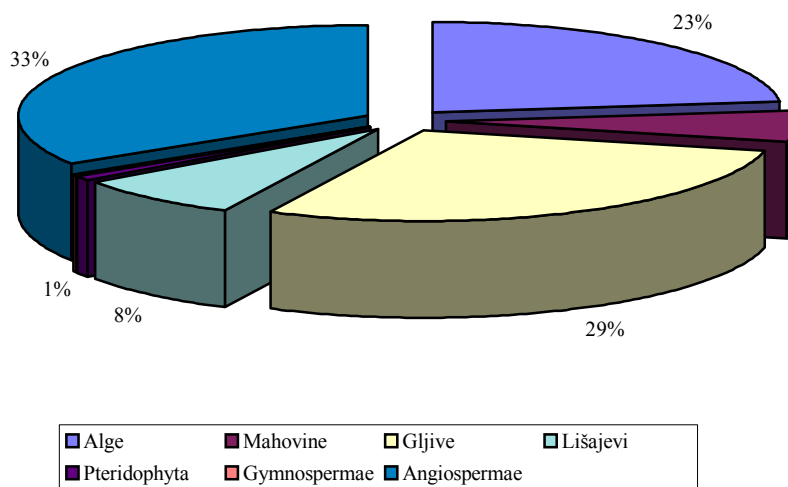


Figure 1. Total number of known species in respective group of flora in Croatia

Presuppose or expected numbers of taxa, however, offer quite different view (Tab. 1, Fig. 2). The most diverse group is fungi with 20.000 expected taxa (68%), followed by vascular flora (13,5%), algae (13%), lichens (4%) and mosses (2%).

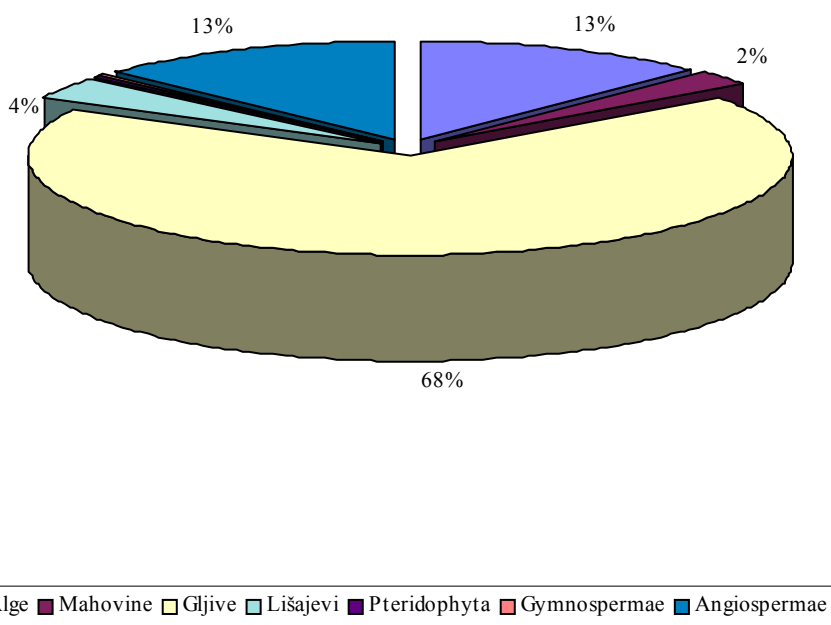


Figure 2. Expected number of species in respective group of flora in Croatia

The comparison with floristic richness with adjacent countries is possible for best known vascular flora.

The comparison between the number of Croatian species with the number of species known for some European countries is given in Table 2. Comparisons of absolutely taxa number, however, have no sense because of often large difference in compared area. (HAWKSWORTH and KALIN-ARROYO 1995).

More realistic and comparable approach is the ratio of the species number and the belonging area. On the basis of this comparison, Croatia is on the 3rd position in Europe (0.075), after Slovenia (0.158) and Albania (0.105). Since the number of taxa for Slovenia includes also the taxonomical category subspecies, it is justified to use, for comparison, the analogous number for Croatia as well. Total order of countries by richness in vascular flora species is not changing. That comparison brings Croatia (0,094) much closer to Albania (Tab. 2). The List of flora by its documented abundance is putting Croatia into the very top of floristically richness amongst the countries in Europe.

Table 2. The comparison of total number in vascular flora species of some European countries according to the order of ratio of species number/state area (km²); ¹ the number of species, ² the number of species and subspecies, ³ without Madeira (796 km²) and Azora, ⁴ the number of species supplemented according to NIKLFELD and SCHRATT-EHRENDORFER (1999), ⁶ framed dimension of area of interest (data on the number of species according to WALTER and GILLET 1998, state areas according to OPPITZ 1974)

no.	state/area	no. species	% threatened	area (km ²)	no. species/km ²
1	Slovenia	3216	12,00	20251,00	0,15881
2	Albania	3031	2,60	28748,00	0,10543
3	Croatia¹	4275	11,01	56538,00	0,07561
4	Croatia²	5347	8,80	56538,00	0,09457
5	Switzerland⁴	2696	32,00	41288,00	0,06530
6	Portugal³	5050	5,30	88500,00	0,05706
7	Slovakia⁴	2500	41,50	49009,00	0,05101
8	Belgia	1550	0,10	30514,00	0,05080
9	Yugoslavia	4282	5,00	102173,00	0,04191
10	Greece	4992	11,40	131944,00	0,03783
11	Netherlands	1221	0,10	33779,00	0,03615
12	Austria⁴	2950	40,20	83850,00	0,03518
13	Denmark	1450	0,10	43069,00	0,03367
14	Bulgaria	3572	3,00	110912,00	0,03221
15	Hungary⁴	2411	1,40	93030,00	0,02592
16	Czech R.⁴	1826	45,00	78851,00	0,02316
17	Italy	5599	5,60	301249,00	0,01859
18	Romania	3400	2,90	237500,00	0,01432
19	Ireland	950	25,30	70280,00	0,01352
20	Turkey	8650	21,70	774810,00	0,01116
21	Spain	5050	19,50	504750,00	0,01000
22	France	4630	0,50	543998,00	0,00851
23	Poland	2450	1,10	311730,00	0,00786
24	Germany⁴	2742	0,50	355872,00	0,00771
25	UK	1623	1,10	244030,00	0,00665
26	Norway	1715	0,70	324219,00	0,00529
27	Sweden	1750	0,70	449750,00	0,00389
28	Finland	1102	0,50	337032,00	0,00327

2.3. Implementation of the SSM Methodology on national level

Leading difficulties in SSM methodology application in Croatia is connected with insufficiency of several types of requested data:

4. complete lack of the newer data on taxa distribution for some floristic groups (mosses), or data large imperfectness (fungi, lichenes, algae)
5. lack of habitats maps in appropriate resolution or scale (manufacture in the cour of, but not available for the purpose of this report development)
6. unsatisfactory presence of taxa from national lists on European and world lists which should be used for the purpose of application of the criteria A(i) i A(ii)

Mentioned reasons make usage of some criteria difficult, and in some cases unworkably. Tab. 3 contain general comments of current usability of IPA Selection Criteria in Croatia.

Table 3. Usability of IPA Selection Criteria in Croatia – shotreview

CRITERION	DESCRIPTION	USABILITY IN CROATIA
A(i) (threatened species)	Site contains globally threatened species	Inappropriate. IUCN global red list from 1997 (Walter and Gillet 1997) mention only 6 taxa for Croatia. Whole book contain 70 taxa which have at least part of areal inside national borders. On-line IUCN Red List 2000 contain only 4 taxa (with two taxonomically doubtful) and IUCN Red List 2002 contain only 2 taxonomically doubtful taxa. It is not possible to use this data as a criteria in IPA selection in Croatia. The Red book from 1994 (Šugar 1994) and Red List (Nikolić 1994, 1997, 2000) are completely ignored. The new Red book (Nikolić et Topić 2003 in press) should probably change this. Currently there are no known global lists for the most lower plants or fungi. Global Red list for lichenes is under construction.
A(ii) (threatened species)	Site contains regionally (European) threatened species	Available partially. Bern Convention cite 29 taxa of vascular flora, and Habitat Directive in Annex IIb 15 taxa, in Annex IVb 18 taxa and in Annex V 8 taxa of vascular flora. The distribution maps for all taxa of vascular flora is not available (see Annex 3.1. and 3.2). Data for fungi, lichens and bryophytes are not available.
A(iii) (threatened species)	Site contains national endemic species with demonstrable threat not covered by A(i) or A(ii)	Available. From total number of endemic taxa in Croatia (323 s.l. for context of endemism see Nikolić 2002), 13 taxa are threatened, 71 are in category NT (Near Threatened), and 31 are DD taxa (Data Deficiency). For threatened endemic taxa distribution maps area available (MTB square ¼). Data for fungi, lichens and bryophytes are not available.
A(iv) (threatened species)	Site contains near endemic/limited range species with demonstrable threat not covered by A(i) or A(ii)	Available partially. From total number of endemic taxa in Croatia (326 taxa, for context of endemism see Nikolić 2002), including threatened (for criteria A(iii)) for 112 endemic and subendemic taxa distribution maps are available (MTB squares ¼). The data (distributional, population status and other) for all endemic and subendemic taxa are not available. Data for fungi, lichens and bryophytes are not available.
B (species richness)	Site contains high number of species within a range of defined habitat types	Available partially. The optimal data for performance of criteria B would be habitat maps in appropriate scale and atlas of species distribution in appropriate grid. In Croatia the

		difficulties are: 1. there are no habitats maps yet, just list. The first maps will be available by June 2003 2. distribution maps are available for cca. 600 taxa of vascular flora (CROFlora database, scientific papers), few fungi taxa (scientific papers) and no lichens and bryophytes taxa.
C(i) Priority threatened habitats	Site contains threatened habitat	Available partially. Priority threatened habitats are selected from Annex I of the Habitats Directive (and any corresponding habitat from the Bern Convention Res. 4). Spatial distribution of these habitat are known only partially (Annex).
C(ii) Threatened habitats	Site contains threatened habitat	Available partially. Threatened habitats could be selected from Annex I of the Habitats Directive and the Bern Convention Resolution 4, not covered by C(i). Spatial distribution of these habitat are known only partially. – pitati Topić & Štrbamac: Natura 2000

Usability of potential European wide databases

Selection of some pan-European databases on species or habitats that potentially could be available for use in national IPA projects presented in SSM document have comments about usability for Croatia in Tab. 4.

Table 4. Usability of potential European wide databases in Croatia

Type	General Information	Status for Croatia
Habitats		
CORINE Land Cover	European land cover data from satellite imagery – 44 classifications, 250x250 m square minimum resolution	Not available. Do not cover Croatia territory. CORINE Habitats types and CORINE Land cover are in the development phase for Croatia. National lists of habitats are available in draft version (Topić et Ilijanić 2001). Habitat mapping project using remote sensing technology should be finished by June 2003 in scale 1:100.000 and with basic pixel of 9 ha.
EUNIS	European Habitats Classification System used in Natura 2000 system – hierarchical system developed from CORINE/PALAEARCTIC – includes cross-references between Habitats Directive & Bern Convention habitats	Available , in basic resolution. CORINE classification developed in Croatia from and with modification from Palearctic shema could be transferred (with some errors) in EUNIS classification schema using cross-references authoriti file.
GLCC	Global Land Cover Characterisation also provides information on the global Forest Resources Assesment.	Available , in basic resolution.
PEEN Map	Map of sites for the Pan-European Ecological Network	Unknown status of Croatia (MZOPU?)
PELCOM	Pan European Land Cover and Monitoring Database, 1km land cover resolution for Europe	Available for Croatia in basic resolution 1km ² (Mücher ed. 2000)

SYNBIOSIS	Species, Plant community and habitat data for Holland & other European countries	Unknown status of Croatia (MZOPU?)
WETLANDS INTERNATIONAL	Information on wetland habitats throughout Europe	Available . Croatia included with 4 RAMSAR sites; map/graphic presentation very broad and unsuitable
Species		
Atlas Flora Europea	Computerised records of 20% of the Flora of Europe – at a resolution of 50x50 km ²	Available . State territory covered for all taxonomic groups published until now (12 vols. of AFE) on UTM 50x50 km basic square. Partially available in digital form.
Bern Convention, appendix I & Resolution 16 of Working Group 4 on habitats	Text of Directive and updated versions of Appendix 1	Available . Appendix I cite 28 taxa distributed in Croatia according to the Check list of Vascular Flora (Nikolić 1994, 1997, 2000) and CROFlora database (Nikolić 2002) (see Annex 3.1)
Habitats Directive Annexes IIb & IVb	Text of Directive and updated versions of Annexes I, IIb & IVb	Available . Habitat Directive in annexes contain 20 taxa presented in Croatian flora according to the Check list of Vascular Flora (Nikolić 1994, 1997, 2000) and CROFlora database (Nikolić 2002) (see Annex 3.2)
IUCN Global Red List/ UNEP-WCMC Threatened Plants database	Annually updated list of threatened species on the Global Red List	Unappropriate . Version from 1997 (Walter et Gillet 1997) contain only 6 taxa from Croatia instead known 226 in that time according Šugar (1994) . New version from 2002 contain even smaller number, only 2 threatened taxa from Croatia instead 418 according new Red Book, Nikolić et Topić (2003) . In The World List of Threatened Trees (Oldfield et al. 1998) Croatian flora is presented by
WorldMap	Computer Programme for assessing potential areas of species richness, diversity and rarity, also capable of assessment of complementarity of sites. Has been used in conjunction with Atlas Flora Europea	Unnecessary ; using ArcView is usual
Large CEE Projects		
CEE Grasslands Project	Dutch funded project to map the natural and semi-natural grasslands in CEE – Participating countries, Bulgaria, Estonia, Hungary, Latvia, Lithuania, Romania, Slovakia, Slovenia	Unknown status of Croatia (MZOPU?)
WWF Danube/Carpathian Project	EcoRegion Projects to define hotspots of biodiversity	Available partially .
Protected Sites Databases		
Important Bird Areas (IBAs)	Database & details of IBAs in Europe & the rest of the World	BirdLife International www.birdlife.org ??
RAMSAR	Database of RAMSAR sites maintained by Wetlands International	see above
UNEP -WCMC	Protected Areas Database	?

General GIS Information		
ESRI	Free GIS – Arcview programmes – also map library	Unnecessary. Using ESRI software is usual; basic topographic themas available on shareware or commercial base
General Conservation Information		
CBD Clearing House	Information Search Engine for biodiversity issues related to the CBD	Not available. Focal point established on MZOPU; CHM not developed in Croatia, not functional as a source of information. The area is partially covered by Croatian Biodiversity Information System, now outdated.
European Environment Agency Clearing House	Information Search Engine for environment issues relating to Europe	?

2.4. National IPA sites

The total number of taxa of vascular flora suffice different IPA criteria is presented in Tab. 5. It must be notice that not all taxa have available distribution maps, so not all taxa could be used in IPA sites selection (full data in Annex 5.1).

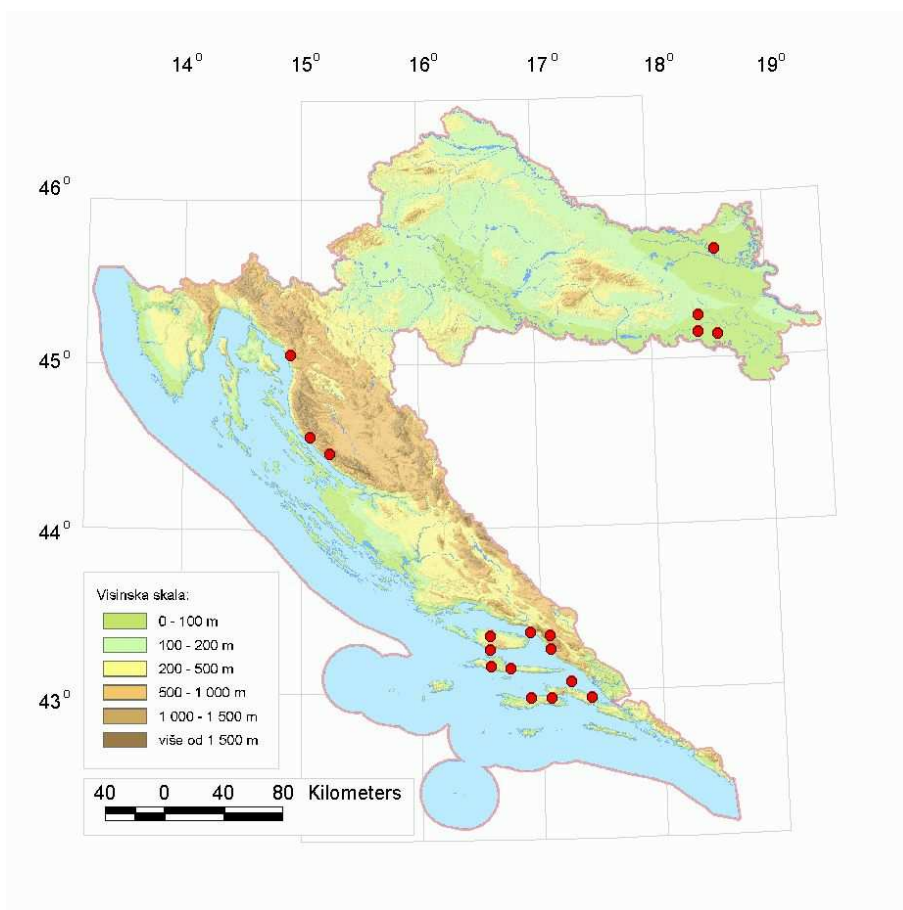
Table 5. Number of taxa of vascular flora suffice different IPA criteria (full data in Annex 5.1)

CRITERION	NUMBER OF TAXA
A(i)	15
A(ii)	62
A(iii)	4
A(iv)	33
B	236
C(i)	none
C(ii)	none

Using criteria A(i)

Criteria A(i) is satisfied for 15 taxa (see Annex 5.1), but site selection could be performed on the basis of available distribution maps only for three taxa: *Degenia velebitica* (Degen) Hayek, *Rhinanthus rumelicus* Velen. and *Pinus nigra* Arnold ssp. *dalmatica* (Vis.) Franco.

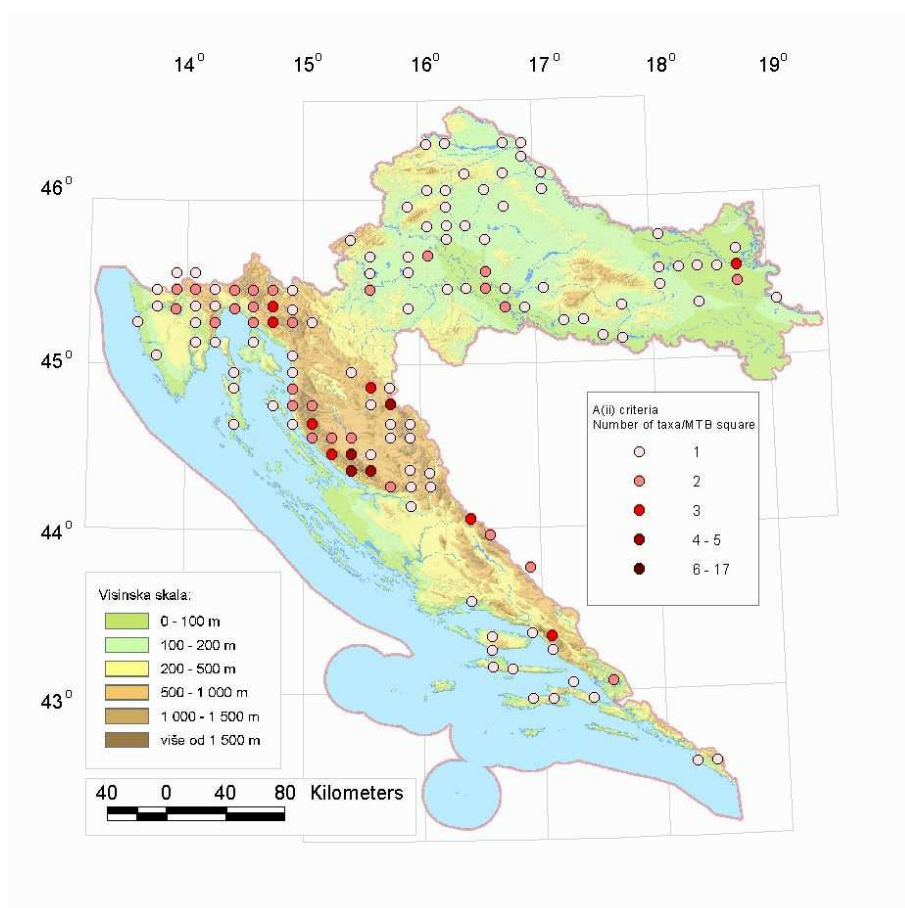
Four sites could be detected: Velebit ridge, south Adriatic islands and part of south Adriatic coast, and several small localities in continental east part of country connected with findings of *Rhinanthus rumelicus* Velen. (Map 1).



Map 1. Distribution map of vascular flora suffice the IPA criteria A(i) – in each MTB square one taxon registered.

Using criteria A(ii)

The total list of taxa for criteria A(ii) contain 32 taxa (see Annex 5.1). But the criteria should be use according to the subset of 16 taxa for which distribution maps are available: *Ligularia sibirica* (L.) Cass., *Lycopodiella inundata* (L.) Holub, *Mandragora officinarum* L., *Pilularia minuta* Durie ex A.Braun, *Typha minima* Funck, *Cypripedium calceolus* L., *Degenia velebitica* (Degen) Hayek, *Eleocharis carniolica* Koch, *Gentiana lutea* L. ssp. *symphyandra* (Murb.) Hayek, *Marsilea quadrifolia* L., *Moehringia tommasinii* Marchesetti, *Aquilegia dinarica* G. Beck, *Pinus nigra* Arnold ssp. *dalmatica* (Vis.) Franco, *Botrychium matricariifolium* (Retz.) A. Br. ex Koch, *Caldesia parnassifolia* (L.) Parl. and *Lindernia procumbens* (Krock.) Philcox (see Annex 5.1)(Map 2).

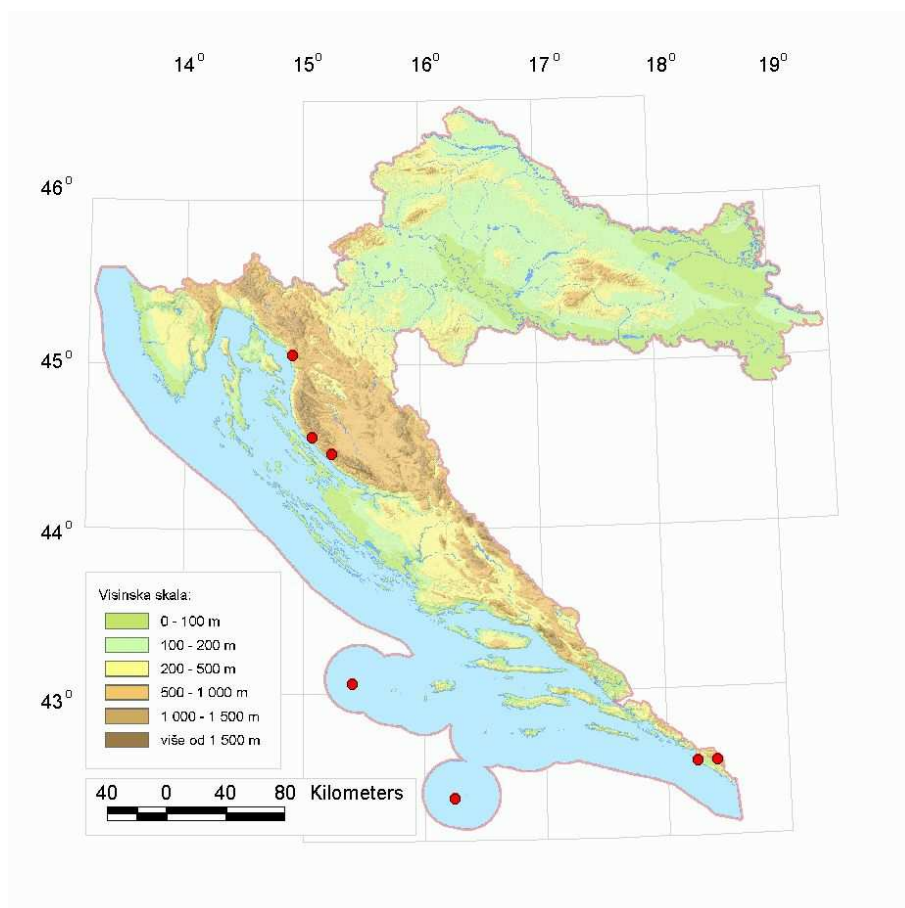


Map 2. Distribution map of vascular flora suffice the IPA criteria A(ii) – number of taxa per MTB square unit

Six especially rich area could be detected: Učka mountain, Velebit ridge, Lička Plješivica mountain, Biokovo and Dinara mountains. Several sites in continental part of country contain also taxa that satisfy criteria A(ii) but there are appear in a smaller number per square unit than in previously mentioned sites.

Using criteria A(iii)

Taxa suffice criteria A(iii) make the smallest group of taxa, i.e. narrow endemics threatened in Croatia (4, see Annex 5.1). Usable distribution maps are developed for *Mandragora officinarum* L., *Degenia velebitica* (Degen) Hayek and *Dianthus multinervis* Vis.. Last taxa must be deleted from this list because in a Red Book this taxa is assessed as extinct. So the localities in the outside Adriatic island (Map 3) should be neglect.

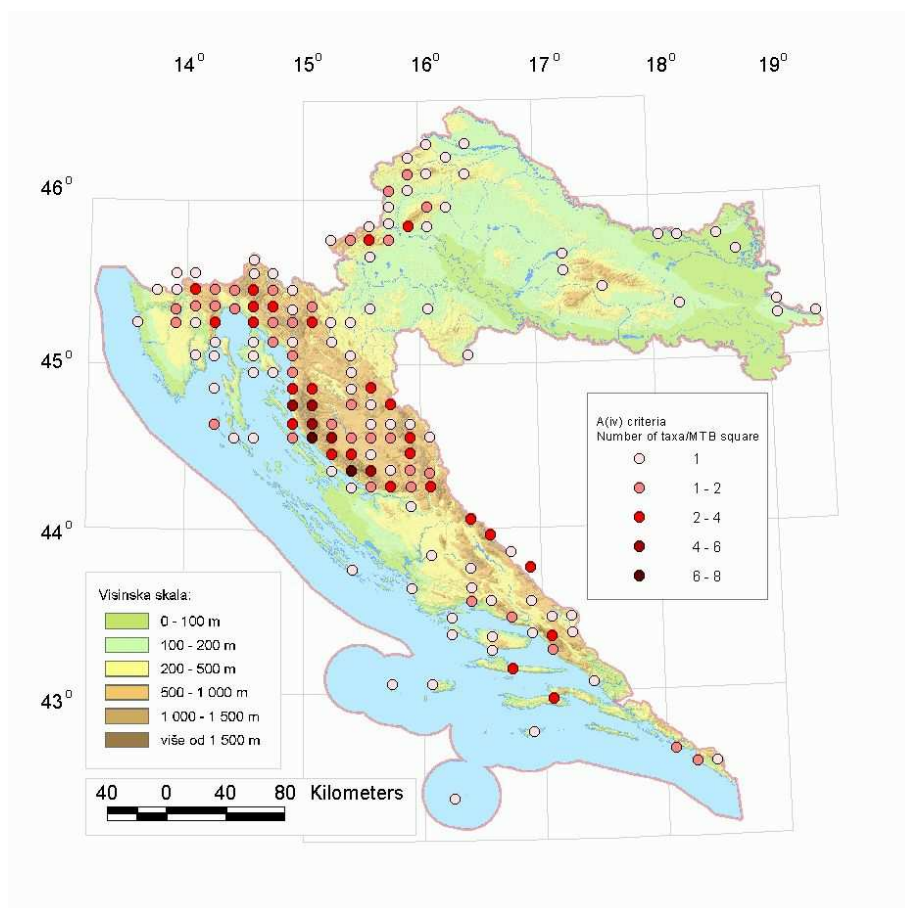


Map 3. Distribution map of vascular flora sufficing the IPA criteria A(iii) – in each MTB square one taxon registered.

So according to the A(iii) criteria two areas could be separate: Velebit ridge and small part of Konavle area in south Croatia.

Using criteria A(iv)

For criteria A(iv) limited range taxa (but no narrow endemic) and threatened on national red list should be used. From the total list of such taxa (33, see Annex 5.1), distribution data are available only for 14 taxa. These are *Alyssum montanum* L. ssp. *pluscanescens* (Raim. ex Baumgartner) Trpin, *Consolida brevicornis* (Vis.) Soo, *Geranium dalmaticum* (Beck) Rech.f., *Kitaibela vitifolia* Willd., *Mandragora officinarum* L., *Gentiana lutea* L. ssp. *symphyandra* (Murb.) Hayek, *Moehringia tommasinii* Marchesetti, *Pedicularis acaulis* Scop., *Aquilegia dinarica* G. Beck, *Dianthus giganteus* D'Urv ssp. *croaticus* (Borbás) Tutin, *Dianthus integer* Vis., *Helleborus niger* L. ssp. *macranthus* (Frey) Schiffner, *Iris croatica* Horvat et Horvat M. and *Lilium bosniacum* (Beck) Beck ex Fritsch.

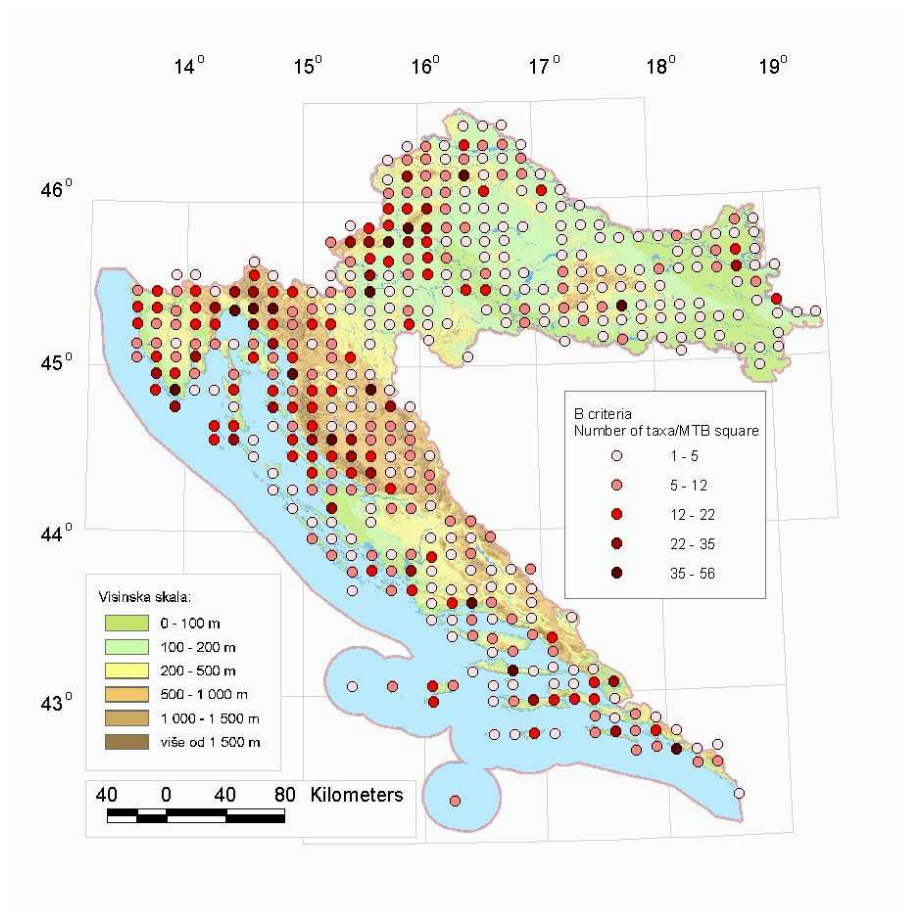


Map 4. Distribution map of vascular flora sufficing the IPA criteria A(iv) - number of taxa per MTB square unit

Area of particular importance using criteria A(iv) are: Učka mountain, Gorski Kotar and parts of Kapela, Velebit ridge, mountains Lička Plješivica, Dinara, Žumberak, Medvednica and Biokovo, few south Adriatic islands and outmost south parts of county (Konavle).

Using criteria B

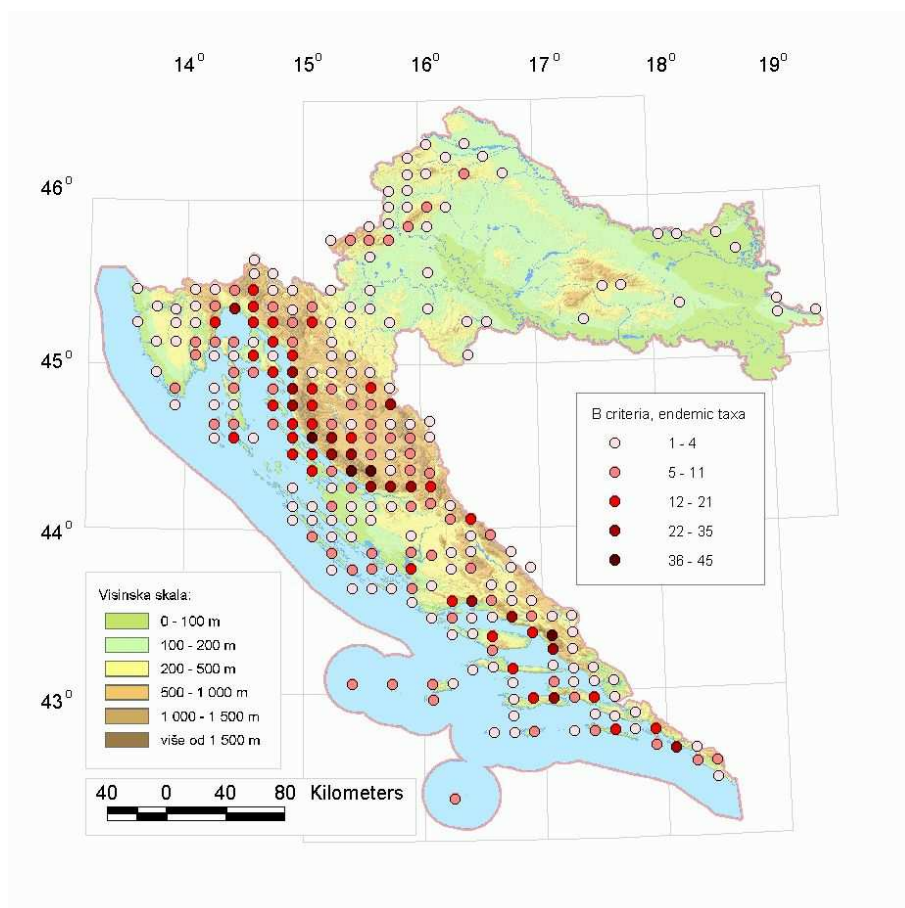
For performance of criteria B, nationally created list of indicator species must be developed for each habitat type including characteristic species, endemic species and/or nationally rare or scarce species. The habitat types are currently available only for taxa included in recent Red Book so the total list of 236 taxa could be used as indicator species. CORINE habitat classification system was used originally, and for draft IPA development purpose the conversion in EUNIS level 2 was done using Authority file for such procedure. The list must be additionally verified, collapse or increased, and all possibly errors induced by CORINE-EUNIS conversion must be resolved. Connection between taxa and EUNIS habitats is presented in Annex 5.1.



Map 5. Distribution map of vascular flora sufficing the IPA criteria B using Croatian Red List taxa as indicator species - number of taxa per MTB square unit

Utilization of national Red Book taxa as indicator species, especially number of taxa per square unit is shown graphically on Map. 5. Area with copious number of such defined indicator species (more than 20 per MTB square) are: Kopački rit, Lonjsko polje, Požeška kotlina, Žumberačko i Samoborsko gorje, Medvednica, okolica Karlovca, Gorski Kotar i Kapela, Učka, parts of Istre peninsula, Velebit ridge, Lička Plješivica, orifice of Krka river, Split area, south Adriatic Island, and Neretva delta.

Additional information in IPA sites selection could be numerous number of endemic and rare taxa, engaged with specific habitat types. These habitat types are still undefined according CORINE or EUNIS so the currently available information is number of endemic taxa, altogether 112 is mapped, per square unit, regardless habitats (Map 6).



Map 6. Number of endemic taxa of vascular flora per MTB square unit as a part of appliances of criteria B (based on distribution of 112 taxa)

The abundance and distribution of endemic taxa purport several important area: parts of Istra peninsula, Gorski Kotar and parts of Kapela, exquisiteness rich of Velebit ridge (up to 45 endemic taxa per 100 km²), Lička Plješivica, Biokovo mountain, and south Adriatic islands.

Using criteria C

The criteria C is most difficult to use in Croatia. As previously stated, no habitats maps are currently available, so the distribution of threatened habitats listed as priority on Annex I of the Habitat directive is not well known. Habitas map using CORINE classification system in scale 1:100000 develop using recent Landstat images, and with copiously filed testing are in the process (project financed by Ministry of Environment Protection and Physical Planning). So the full application of criteria C is not possible in the moment, and this draft report does not contain application of criteria C.

What is available now is the list of the priority threatened habitats present in Croatia listed as priority on Annex I of the Habitats Directive (and any corresponding habitat from the Bern Convention Res. 4) requested for SSM Criteria C(i) (red letters) **and** threatened habitats present in Croatia listed on Annex I of the Habitats Directive and the Bern Convention Resolution 4, **not covered by C(i)** (those habitats with additional explanation and red letters), i.e. C(ii). Nomenclature is fixed according to Palearctic habitat classification and could be optionally transferred to EUNIS level 2 (Annex 5.2). Also, according to the analysis of data collected for the new Red Book, the most threatened habitats list could be quantify (see page __).

Provisional IPA sites selection

Limitation

For IPA sites selection, as stated previously, several main limiting factors occur:

1. data weakness (astride distribution data for some taxa, habitats maps, ...)
2. oldness of available data (more than 70% older than 50 years)
3. uneven distribution of spatial data
4. inexactness of data

Insufficiency is the most in mosses and algae, and than in lichenes and liverworts and also fungi. In Even in best known vascular flora, distribution maps are know only for the small amount of the total number of taxa. Essential elements for criteria C could be used only according to the personal experience of particular botanist, which is not done in this provisional report.

Oldness of data is illustrated on Tab. 6. and Fig. 3. on sample data based on threatened vascular flora distribution.

Table 6. Source and oldness of chorological data

Period	Collections		Literature		Total	
	No.	%	No.	%	No.	%
to 1899	721	30,15	1188	11,30	1909	14,79
between 1900-1949	1387	58,01	5551	52,79	6938	53,75
between 1950-2002	283	11,84	3777	35,92	4060	31,46
Total	2391		10516		12907	

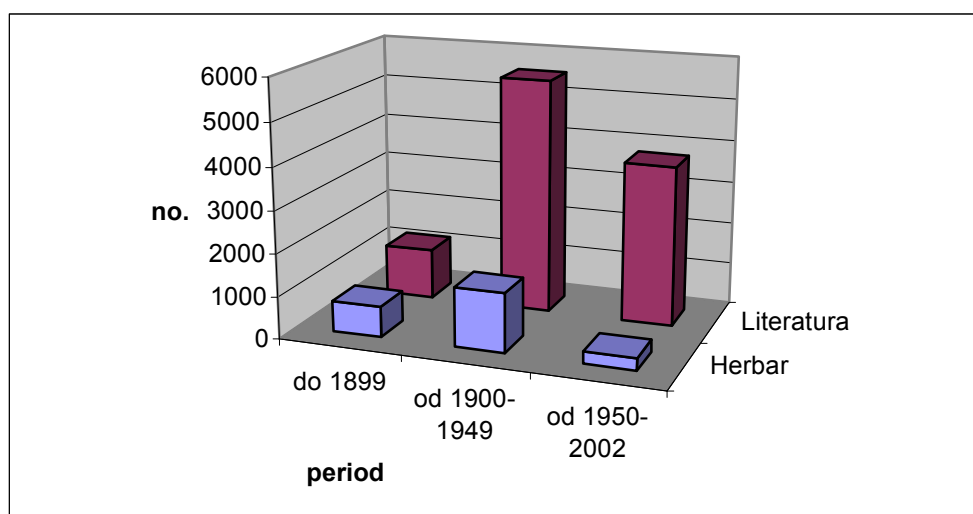
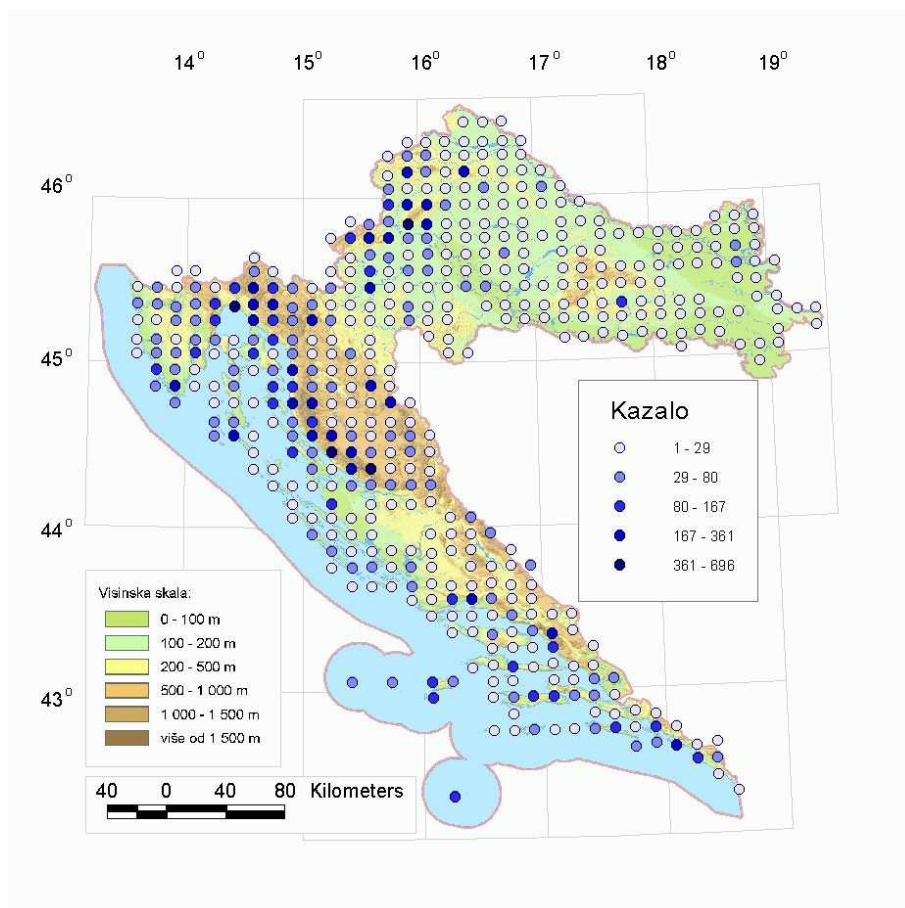


Figure 3. Oldness of data based on sample of threatened vascular flora distribution data

Namely, major part of data (readily 70%), are older than 50 years, i.e. recent distribution of some species could be quite different than presented. So, the old data could lead in misbelieve IPA sites importance.

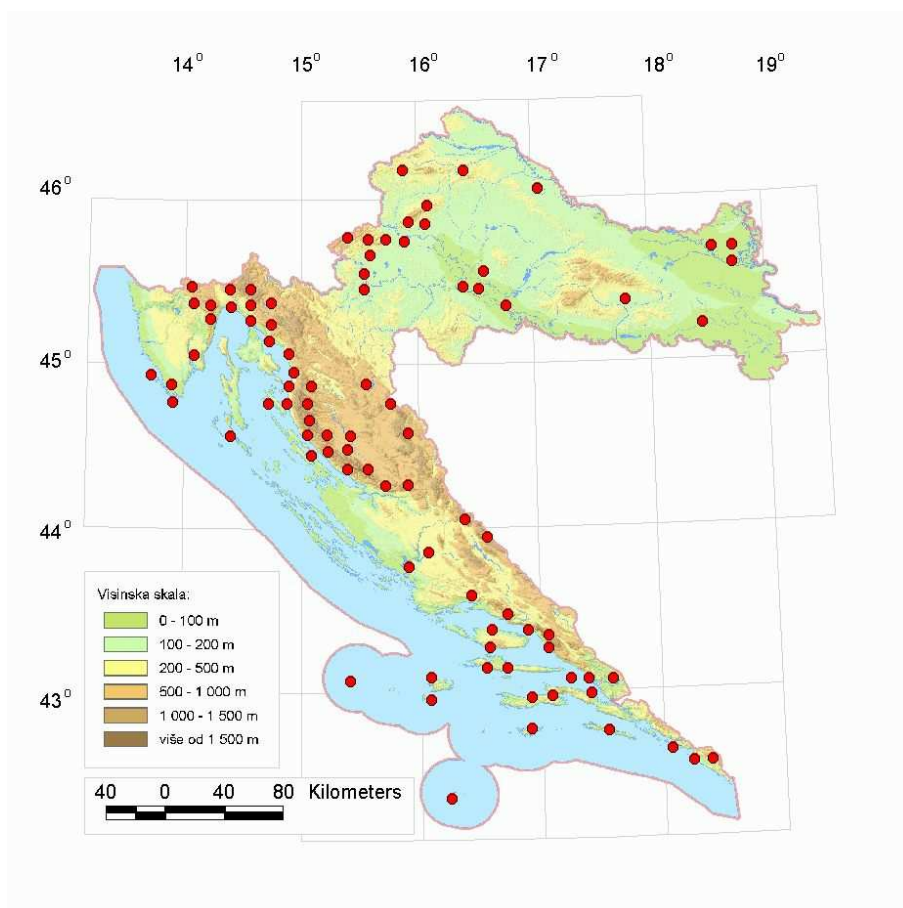
Uneven distribution of spatial data are visible on Map 7. Some area of Croatia are well investigated (more than 600 findings per 100 km²), and for some there are no data about threatened flora at all, not because these taxa are not presented in the area. Uneven spatial data is consequence of investigation often based on interest of particular person, institution or project from the one side, and never conduct sistematic floristic mapping in Croatia from the other.



Map 7. Occurrence of chorological data (level of examination) per MTB square unit according to the threatened vascular plants distribution data

Site selection

With mentioned limitations on mind, a list of 88 IPA sites could be produced (Map 8). Most of them is justifiable according to not only one criteria.



Map 8. Provisional IPA sites selection in Croatia according to the available data on criteria A and B.

Principal amount of sites are connected with geological phenomenon of karst, i.e. karstic ecosystem along Dinaric mountain range (including islands), and with so called, extrazonal karst area in continental part of Croatia. Minor number of sites is connected with particular types of localities, mostly connected with wet habitats (meadows, bogs, marshes), elements of stepa, and inland sand and salt habitat. Potentially an IPA could be very small and designated to protect a single species or small area of a specific habitat, or it could incorporate a large area with many different IPA species, or habitats, or areas of richness and diversity.

According to this provisional report, it seems conveniently to use:

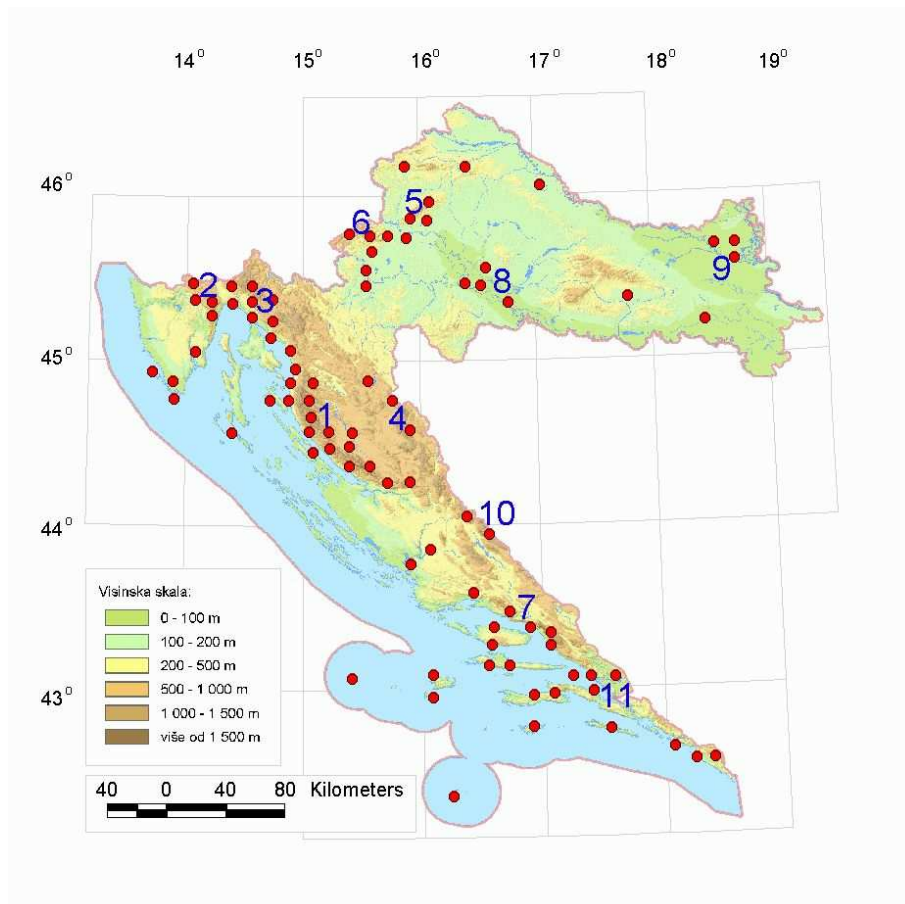
1. few larger area including taxa and habitats that pander several criteria and
2. several small sites designated to protect a single species, small number of species, habitats or richness

Larger area are (presented by numbers on Map 9):

1. Velebit mountain (the biggest IPA site in Croatia)
2. Učka and Čičarija mountain
3. Gorski kotar and Kapela
4. Lička Plješivica (including Plitvička jezera)
5. Medvednica mountain
6. Žumberak and Samobor mountain
7. Biokovo mountain (wider area)
8. Lonjsko polje
9. Kopački rit
10. Dinara mountain
11. Neretva delta

From the group of small sites particularly are important south Adriatic islands, which may be too small to be threatened as large area, but must be threatened as a separate and complete units, i.e. islands Brač, Hvar, Korčula, Lastovo, Mljet, Vis, Biševo, Palagruža, Jabuka and others (see Map 7).

Other small sites visible on the map are designated to protect mostly habitats or expressly floristic richness and/or species composition.



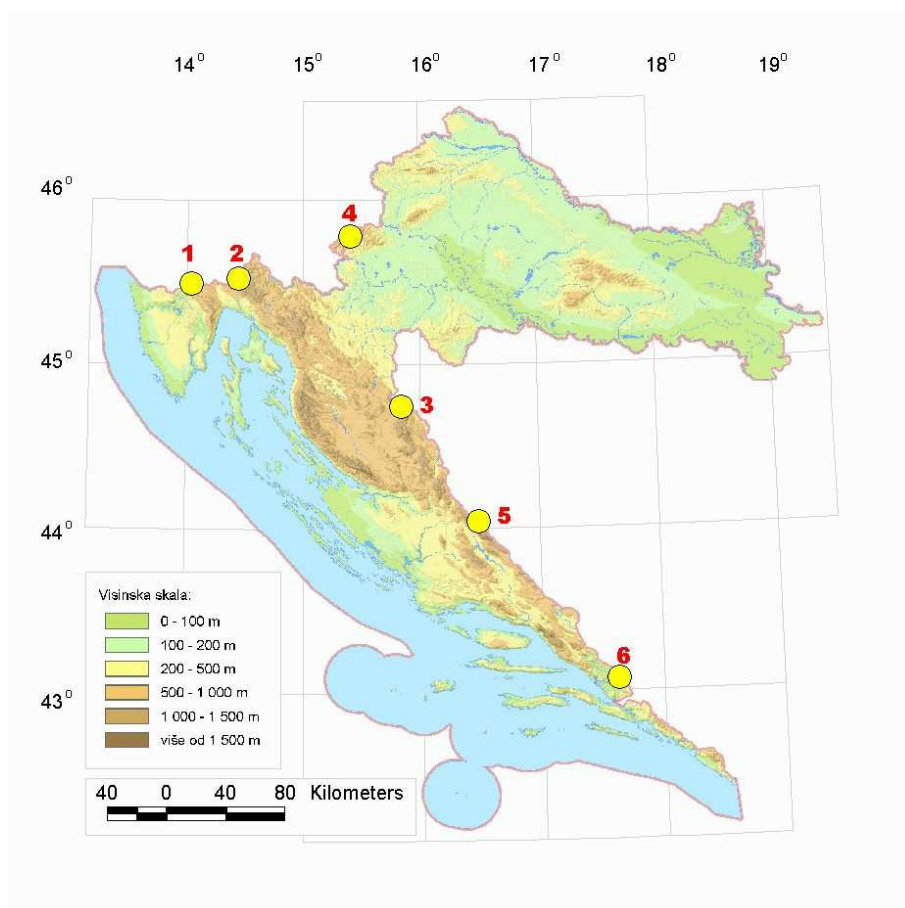
Map 9. Large area as IPA sites; 1/ Velebit mountain (the biggest IPA site in Croatia), 2/ Učka and Čičarija mountain, 3/ Gorski kotar and Kapela, 4/ Lička Plješivica (including Plitvička jezera), 5/ Medvednica mountain, 6/ Žumberak and Samobor mountain, 7/ Biokovo mountain (wider area), 8/ Lonjsko polje, 9/ Kopački rit, 10/ Dinara mountain, 11/ Neretva delta

Potential crossborder IPAs

Accordingly to the previous map, several potential crossborder IPAs could be detected (Map 10):

1. Učka and Čičarija mountain – rely on border with Slovenia
2. Gorski kotar and Kapela – rely on border with Slovenia
3. Lička Plješivica (including Plitvička jezera) – rely on border with Bosnia and Herzegovina
4. Žumberak and Samobor mountain – rely on border with Slovenia
5. Dinara mountain - rely on border with Bosnia and Herzegovina and
6. Neretva delta– rely on border with Bosnia and Herzegovina

Intergovernmental cooperation in all activities connected with IPA sites is desirable.



Map 10. Potential crossborder IPAs in Croatia: 1/ Učka and Čičarija mountain – rely on border with Slovenia, 2/ Gorski kotar and Kapela – rely on border with Slovenia, 3/ Lička Plješivica (including Plitvička jezera) – rely on border with Bosnia and Herzegovina, 4/ Žumberak and Samobor mountain – rely on border with Slovenia, 5/ Dinara mountain - rely on border with Bosnia and Herzegovina and 6/ Neretva delta– rely on border with Bosnia and Herzegovina

Potential crossborder IPAs descriptions

Učka and Čičarija mountain

Geographic scope: cca 25000 ha, west part of Croatia, mountain area which isolate Istrian peninsula, borderland with Slovenia

Number of plant species and habitats: unknown for such defined area, cca 1500 taxa

Species with conservation value:

Threats: harmonization of various space users' interests

Measures undertaken already: one Park of nature 14.600 ha

Measures which should be taken: unknown

Prognoses for future development: ?

Gorski kotar and Kapela

Geographic scope: cca 40000 ha, mountain area in north-west part of Croatia, borderland across Kupa river with Slovenia

Number of plant species and habitats: unknown for such defined area, cca 1700

Species with conservation value:

Threats: more guards are required, need to buy off private pockets, impact of acid rains on forests, unsustainable forestry, tourism

Measures undertaken already: one National park 6400 ha, one stric reserve cca 800 ha

Measures which should be taken: unknown

Prognoses for future development: ?

Lička Plješivica (including Plitvička jezera)

Geographic scope: cca 36000 ha, borderland with Bosnia and Herzegovina, inland waters specific phenomenon, also strict mountain region

Number of plant species and habitats: unknown for such defined area, >2000 taxa

Species with conservation value:

Threats: anthropogenic causes of lakes eutrophication, freight traffic close to the lakes, need for construction of drainage system, tourism, infrastructure

Measures undertaken already: one national park 26600 ha, virgin-forest reserve of Čorkova uvala, part is listed among world heritage in 1979

Measures which should be taken: unknown

Prognoses for future development: ?

Žumberak and Samobor mountains

Geographic scope: 33000 ha, mountain region in vicinity of capitol, borderland with Slovenia

Number of plant species and habitats: unknown for such defined area, cca 1200 taxa

Species with conservation value:

Threats: harmonization of various space users' interests

Measures undertaken already: one park of nature 33000 ha (from 1999), special reserve Japetić (from 1975.) and protected landscape Slapnica (from 1964.)

Measures which should be taken: unknown

Prognoses for future development: ?

Dinara mountain

Geographic scope: cca 25000 ha, mountain region, borderland with Bosni and Herzegovina

Number of plant species and habitats: unknown for such defined area, ?

Species with conservation value:

Threats:

Measures undertaken already: none

Measures which should be taken: unknown

Prognoses for future development: ?

Neretva delta

Geographic scope: cca 30000 ha, borderland with Bosnia and Herzegovina, a great wealth of ornithofauna, ichtiofauna

Number of plant species and habitats:

Species with conservation value:

Threats: shifting agriculture, drenage systems, game sports, eutrofication, infrastructure

Measures undertaken already: Ramsar site

Measures which should be taken: unknown, proposal for park of nature

Prognoses for future development: ?

Note: Neretva Delta is particularly important potential IPA. For the one side it is extremely rich area, full of habitats effacement in other parts of country and Europe (wetlands, moisture grasslands, water habitats, springs, lakes, salt marshes, etc.), with large numbers of plant and other species, with several included special reserves (for birds, fishes and vegetation) and plans for park of nature pronouncement. On the other side, the same area suffer from high pressure from several human activities, particular fast agriculture development, water regime influence, pollution, artificialisation, hunting and fishery and industry in upper river parts. Splited between two countries, area desperately need fast and international conservation activity.

Provisional IPA sites and protected area

Croatia have 8 National parks (Tab. 7) and 10 parks of nature (Tab. 8), 2 strict reserves and 4 Ramsar sites and in all other protected categories total of 352 objects, sites or area.

Table 7. National parks, basic data, features and protection problems; state on 1 October 1999

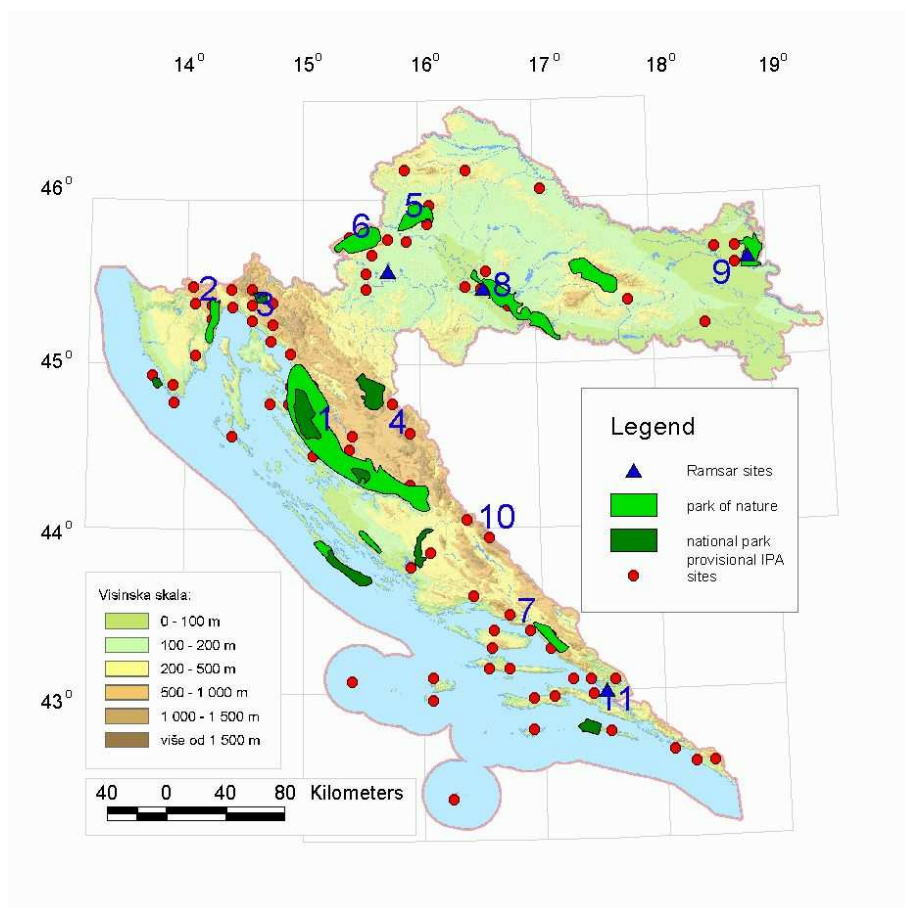
Name/ surface area	Basic features	Problems
Plitvice Lakes 29,482 ha	a phenomenon of karst hydrography: 16 lakes arranged in a cascade, with numerous travertinedownstream beds in a vivid biodynamic process; over 2/3 of the NP area covered by well-preserved forests (virgin-forest reserve of Āorkova uvala), rich fauna, listed among world heritage in 1979	<ul style="list-style-type: none"> · anthropogenic causes of lakes eutrophication · freight traffic close to the lakes · need for construction of drainage system
Paklenica 10,200 ha	deep ravines – Velika and Mala Paklenica; autochthonous forests of black pine and several types of beech woods	<ul style="list-style-type: none"> · after tripling the park area more guards are required · lack of new signalisation
Risnjak 6,400 ha	main types of highland forests with a typical height-related arrangement gathered on a comparatively small surface area	<ul style="list-style-type: none"> · after doubling the park area more guards are required · need to buy off private pockets · impact of acid rains on forests
Mljet 5,480 ha	specific indentation of the coast with two “lakes” (flooded karst depressions); Aleppo pine and holm-oak forests and dense evergreen underbrush; cultural heritage with remnants of an antique palace and a complex of the Benedictine monastery from the 12 th century	<ul style="list-style-type: none"> · complex property rights relations (over ½ of the land is owned by the church, with ¼ privately owned) · problems of illegal housing construction · need to dislocate of waste disposal site out of the NP
Kornati 23,400 ha	the most indented island group of the Mediterranean; landscape values, high cliffs, interesting relief structures; over ¾ of the NP area belonging to the sea with biocenoses ranked one of the richest in the Adriatic	<ul style="list-style-type: none"> · difficulties in effective control of visitors (shortage of ships, etc.) · no office building for the management (offices rented) · the mainland part of the NP completely privately owned (tendency of illegal housing construction)
Brijuni 3,635 ha	a group of 14 islands with a total surface area of 734.5 ha; excellently preserved Mediterranean community of holm-oak; landscape parks on the Veli Brijun and the pertaining sea and undersea; rich cultural heritage, especially from Roman and Byzantine times	<ul style="list-style-type: none"> · worn out facilities and infrastructure · harmonization of space use and financial obligations of several users (public enterprise – army – the President’s office)
Krka 10,300 ha	a karst river with travertine downstream beds, partly in a form of lakes, with a canyon valley in some places picturesquely cut into the limestone plateau; several endemic fish species, cultural heritage – the monasteries of Visovac and Aranđelovac, remnants of Middle Age towns	<ul style="list-style-type: none"> · problems with waste waters of Knin and Drniš; harmonization of the operation of existing hydropower plants with water requirements of downstream beds · property rights problems (e.g. a major part of Skradinski buk is privately owned) · some facilities within the NP owned by Hrvatske šume
Sjeverni Velebit 10,900 ha	in terms of landscape, geomorphology, botany and forestry the richest area of Velebit; includes the strict reserve of Hajdučki and Rožanski kuk; botanical garden and two botanical reserves	<ul style="list-style-type: none"> · harmonization of interests of various space users

Table 8. Nature parks, basic data, features and protection problems; state on 1. October 1999

Name/ surface area	Basic features	Problems
Kopački rit 17,770 ha	a fluvial wetland biotope at the mouth of Dravaand Danube, a great wealth of ornithofauna, fish hatchery, a closer area (7,000 ha) specially separated as a zoological reserve	<ul style="list-style-type: none"> · mine clearance · harmonization of various interests (forestry-hunting -water management -protection) · staff shortage
Medvednica	a mountain massif (1,035 m) near Zagreb; well-	<ul style="list-style-type: none"> · harmonization of various space

22,826 ha	preserved forests and forest communities; 8 forest reserves; recreational area of Zagreb	users' interests · establishment of a public enterprise to manage the area; office space
Velebit 200,000 ha	the most important mountain of Croatia (145 m long) from the aspect of relief and vegetation; a biosphere reserve (UNESCO, 1978)	· harmonization of various interests (forestry – hunting – protection)
Biokovo 19,550 ha	craggy, limestone mountain immediately by the sea; extraordinary littoral landscape (beaches with pine forests and mountains); wealth of flora in a height range of 0-1,762 m; chamoises	· office space
Telaševica 6,706 ha	southern part of Dugi Otok with a deeply incised and highly indented cove (Telaševica) and several smaller islands; continuation of natural features of Kornati islands; on the open-sea side the highest cliffs in the country (up to 180 m)	· relocation of waste disposal sites
Lonjsko polje 50,650 ha	flood area along the Sava, between Sisak and Nova Gradiška; a wealth of plant and animal life; nesting place for spoonbills; interesting architecture of wooden houses of the Sava basin	· public enterprise without its own office building · harmonization of various interests (water management – agriculture–forestry – hunting–protection)
Papuk 33,600 ha	the most important mountain of Slavonia's highlands dominated by wooded areas; the entire mountain has rounded, wooded peaks; thanks to the geomorphological structure its northern and southern slopes are furrowed by watercourses	· harmonization of various space users' interests
Učka 14,600 ha	a peculiarity of White Istria by its geographical position, relief, geological structure, geomorphology, climate, luxuriant forest vegetation, protected and endemic flora species; the relief and nearness of the sea contributed to development of a specific climate that facilitated the development of luxuriant forest vegetation from the sea to the top of mountain	· harmonization of various space users' interests
Žumberak-Samoborsko gorje 33,300 ha	meadows and pastures as basic features of the landscape provide extraordinary wealth of flora and alternate with forest areas	· harmonization of various space users' interests
Lake Vransko near Biograd n/m 5,700 ha	Croatia's largest natural lake; connected with the sea which makes the lake water brackish; accommodating yearly over 100,000 waterfowls; nesting place of the last heron colony in the Mediterranean part of Croatia	· the newly established nature park with the public enterprise for management to be founded

As stated in SSM, the ultimate aim of the IPA programme is to ensure that the sites identified as being important for plants are adequately protected and managed to ensure the continued existence of those plants and habitats. Obviously, some provisionally identified IPA sites are already protected and managed as National parks or Parks of nature in Croatia (Map 10). Some of larger area identified as IPA sites do not fit strictly the boundaries of protected area, what could be interpreted as a plausibility of boundaries changes. Lot of small sites drop inside protected area, but a still large number are not covered by protected area system. This are specially true for south Adriatic islands and area of Gorski kotar and Kapela (area 3).



Map 11. Spatial relation between provisional IPA sites and protected area in Croatia, national parks, parks of nature and Ramsar sites (see legend)

2.5. Overview of the main conservation threats in Croatia

Main conservation threats in Croatia would be the most visible using three different access: (1) analysis of IUCN criteria used in new Red Book of Croatian vascular flora, (2) analysis of usage of IUCN major threats authority file as a threats index in Red Book, and (3) analysis of the most threatened habitats according to the CORINE classification and Red Book data.

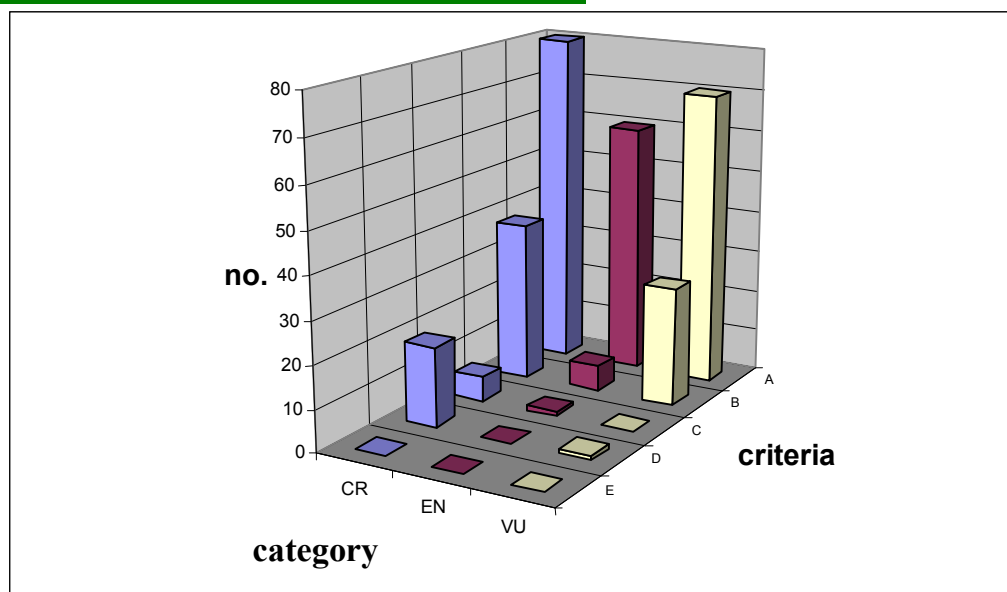
IUCN Red Book criteria as threats index

During assessment of threats in Red Book, the IUCN criteria was used 309 times in different combinations, often more than once for each taxon. The most often used criteria was criteria A (68%), i.e. population reduction (as the population is defined by IUCN guidelines), especially in the form A4c (187 times) (Tab. 9, Fig. 4).

The criteria are mostly make out according to the more or less justifiable suspicion in population reduction (so called “shifting window”), based on reduction of area of occupancy or distribution or/and quality of habitats. Criteria which include data about extent of occurrence or area of occupancy (criteria B) was used 72 times. Criteria C and D connected with small and extremely small population was used 27 times, mostly, as could be expected, for critically threatened taxa and endangered taxa (i.e.. *Agropyron cristatum* (L.) Gaertn. subsp. *pectinatum* (M.Bieb.) Tzvelev, *Bassia laniflora* (S.G.Gmel.) A. J. Scott, *Carex bohemica* Schreb, *Chamaecytisus ratibonensis* (Schaeff.) Rothm i dr.). Quantitative analysis showing the probability of extinction (criteria E, i.e. PVA – Population Viability Analysis) is not used at all.

Table 9. Usage of different groups of criteria in different IUCN categories (according to the assessment in Red Book)

Criteria/category	CR	EN	VU	Total	%
A	80	60	70	210	67,96
B	38	6	28	72	23,30
C	6	1	0	7	2,27
D	19	0	1	20	6,47
E	0	0	0	0	0,00
Total	143	67	99	309	100,00

**Figure 4.** Frequency of usage of particular criteria in each category, according to the assessment for Red Book

IUCN Major Threats Authority File for threats index

Analysis of the causes of species decline in the new Red Book according to the IUCN Major Threats Authority File point out on dominant negative factors. Assessment shows that even 62% of all causes of threats of vascular flora in Croatia is connected with habitat loss or degradation human influenced. Additional 24% are indirect consequence of different causes (Tab. 10, Fig. 5). Because habitat loss and indirect influence made even 85 % of all threats causes, it is interesting to review the participation of sublevels (see latter on).

Direct loss, mostly connected with exceeding plants collection for decorative or medical purposes make 7% of total registered causes. Thanks to sustained work on education in schools, NGOs, mountaineer clubs, the risk of plant ravage by this is mighty attenuate. In fact, there are only small number of plants threatened by picking (i.e. *Gentiana lutea* L. ssp. *symphyandra* (Murb.) Hayek for pharmaceutical industry). The changes could come off only with legal acts about possession of certificate on production, as a case in some european countries. All other causes together are present with less than 8%.

Table 10. Most important causes of threats of vascular flora in Croatia

No.	Threats causes	Total	%
1	Habita loss	339	61,64
2	Direct loss	37	6,73
3	Indirect loss	130	23,64

4 natural disaster	3	0,55
5 Atmospheric pollution	1	0,18
6 Pollution of ground and waters	18	3,27
7 Intrinsic factors	4	0,73
8 Other	16	2,91
9 Unknown	2	0,36
Total	550	100,00

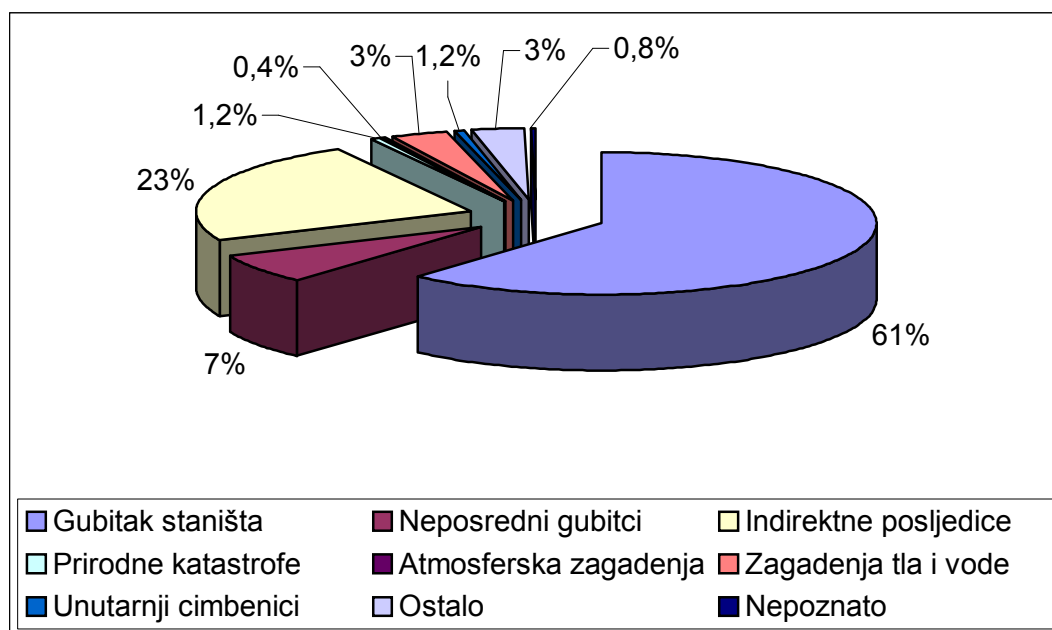


Figure 5. Causes of threats of vascular flora in Croatia in percent of total causes

Habitat loss

From the total of 29 possible causes of habitat loss or degradation primarily by human impact, in Tab. 11 and Fig. 6 is presented the first eight – causes of habitat loss in 90% of all cases. Two anthropogenic functions are causes of habitat loss in almost half of all cases. The first and most important influence is influence on inland waters, draining of mires and similar habitats and influence on inland waters banks (31%).

Table 11. Most important causes of threats by habitat loss or degradation primarily by human impact

No.	Causes	No.	%
1	1.4.3. Draining / irrigation - mire/coastline	94	30,72
2	1.1.3. Shifting agriculture	54	17,65
3	1.3.4. Infrastructure	35	11,44
4	1.3.2. Human settlement	34	11,11
5	1.3.3. Turism	30	9,80
6	1.4.1. Fragmentation	15	4,90
7	1.1.1. Plowed land and other agricultural surface / horticulture	12	3,92
8	1.2.3. Forestry	6	1,96
9	All others	26	8,50
	Total	306	100,00

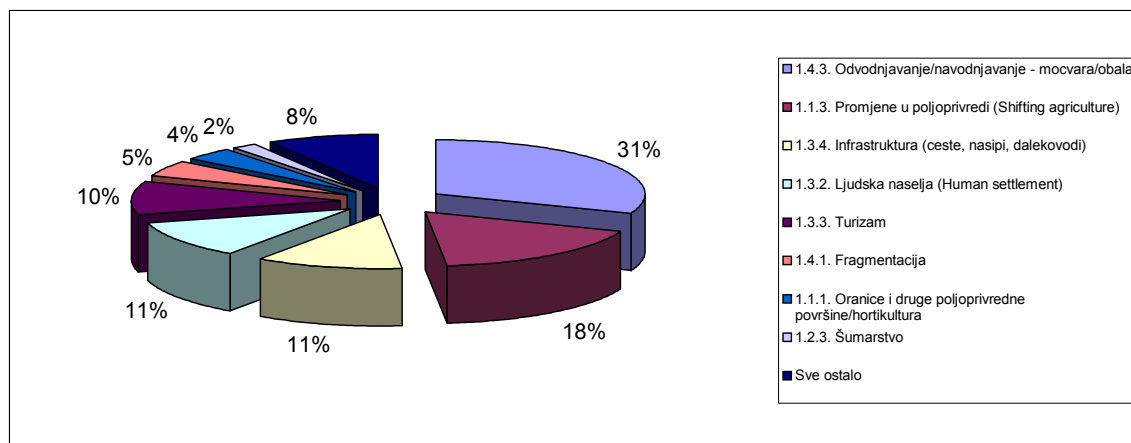


Figure 6. Causes of threats by habitat loss or degradation primarily by human impact in percent of all causes

The second important human activity is shifting agriculture (18%), mostly change the habitats that is instantly visible.

From the other, on habitat loss significantly influence building of human infrastructure (construction of communication, channels, mound, grid, etc.) (11.4 % of all causes).

As a causes of habitat loss less important but still attendant are chopping of human settlement, tourism activities (mostly connected with degradation of rare types of sublittoral habitats), habitat fragmentation, activities connected with agricultural area and other less important causes (i.e. forest cultivation, mining industry (connected with quarry), negative influence of of grazing, industry). By the other words data about habitats degradation and loss shows that in Croatia are acting same or similar causes well known from the far European countries.

Indirect influences

The dominant indirect negative influence on vascular flora is again connected with habitat loss but in this case as a result of “ecological disbalance” (74%, Fig. 6, Tab. 12), not as a direct human influence, but as a secondary or tertiary effect. In the most cases disappear of semi-natural habitats appear by the progression of natural vegetation, mostly forest.

Table 12. Most important indirect causes of threats

No.	Causes	No.	%
1	3.3.5. Habitat loss	84	74,34
2	3.2.5. Habitat disappearance	17	15,04
3	3.1.1. Recreation/tourism	7	6,19
4	3.1.4. Other	2	1,77
5	3.3.8. Other	2	1,77
6	3.3.1. Competitiveness	1	0,88
Total		113	100,00

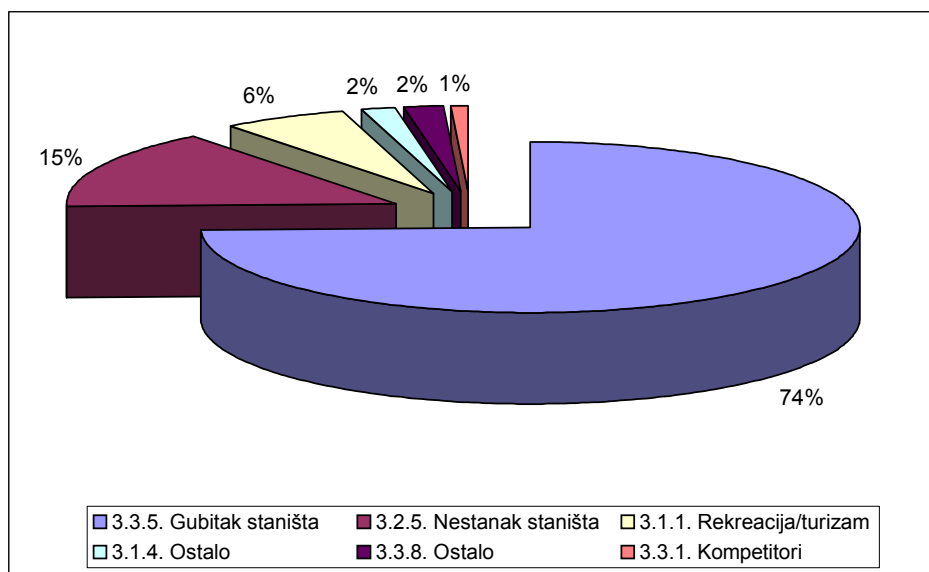


Figure 7. The most important indirect influences on flora extinction in Croatia

Natural vegetation succession is incessantly causes of habitat changes. Croatia belong to climazonal area dominated by forests, and without human influence on almost whole territory would be covered by forest (excluding inland waters and mires, rocks, the highest mountain ridges, etc.). According to the available data, 300 years ago about 75% of Slavonija was covered by forest. Today, forests cover about 40% of the state territory. Decrease of beehive area and grazing area case the forest progression and floristic diversity loss.

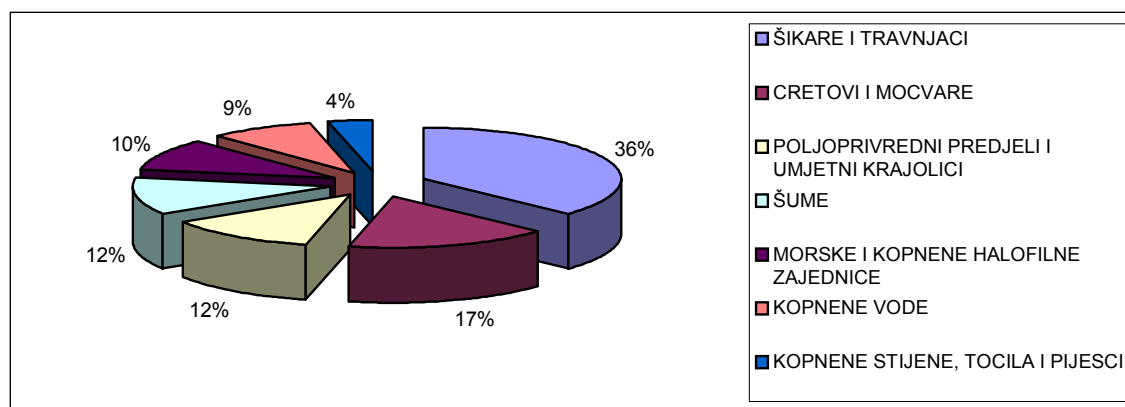
2.6. The most threatened habitats

Because the habitat loss is the most important reason of threaten of flora, in most cases the presence of threatened flora connotate in the same time the threaten of habitat on which they come. It could be expected that in the near future the Red list of habitats will be developed for Croatia, and simple data presented here could serve as draft list.

Threatened taxa are most presented in group of habitats no. 3 (1st CORINE level) – habitats of scrub and ley (37%) (Tab. 13). Follows group of habitats bogs and swamps (17%), and after that agricultural and artificial area, woods, and all others, each present with less than 10% in total. S obzirom na širinu prvog nivoa klasifikacije staništa, zanimljivo je promotriti ga na drugom, preciznijem novou (najprecizniji navodi staništa navedeni su uz svaku pojedinu svojtu).

Table 13. List of habitats (1st CORINE level) with the biggest number of threatened taxa of vascular flora

Code level 1	Habitat name (CORINE level 1)	quotation	no. of different second levels	% quotation
3	scrub and ley	179	8	36,98
5	bogs and swamps	81	2	16,74
8	agricultural and artificial area	60	4	12,40
4	forests	57	3	11,78
1	MARINE and inland salt community	48	4	9,92
2	inland waters	42	2	8,68
6	inland rocks and, screws and sands	17	3	3,51
	Total	484	26	100,00



For the biggest number of threatened taxa (15%), habitats are steppe and dry grassland especially on limestone, particularly continuously tightly turfies and middleeuropean steppe (*Festuco-Brometea*), thereof mediterranean-mountain grasslands (*Festuco-Brometea*, *Brachypodio-Chrysopogonetea* p.p.) which shows as habitats or one of habitats for 65% of taxa inside this habitats group. In the group of wet graslands and community of high lignous (12%), threatened taxa appear inside (68% of all quotation) the habitats of eutrophic and oligotrophic wet meadows. In the group of vegetation on waterway borders (9%), the most often habitat of threatened flora are habitats from the group of order *Phragmitetalia* and communities of large sedges (*Magnocaricetalia*) (86%). Broadleaf forests are habitats for 7.8% of threatened taxa, specially of beech forests, hereupon termophilous and supramediterranean oak forests and mixed termophilous forests (80%) (Tab. 14).

Aquatic plants communities (euhydrophytes) is the most common habitats (96%) inside the group of inland waters habitats (total proportion in all habitats of 7.6%). In the group of habitats of bogs and wellsprings, the biggest number of threatened taxa (96%) are connected with communities of *Caricetalia davallianae* and acidophilous bogs.

Review of all CORINE level 2 habitats that contain threatened taxa show that almost half are directly or indirectly dependent on inland waters or water regimen, what is completely in agreemant with main causes of habitat loss – human influence on inland waters.

Table 14. List of habitats (2nd CORINE level) with the biggest number of threatened taxa of vascular flora

Level 1 Habitats CORINE (level 2)	No.	%
3 34. STEPE I SUHI TRAVNJACI NA VAPNENCIMA	72	14,88
3 37. VLAŽNI TRAVNJACI I ZAJEDNICE VISOKIH ZELEN	57	11,78
5 53. VEGETACIJA VODNIH RUBOVA	44	9,09
4 41. ŠIROKOLISNE LISTOPADNE ŠUME	38	7,85
2 22. SLATKOVODNE STAJAČICE	37	7,64
5 54. CRETOVI I VRELA	37	7,64
1 15. MOČVARNE SLANUŠE, SLANE "STEPE", GRMOLIKE SLANUŠE	25	5,17
8 82. USJEVI	22	4,55
8 87. NAPUŠTENA POLJA I ZAPUŠTENA (RUDERALNA) MJESTA	20	4,13
1 16. OBALNE PJEŠČANE SIPINE (DINE) I PJEŠČANE PLAŽE	17	3,51
4 44. PRIOBALNE I MOČVARNE ŠUME I ŠIKARE	16	3,31
3 32.B ILIRSKI GARIZI	15	3,10
8 83. VOĆNJACI, NASADI I PLANTAŽE DRVEĆA	14	2,89
3 36. PLANINSKI I PRETPLANINSKI TRAVNJACI	12	2,48
6 64. KOPNENE PJEŠČANE SIPINE (DINE)	11	2,27
3 31. VRIŠTINE I ŠIKARE UMJERENIH PODRUČJA	10	2,07
3 32. TVRDOLISNE ŠIKARE	6	1,24

Besides, the Act provides a **special protection** for certain particularly valuable parts of the animate and inanimate nature. By various categories of physical protection (national parks, nature parks, strict reserves, special reserves, forest parks, protected landscapes, natural and horticultural monuments) **about 9.9% of Croatia's surface area is protected**. The Act has also laid down the methods of protection, government, management and control over individual categories of protected parts of the nature. The category of individual plant and animal species is used to protect individual taxa, including the entire wild fauna and flora in national parks, strict and special reserves and the whole of the cave fauna. Commercial gathering of unprotected plant and animal species is regulated by special licences given by the Ministry of Environmental Protection and Physical Planning.

In recent years the indisputable need for the adoption of a new **Nature Protection Act** has arisen, in which a classical approach to nature protection focused on protected areas and species would be replaced by a more advanced integrated approach as outlined in the Convention on Biological Diversity.

In 1992 the Croatian National Parliament passed the **Declaration of Environmental Protection** - the first document to incorporate in full the problem area of environmental and natural resources protection and to lay down principles of sustainable development.

The Croatian National Parliament also adopted individual national strategies related to the field of the protection of biological and landscape diversity. The 1997 **Regional Development Strategy of the Republic of Croatia** defined strategic directions and plans of all users of Croatia's space. Although without overlapping them and giving a synthesized analysis and final decisions on the methods to use individual spatial units of the Republic of Croatia, this is a valuable document incorporating all "wishes and plans" in one place.

In 1995 the **Agricultural Development Strategy of Croatia** was adopted focusing on principles of sustainability and on encouraging the so-called ecological agriculture.

In 1998, after having prepared a comprehensive **Report on Environmental State which was adopted by the Parliament**, the Ministry of Environmental Protection and Physical Planning started developing the National Strategy of Environmental Protection.

The **Tourism Development Strategy** and the **National Programme for Development of Islands** (1997) are completed, and the **National Development Strategy of the Republic of Croatia**, co-ordinated by the Ministry of Science and Technology, and the **Transport Development Strategy of the Republic of Croatia** are in preparation.

Table 15. Acts and subordinate legislation partly governing the exploitation and protection of biological and landscape diversity

Regulation	Year	Field
Nature Protection Act	1994	identification of parts of animate and inanimate nature, ensuring economical use of nature, prevention of harmful activities, adoption of long-term and short-term plans
Environmental Protection Act	1994	environmental protection regulated for the purpose of preserving the environment, preserving natural communities, reducing risks for human life and health, economical use of natural resources and energy in the environmentally most friendly way, as a prerequisite for a healthy and sustainable development
By-Law on Environmental Impact Assessment	1997	introduction of obligation to carry out the procedure of environmental impact assessment for all major activities threatening nature and environment
Air Protection Act	1995	laying down measures, organisation methods and implementation of air quality protection and improvement
Act on Hunting	1994	regulating the breeding, protection, hunting and exploitation of wildlife and its components, including the methods of hunting ground establishment and management

Freshwater Fishery Act	1986	protection, farming and catching of fish in freshwaters
Sea Fishing Act	1997	management of renewable biological resources of the sea, including protection, fishing and farming fish and other marine organisms
Act on Forests	1990	governing the management of forests and forest land in the continental and karst area, stressing the importance of useful forest functions
Forest Seeds and Forest Seedlings Act	1998	governing the production, processing, quality and sale of forest seeds and the production and sale of forest seedlings
Waters Act	1995	regulating legal status of waters and water resources, methods and conditions of water management
Maritime Code	1994	governing the method maritime resources exploitation (coastal and territorial waters and a part of the mainland intended by its nature for public maritime use or as such designated)
Agricultural Land Act	1994	rational use of agricultural land, agricultural land protection against pollution by harmful substances and other methods of transforming the agricultural land into building land, and agricultural land management
Act on Ecological Production of Agricultural and Food Products	1999	governing the issues of ecological production of agricultural and food products
Act on Seeds, Seedlings and Approval of Agricultural Plant Sorts	1997	governing the production, processing, quality and sales of seeds, approval of agricultural plant sorts, including production and sales of agricultural seedlings
Act on the Protection of Agricultural Plant Sorts	1997	governing the issues of rights of persons improving the agricultural plants and the protection of agricultural plant sorts
Act on Protection of Plants	1994	regulating protection of plants and plant products against pests, health control of plants traded, trading in plant protection chemicals and equipment for their use
Plant Protection Act	1994	laying down the protection of plants and plant products against pests, sanitary control of plants intended for sale, the sale of plant protection agents and equipment for their use
Wine Act	1995	governing the production and sale of grapes intended for production of wine, production and sale of wine, marking and protection of the controlled origin, name and identification of wine, operations and control in the field of grape-growing and wine-selling
Cattle-Breeding Act	1997	regulating the rearing of appropriate breeding cattle with particular emphasis on rearing the original and protected breeds and kinds
Animal Welfare Act	1999	dealing with welfare of animals with respect to their keeping, accommodation, feeding, protection and relationship towards animals
Act on Financial Incentives and Compensations in Agriculture and Fishery	1997	lays down the methods of receiving financial incentives and compensations from the national budget for specific segments of agricultural production

International legislation

The international system of the protection of natural resources is governed by a number of international conventions, recommendations and resolutions, including bilateral and multilateral treaties through which countries regulate systematically the protection of biological and landscape diversity taking into consideration their needs and interests.

The Republic of Croatia is a party to several international conventions related to this field and the laws on ratification of the rest are in the process of preparation.

Table 16. International conventions to which the Republic of Croatia is a party (2001 data)

NAME	PROBLEM AREA
Convention on Biological Diversity (Rio de Janeiro, 1992)	preservation and improvement of the existing biological diversity in the country, and sustainable use of its components
Convention on Wetlands of International Importance, Especially as Waterfowl Habitats (Ramsar, 1971)	rational use of all wetlands within the country's territory; inclusion of the most valuable wetlands into the Ramsar List of wetlands of international importance
Convention on the Protection of the Mediterranean Sea against Pollution (Barcelona, 1976) Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean (Geneva, 1982)	regional convention on the protection of the Mediterranean, including the special protocol concerning protected areas and the entire biological diversity
Convention on the Protection of World Cultural and Natural Heritage (Paris, 1972)	protection of national cultural and natural heritage; evaluation and inclusion of the most valuable areas in the World Cultural and Natural Heritage List

Table 17. International conventions to which the Republic of Croatia is still not a party (2001 data)

NAME	PROBLEM AREA
Convention on International Trading in Threatened Species of Wild Fauna and Flora (CITES) (Washington, 1973)	control of international trading in threatened species through the system of issuing import and export licences and certificates
Convention on the Protection of Migratory Wildlife Species (Bonn, 1979) · Agreement on the Protection of Euroasian-Northafrican Migratory Waterfowls (AEWA) · Agreement on the Protection of European Bats (EUTOBATS) · Agreement on Preservation of Cetaceas in the Black Sea, the Mediterranean Sea and the Adjacent Atlantic Area (ACCOBAMS)	protection of all wildlife species crossing the national borders during migration; the protection of certain animals is regulated by individual agreements
Convention on the Conservation of European Wildlife and Natural Habitats (Bern, 1979)	laying down measures to be taken by all European countries to protect wildlife species, especially those threatened as stated in Annexes, and to protect their natural habitats

3.2. Implemented and suggested conservation measures

Conservation measures implemented until now are mostly connected with two types of activities. The first group of measures, i.e. activities, is based on politics - 56% of all implemented measures. These measures are look on broad sense, and contain legal protection of taxa since now, quotation of taxa in some international conventions or conservation programme, even planed but not realised activities (i.e. planed manufacture and performance of action plan of conservation of respective taxa and/or habitats according to the NSAP). Thus dominant group of implemented measures should be taken as relative index, because lot of these measures are not follow by concrete results or actions.

The second group of implemented measures - 43%, are measures connected with conservation of habitats and localities primarily inside already protected area. Namely, if some taxon have at least part of distribution inside some of protected area, regalement protection accordintg to the internal

bylaws. Protected area are not taken in full spectrum, already only those which are steering by Public institution, i.e. national parks and parks of nature. In explanation, these categories of protected area, have opportunity to performs a flora and fauna conservation on its area (renger service, expert service, warnings, other surveillance, etc.). High percent of such measures, nevertheless, could give a somewhat falseness picture about current level of conservation because, parks often have not well developd park sevicees (Tab. 18, Fig. 9).

Table 18. Implemented and suggested conservation measures (IUCN SSC, Conservation Measures Authority File, 1st level)

Activity	No.	Implemented %	Suggested %
Activities based on politics	1	183 56	115 15
Communication and education	2	1 0	4 1
Investigative activities	3	3 1	474 62
Activities connected with habitas and localities	4	140 43	167 22
Activities on taxa	5	1 0	3 0
Other	6	0 0	0 0
Total		328 100	763 100

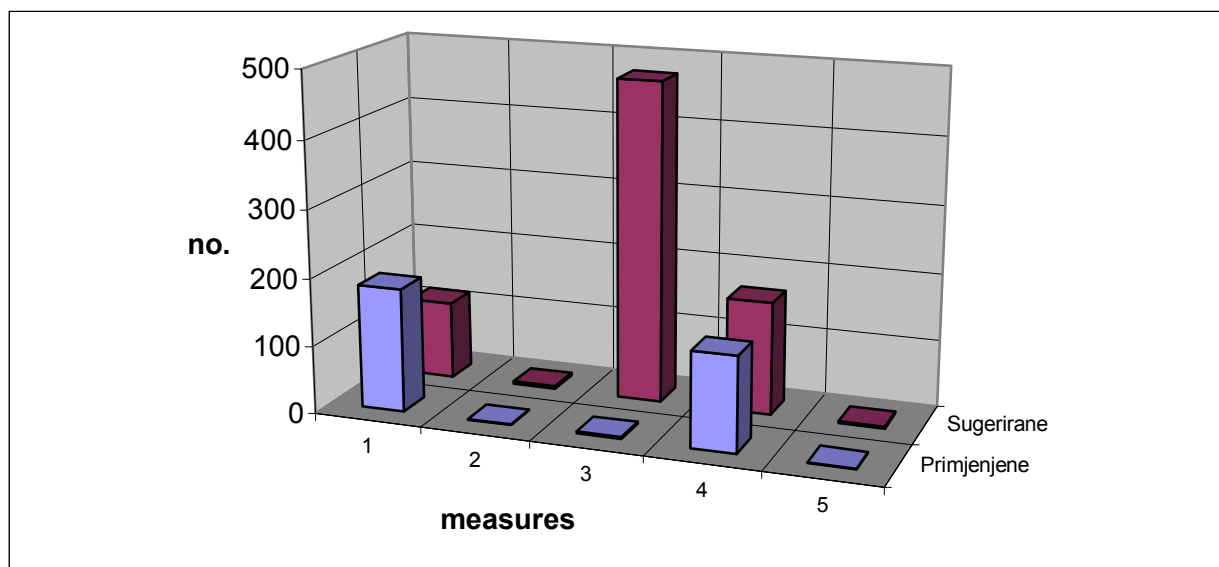


Figure 9. Implemented and suggested conservation measures (IUCN SSC, Conservation Measures Authority File, 1st level)

Amongst suggested measures even 62% does the proposition of investigation. Even 219 times the investigation of population and taxa distribution are suggested, and 198 times investigation of habitat condition (hence 88% of all suggested investigation activities). These measures are obviously highly correlated with incompleteness of filed data and current distribution maps. Suggested measures purport unquestionably on poverty of floristic mapping projects as a priority ones.

Relatively important component of suggested measures does the activities based on politics (15%), mostly suggested for taxa confront with very high risk of extinction (CR).

3.3. Other relevant issues

Designation of responsible management, scientific and enforcement authorities are the most visible in National Environmental Data Gathering Capacity report builded in 2001 by Ministry of Environmental Protection and Physical Planning (Tab. 19).

Table 19. Basic information about EEA bio-indicators; assessment yes - ☺, no - ☹, when data necessary to calculate indicator or similar situation exists - ☹. For DPSIR meaning – see text after table

Indicator	DPSIR	Assesment	Responsible institution as a data source
1 Protected area loss, damage and fragmentation	pressure	☹	-
2 Wetland loss through drainage	pressure	☺	Croatian Bureau of Statistics
3 Agricultural intensity: area used for intensive arable agriculture	state	☺	Croatian Bureau of Statistics
4 Fragmentation of forests and landscapes by roads/intersections	pressure	☹	Croatian Forests, MEPPP – Physical Planning Department, + State Geodetic Administration
5 Clearance of natural and semi natural forested area	pressure	☹	Croatian Bureau of Statistics, Croatian Forest
6 Change in traditional land-use practice	pressure	☹	-
7 Loss of genetic resources	pressure	☹	-
8 Pesticide use on land	pressure	☺	Croatian Forests
9 Loss of forest diversity – increase in exotic mono culture	pressure	☺	Croatian Forests, Croatian Bureau of Statistics
10 Riverbank loss through artificialisation	pressure	☺	Croatian Bureau of Statistics
11 Threatened plants population/distribution declines	impact	☺	Faculty of Science, Department of Botany, Faculty of Science, University of Zagreb
12 Threatened animals population/distribution declines	impact	☺	-
13 Plant species diversity and richness	impact	☺	Faculty of Science, Department of Botany, Faculty of Science, University of Zagreb
14 Animal species diversity and richness	impact	☺	-
15 Plant endemic species diversity and richness	impact	☺	Faculty of Science, Department of Botany, Faculty of Science, University of Zagreb
16 Animal endemic species diversity and richness	impact	☺	-
17 Habitat diversity/distribution declines	impact	☹	MEPPP
18 Designated area under the Ramsar convention	response	☺	MEPPP
19 Land cover in and around Ramsar area	pressure	☺	-
20 Proximity of transport infrastructure to Ramsar area	pressure	☺	MEPPP - Physical Planning Department, + State Geodetic Administration (?)
21 Wintering water birds	state	☺	Croatian Academy for Science and Art, Department of Ornithology
22 Pressures on grasslands	pressure	☹	-
23 Change in area and use of grassland	driving forces	☹	-
24 Species in dry grassland	state	☺	-
25 Protection of grassland	response	☺	MEPPP

According to European Environmental Agency typology of indicators DPSIR framework contain:

- Driving Forces – (**D**): the basic mover mechanisms of negative influence (i.e. the agricultures, the industries, the forestry, the transportation, the energetics, water use and management, industrial and tourism development and infrastructure, etc.)
- Pressures – (**P**): the consequences of driving forces mechanisms (i.e. enlargement of the concentrations of fertilizer in the soil, the development and townification, the building of communications, etc.)

- State – (**S**) (i.e. the deterioration of quality of air, the soils and water, damaging the ozon layer, the negative changes in the habitats, etc.)
- Impact – (**I**) (i.e. qualitative and quantitative changes in species composition in the fresh waters, the eutrofication of coastal areas, the fragmentation, the loss of biodiversitz, the decrease of forest areas, the changes of the taxa distribution, etc.)
- Response – (**R**) (the conventions, the acts, the physical activities on the prevention of impact of pressures, etc.)

3.4. National capacity on implementig IPA

The assessment of potential sites was made on existing data and the point about many of the data being very old was forcefully made. It is clear that the major fieldwork is needed to verify the data records and to assess potential sites more thoroughly. Do the national capacity for botanical exploration premit such activities?

The biggest group of proffesional botanists in the country are centralised in Department of Botany, Faculty of Science, University of Zagreb (<http://public.srce.hr/botanic/biologija/biology/boteng11.htm>). Smaller groups, offen specialised on applicative botany are located on Faculty for Forestry and Faculty for Agronomy. Particular persons, weel educated, are dispersed overall country. Almost all experts in country, substantive on parent company, are members of newly established Croatian Botanical Society (<http://hirc.botanic.hr/HBoD/HBoD-home.htm>). The number of weel educated amateurs are very low.

The expected problems in IPA establishment, i.e. major fieldwork could be:

1. relatively low number of experts
2. insufficiency of funds
3. time consuming processes (related to above)

The possible solutions could be:

1. to accumulate and use the new data collected inside other programs of inventory in area (i.e. Kars Ecosystem Conservation Project, inventory of flora in four national parks, largest park of nature and several other priority area)
2. to map distribution of selected target species
3. to use personal observation data of the most lettered botanist
4. to begin with flora mapping in area selected in draft IPA document
5. to organise international group of botanists from adjacent coutries
6. to begin with complete national flora mapping despite endurance
7. etc. (to be disscused in, for example, Croatian Botanical Society workshop)

Capabilities on methodology, data procesing (i.e. databases), data analysing (i.e. GIS), collection etc. are well developed in Croatia, and does not impersonate hardness.

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5. Annexes

5.1. Taxa list for Criteria A(i), A(ii), A(iii), A(iv) and B completed with information about taxa bondage with EUNIS habitat Level 2 and CORINE habitat Level 2.

See attachment (xls file)!

5.2. Priority threatened habitats for Criteria C(i) and C(ii)

Priority threatened habitats present in Croatia listed as priority on Annex I of the Habitats Directive (and any corresponding habitat from the Bern Convention Res. 4) requested for SSM Criteria C(i) (red letters) **and** threatened habitats present in Croatia listed on Annex I of the Habitats Directive and the Bern Convention Resolution 4, **not covered by C(i)** (those habitats with additional explanation and red letters), i.e. C(ii). Nomenclature according to Palearctic habitat classification. Beside each threatened habitat is geogeographic regions abbreviations: **A**-alpine, **C**-contintal, **M**-mediterranean and **P**-pannonical) according to the biogeographic map developed under Council Directive 92/43/CEE (NATURA 2000) formed on the basis for Pan-European extensions.

1. COASTAL AND HALOPHYTIC COMMUNITIES

11. OCEAN AND SEAS, MARINE COMMUNITIES

11.2 Benthic communities

- ! 11.22 Sublittoral soft seabeds
- ! 11.24 Sublittoral rocky seabeds and kelp forests
- ! 11.25 Sublittoral organogenic concretions
- ! 11.26 Sublittoral cave communities
- ! 11.27 Soft sediment littoral communities

! 11.3 Sea-grass meadows

11.4 Brackish sea vascular vegetation

- ! 11.42 Marine spike-rush beds

12. SEA INLETS AND COASTAL FEATURES

! 12.7 Sea-caves

13. ESTUARIES AND TIDAL RIVERS

! 13.2 Estuaries (M)

! 14. MUD FLATS AND SAND FLATS

15. SALTMARSHES, SALT STEPPES, SALT SCRUBS, SALT FORESTS

15.1 Annual salt pioneer swards

- ! 15.1132 Venetian glasswort swards (M)
- ! 15.114 Iberian glasswort swards
- ! 15.115 Continental glasswort swards
- ! 15.13 Sea-pearlwort communities
- ! 15.14 Central Eurasian crypsoid communities

15.3 Boreo-nemoral coastal salt meadows

- ! 15.32 Atlantic lower schorre communities
- ! 15.33 Atlantic upper schorre communities
- ! 15.34 Atlantic brackish saltmarsh communities

! 15.4 Suboceanic inland salt meadows

! 15.5 Mediterranean salt meadows (M)

! 15.6 Mediterraneo-Nemoral saltmarsh scrubs (M)

! 15.7 Mediterraneo-Canarian xero-halophile scrubs

! 15.8 Mediterranean salt steppes (M)

! 15.9 Mediterranean gypsum scrubs

- ! 15.A** **Continental salt steppes and saltmarshes** **(M)**
- 16.** **COASTAL SAND DUNES AND SAND BEACHES**
- ! 16.2** **Dunes** **(M)**
- ! 16.3** **Humid dune-slacks**
- 17.** **SHINGLE BEACHES**
- ! 17.3** **Sea kale communities** **(M)**
- 1A.** **COASTAL AGROSYSTEMS**
- ! 1A.1** **Machair**
- 2.** **NON-MARINE WATERS**
- ! 21.** **COASTAL LAGOONS** **(M)**
- 22.** **STANDING FRESH WATER**
- 22.1** **Permanent ponds and lakes** **(M)**
! 22.11 Lime-deficient oligotrophic waterbodies
- 22.3** **Amphibious communities**
- ! 22.31** **Euro-Siberian perennial amphibious communities** **(CP)**
22.32 Euro-Siberian dwarf annual amphibious swards
- ! 22.321** **Dwarf spike-rush communities** **(CP)**
! 22.322 Dune-slack centaury swards
22.323 Dwarf toad-rush communities
! 22.3232 Small galingale swards
! 22.3233 Wet ground dwarf herb communities
22.34 Mediterraneo-Atlantic amphibious communities
- ! 22.341** **Short Mediterranean amphibious swards** **(M)**
! 22.342 Tall Mediterranean amphibious swards
! 22.344 *Serapias* grasslands
22.35 Central Eurasian amphibious communities
! 22.351 Pannonic riverbank dwarf sedge communities
- 22.4** **Euhydrophyte communities**
- 22.41 Free-floating vegetation
- ! 22.412** **Frogbit rafts** **(CP)**
! 22.413 **Water-soldier rafts** **(CP)**
! 22.414 **Bladderwort colonies** **(CP)**
! 22.415 **Salvinia covers** **(CP)**
! 22.416 Aldrovanda communities
- 22.43 Rooted floating vegetation
22.431 Floating broad-leaved carpets
! 22.4316 Sacred lotus beds
22.432 Shallow-water floating communities
- ! 22.4321** **Water crowfoot communities** **(CP)**
! 22.4323 **Water violet beds** **(CP)**
! 22.44 **Chandalier algae submerged carpets** **(C)**
- ! 22.5** **Turlough and lake-bottom meadows**
- 23.** **STANDING BRACKISH AND SALT WATER**
- ! 23.1** **Athalassal saline lakes**
- ! 23.3** **Salt lake islands**
- 24.** **RUNNING WATER**

! 24.2 River gravel banks (MC)**! 24.422 Tufa stream vegetation (MC)**

Euhydropyte moss and algae communities of Palearctic streams poor in nutrients but rich in lime, forming infra-aquatic tufa deposits.

This type of vegetation is important for some karstic rivers (Krka National Park) including continental and mediterranean part of flow with specific habitats. The habitat is endangered by hydroaccumulation bodies and dams causing the change in water regime, as well as by eutrofication.

! 24.423 Tufa cascade vegetation (MC)

Euhydropyte moss and algae communities of streams poor in nutrients but rich in lime, forming large, structuring, tufa deposits, with a complex arrangement of subcommunities, characteristic, in particular, of the karst region of the eastern Adriatic. Unique cascades on Krka river, Korana river and National park of Plitvice are endangered by hydroaccumulation bodies and dams, or by eutrofication, causing the overgrowing of cascades by bushes and trees and breaking them down.

3. SCRUB AND GRASSLAND**31. TEMPERATE HEATH AND SCRUB****! 31.1 European wet heaths****! 31.2 European dry heaths (C)****! 31.3 Macaronesian heaths****31.4 Alpine and boreal heaths**

31.42 Alpenrose heaths

! 31.424 Carpathian Kotschy's alpenrose heaths

! 31.425 Balkan Kotschy's alpenrose heaths

! 31.46 *Bruckenthalia* heaths**! 31.7 Hedgehog-heaths****31.8 Western Eurasian thickets**

31.8B South-eastern deciduous thickets

! 31.8B1 Pannonic and sub-Pannonic thickets

32. SCLEROPHYLLOUS SCRUB**32.2 Thermo-Mediterranean shrub formations**

! 32.22 Tree-spurge formations

! 32.24 Palmetto brush

! 32.25 Mediterranean pre-desert scrub

! 32.26 Thermo-Mediterranean broom fields (*retamares*)

! 32.2B Cabo de Sao Vicente brushes

! 32.B Illyrian garrigues (M)

Shrubby formations, often low, of the meso- and occasionally supra-Mediterranean zones of the Adriatic coast and islands, composed of sclerophyllous heliophytes, such as *Rosmarinus officinalis*, *Erica arborea*, *Erica manipuliflora*, *Cistus incanus*, *Cistus monspeliensis*, *Cistus salviifolius*, *Pistacia lentiscus*, with a number of geophytes such as mediterranean orchids, *Crocus* ssp., *Romulea bulbocodium*, *Colchicum* ssp. These habitats (communities *Erico-Rosmarinetum*, *Erico-Cistetum cretici*, *Cisto-Ericetum arboreae*) are endangered by abandoning traditional agriculture (extensive sheep grazing), firing and cutting off, reforestation with *Pinus halepensis* and vegetation succession toward the mediterranean forests. Such areas represents not only the biological diversity (several times more plant species than climat zonal forest), but also the landsape peculiarity of Adriatic coast.

- ! 33. PHRYGANA**
- 34. STEPPES AND DRY CALCAREOUS GRASSLANDS**
- 34.1 Middle European pioneer swards**
- 34.11 Middle European rock debris swards
- ! 34.112 Houseleek communities
- ! 34.2 Lowland heavy metal grasslands**
- ! 34.3 Dense perennial grasslands and middle European steppes (C)**
- ! 34.5 Mediterranean xeric grasslands (M)**
- ! 34.9 Continental steppes**
- ! 34.A Sand steppes**

- 35. DRY SILICEOUS GRASSLANDS**
- 35.1 Atlantic mat-grass swards and related communities**
- ! 35.11 Mat-grass swards (C)
- ! 35.7 **Mediterraneo-montane mat-grass swards (M)**
- 37. HUMID GRASSLAND AND TALL HERB COMMUNITIES**
- 37.1 Lowland tall herb communities**
! 37.13 Continental tall herb communities
! 37.14 Eastern nemoral tall herb communities
- ! 37.2 **Eutrophic humid grasslands (CP)**
- ! 37.3 **Oligotrophic humid grasslands (C)**
- ! 37.4 **Mediterranean tall humid grasslands**
- 37.7 Humid tall herb fringes**
37.71 Watercourse veils
! 37.711 *Angelica archangelica* fluvial communities
! 37.712 *Angelica heterocarpa* fluvial communities
! 37.713 Marsh mallow screens
- 38. MESOPHILE GRASSLANDS**
- 38.2 Lowland high meadows**
38.23
! 38.237 **Illyrian submontane hay meadows (C)**
- Submontane mesophile hay meadows of the beech level of the Dinarides, within the range of the Fagion illyricum, dominated by *Trisetum flavescens*, with *Poa pratensis*, *Arrhenatherum elatius*, *Festuca pratensis*, *Achemilla xanthochlora*. The meadows of *Alchemillo-Trisetum* are endangered by both the abandoning of mowing and excessive manuring, the latter causing the development of *Arrhenatherum*, much poorer community in plant species.
- ! 38.25 **Continental meadows (C)**
- 4. FORESTS**
- 41. BROAD-LEAVED DECIDUOUS FORESTS**
- ! 41.1 **Beech forests (C)**
- ! 41.2 **Oak-hornbeam forests (CP)**
- ! 41.4 **Mixed ravine and slope forests (C)**
- ! 41.5 **Acidophilous oak forests (C)**
- ! 41.6 ***Quercus pyrenaica* forests**
- ! 41.7 **Thermophilous and supra-Mediterranean oak woods (MC)**
- ! 41.8 **Mixed thermophilous forests (MC)**
- ! 41.H **Euxino-Hyrcanian mixed deciduous forests**
- 42. TEMPERATE CONIFEROUS FORESTS**
- 42.1 Western Palaearctic fir forests**
! 42.124 **Dinaric calcareous block fir forests (C)**

Abies alba-dominated forests of calcareous block slopes of the Dinarides, in Croatia mostly in Gorski kotar (western Croatia). They include primaeval and near natural forests of considerable biological and aesthetic value. In addition to *Abies alba*, there grow *Juniperus nana*, *Calamagrostis varia*, *Rosa pendulina*, *Clematis alpina*, *Ribes petraeum*, *Cirsium erisithales*, mosses and ferns. Being there on the verge of its ecological possibilities, *Abies alba* is very sensitive to climate changes and air pollution.

! 42.1322 Illyrian acidophile fir forests (C)

Acidophile fir forest of the montane and submontane levels of the Dinarides, developed in stations edaphically or microclimatically unfavourable to beech, dominated by *Abies alba* with a varying admixture of *Picea abies* and *Fagus sylvatica*, with a mixture of illyrian (*Fagion illyricum*) and boreal (*Piceion*) species, unusually rich in ferns and mosses.

Rare habitat in Dinarides with relatively small area of acidophilous forest (*Blechno-Abietetum*) is, due to high quality of *Abies alba* trunks (height to 30m), potentially endangered by excessive cutting.

! 42.15 Southern Apennine silver fir forests

! 42.16 Southern Balkan silver fir forests

! 42.17 Balkano-Pontic fir forests

! 42.19 Afro-Asian fir forests

42.2 Western Palaearctic orogenous spruce forests

! 42.21 Alpine and Carpathian sub-alpine spruce forests

! 42.22 Inner range montane spruce forests

! 42.23 Hercynian subalpine spruce forests

42.24 Sub-Mediterranean Norway spruce forests

! 42.241 Rhodope spruce forest

! 42.243 Montenegrine spruce forest

! 42.244 Paenonian spruce forest

! 42.245 Balkan Range spruce forest

42.25

! 42.255 Dinaric spruce forests (C)

Spruce forests of the subalpine, montane or submontane levels of the Dinarides, dominated by *Picea abies* on calcareous block slopes, karst-dolines and dolomite rendzina containing both illyrian and boreal plants, acidophilous as well as calciphilous ones. These forests are mostly virgin forests or near-natural forests of biological and landscape value. The only thread is the use of spruce wood, which is of excellent hardness quality, due to very slow growth.

! 42.27 Omorika spruce forests

! 42.28 Oriental spruce forests

42.3 Alpine larch-arolla forests

! 42.31 Eastern Alpine siliceous larch and arolla forests

! 42.32 Eastern Alpine calcicolous larch and arolla forests

! 42.35 Carpathian larch and arolla forests

! 42.36 *Larix polonica* forests

42.4 Mountain pine forests

! 42.41 Rusty alpenrose mountain pine forests

! 42.42 Xerocline mountain pine forests

42.5 Western Palaearctic Scots pine forests

! 42.51 Caledonian forest

42.52 Middle European Scots pine forests

42.523 Western Eurasian steppe pine forest

! 42.5232 Sarmatic steppe pine forest

! 42.5233 Carpathian steppe pine forests

! 42.5234 Pannonic Scots pine steppe woods

42.54 Spring heath Scots pine forests

! 42.542 Carpathian relict calcicolous Scots pine forest

! 42.5C South-eastern European Scots pine forests (C)

- ! 42.5F Ponto-Caucasian Scots pine forests
- 42.6 Black pine forests**
- ! 42.61 Alpino-Apennine *Pinus nigra* forests
- ! 42.62 **Western Balkan *Pinus nigra* forests (MC)**
- ! 42.63 Salzmann's pine forests
- ! 42.64 Corsican laricio pine forests
- ! 42.65 Calabrian laricio pine forests
- ! 42.66 Banat and Pallas' pine forests
- ! 42.7 High oro-mediterranean pine forests**
- 42.8 Mediterranean pine woods**
- 42.81 Maritime pine forests
- ! 42.811 Charente pine-holm oak forests
- ! 42.812 Aquitanian pine-cork oak forests
- ! 42.814 Iberian maritime pine forests
- ! 42.82 Mesogean pine forests
- ! 42.83 **Stone pine forests (M)**
- 42.84 Aleppo pine forests
- ! 42.841 Iberian Aleppo pine forests
- ! 42.842 Balearic Aleppo pine forests
- ! 42.843 Provenço-Ligurian Aleppo pine forests
- ! 42.844 Corsican Aleppo pine woods
- ! 42.845 Sardinian Aleppo pine woods
- ! 42.846 Sicilian Aleppo pine woods
- 42.847 Italic Aleppo pine forests
- ! 42.8471 Gargano Aleppo pine forests
- ! 42.8472 Metapontine Aleppo pine forests
- ! 42.8473 Umbrian Aleppo pine forests
- ! 42.848 Hellenic Aleppo pine forests
- ! 42.849 Illyrian Aleppo pine forests
- ! 42.84A East Mediterranean Aleppo pine forests
- ! 42.85 Aegean pine forests
- ! 42.9 Canary Island pine forests**
- ! 42.A Western Palaearctic cypress, juniper and yew forests (CM)**
- ! 42.B Western Palaearctic cedar forests**
- 44. TEMPERATE RIVERINE AND SWAMP FORESTS AND BRUSH**
- ! 44.1 Riparian willow formations (CP)**
- ! 44.2 Boreo-alpine riparian galleries (C)**
- ! 44.3 Middle European stream ash-alder woods (C)**
- 44.4 Mixed oak-elm-ash forests of great rivers**
- ! 44.41 Great medio-European fluvial forests
- ! 44.43 **South-east European ash-oak-alder forests (C)**
- ! 44.44 Po oak-ash-alder forests
- ! 44.5 Southern alder and birch galleries**
- 44.6 Mediterraneo-Turanian riverine forests**
- ! 44.66 Ponto-Sarmatic mixed poplar riverine forest
- ! 44.69 Irano-Anatolian mixed riverine forests
- ! 44.7 Oriental plane and sweet gum woods**
- ! 44.8 Southern riparian galleries and thickets**
- 44.9 Alder, willow, oak, aspen swamp woods**
- 44.91 Adler swamp woods
- 44.911 Meso-eutrophic swamp alder woods
- ! 44.9115 Eastern Carpathian alder swamp woods

- ! 44.914 Steppe swamp alder woods
- ! 44.A Birch and conifer mire woods (C)**
- ! 44.B Euxino-Hyrcanian wet ground forests**
- ! 45. TEMPERATE BROAD-LEAVED EVERGREEN FORESTS(M)**
- 5. BOGS AND MARSHES**
- 51. RAISED BOGS**
- ! 51.1 Near-natural raised bogs**
- ! 52. BLANKET BOGS**
- 53. WATER-FRIDGE VEGETATION**
- ! 53.3 Fen-sedge beds (CM)**
- 54. FENS, TRANSITION MIRES AND SPRINGS**
- 54.1 Springs**
- ! 54.12 Hard water springs (MC)**
- ! 54.2 Rich fens (C)**
- ! 54.3 Arcto-alpine riverine swards**
- 54.4 Acidic fens**
- 54.42 Black-white-star sedge fens
- ! 54.426 Peri-Danubian black-white-star sedge fens
- ! 54.483 Illyrian sedge-beak-sedge fens (C)**
- Specific acidic fen community of the Illyrian region composed of *Carex nigra*, *Carex echinata*, *Carex flava*, *Eriophorum angustifolium* and *Rynchospora alba*. Being more spread in Croatia in past, now is progressively and rapidly decreasing its area and loosing the characteristic fen species. At the moment only fragments occur in Hrvatsko Zagorje and Banovina. They are endangered by anthropogeneous influence (manuring of surrounding area), changes in water regime, longterm climate changes, vegetation succession.
- ! 54.5 Transition mires**
- ! 54.6 White beak-sedge and mud bottom communities**
- ! 54.8 Aapa mires**
- ! 54.9 Palsa mires**
- ! 54.A Polygon mires**
- 6. INLAND ROCKS, SCREES AND SANDS**
- 61. SCREES**
- 61.3 Western Mediterranean and thermophilous screes**
- 61.31 Peri-Alpine thermophilous screes
- ! 61.313 Paris Basin screes
- ! 64. INLAND SAND DUNES (CP)**
- ! 65. CAVES (M)**
- 9. WOODED GRASSLANDS AND SCRUBS**
- 91. PARKLANDS**

- ! 91.2 Dehesa**
! 93. WOODED STEPPE

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To add!

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