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PHYTOCENOLOGICAL AND PHYTOGEOGRAPHICAL CHARACTERISTICS OF THE HOE WEED VEGETATION IN THE CONTINENTAL PART OF CROATIA

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In the period from 1976 to 1980 phytocenological investigations of the hoe weed vegetation were carried out in the continental region of Croatia.

The investigated hoe weed vegetation belongs to the class *Stellarietea mediae*, which unites the whole segetal weed vegetation and to the order *Chenopodietalia albi*, including the hoe weed vegetation. There are two alliances within this order: the alliance *Polygono-Chenopodion* with the associations *Panico-Galinsogetum, Panico-Mercurialietum annuae* and *Galeopsio-Sperguletum* and the alliance *Eragrostion* with the association *Hibisco-Eragrostietum*.

Introduction

Nowdays, parallelly with the increasing necessity for higher crop yields great attention is paid to the weed component of agrophytocenose. Because of the direct and indirect influence of weeds on cultivated plants eforts are made to destroy them by means of different mechanical and chemical methods. To do it the most effectively it is necessary to know the characteristics of weeds and weed vegetation.

This paper presents the results of investigations of the hoe weed vegetation in the continental part of Croatia.

Characteristics of the area

The hoe weed vegetation was investigated in the continental part of Croatia, from Gorski Kotar district in the west to the Danube river

in the East. On this large area exist different ecological conditions (climatic, edaphic, relief and biotic) which influence the variability of vegetation.

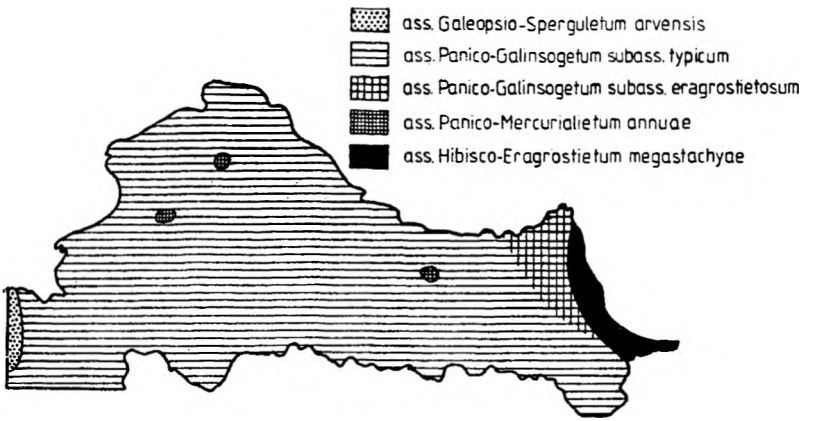

Fig. 1. Distribution of hoe weed communities in the continental part of Croatia

In the horizontal direction (South-North, East-West) as well as in the vertical relief division the differences in the temperature and precipitation are obvious. The climate humidity is shown in Table 1. The meteorological stations are located from West to East, so the increase in aridity in this direction is visible.

The soils of this area are also variable (Škorić 1977) owing to the distinct relief, climate and geological substrate. Nevertheless, considering the intensive mechanical treatment and manuring, the surface layer under the hoe cultures is rather uniform.

The most important factor influencing the formation and composition of the weed communities, the anthropogeneous factor, although present everywhere, is not the same. The influence is greater in the eastern, traditionally agricultural area, where mechanical and chemical treatments and manuring are more intensive.

Methods

The weed vegetation was investigated in different hoe cultures such as maize, sugar beet, vine, sunflower, tobaco and potato.

The phytocenological investigations were made according to the phytocenological methods (Braun-Blanquet 1964) and nomenclature is listed after Ehrendorfer (1973).

About 500 vegetational records were made mostly in the summer aspect.

Table 1. Rain factors (monthly and yearly)* for the period 1948—1960.

Meteorological station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Zalesina	—	—	93,08	24,29	14,29	9,73	7,65	7,64	15,56	25,20	66,12	315,71	276,39
Ogulin	473,00	110,91	92,77	12,63	8,41	6,3	4,82	5,28	7,81	14,62	28,62	51,79	148,73
Topusko	—	79,00	12,31	8,02	5,89	5,59	4,45	3,32	5,51	10,00	19,83	39,62	103,37
Botinec	—	68,57	8,65	5,78	5,86	5,57	4,83	4,09	5,93	7,13	16,96	39,00	90,38
Varaždin	—	140,00	7,87	6,12	6,0	5,60	5,80	4,35	4,90	7,62	16,11	32,63	88,80
Karlovac	252,50	48,68	11,53	7,50	6,04	5,54	4,65	3,21	5,33	9,29	19,19	40,00	101,31
Bjelovar	—	65,00	6,04	5,09	5,10	5,65	4,53	3,47	4,29	6,06	15,27	32,50	78,93
Virovitica	—	114,00	7,71	5,00	6,30	5,55	3,67	2,87	3,59	6,60	15,28	30,43	80,80
Slavonska Požega	—	72,50	7,41	4,91	5,29	5,48	2,36	3,45	3,00	6,48	11,45	34,29	74,33
Slavonski Brod	480,00	58,00	7,14	5,18	4,78	5,88	3,30	3,03	2,69	5,71	12,50	32,50	71,64
Spačva	490,00	30,59	8,30	5,82	5,99	5,03	3,19	2,94	3,23	6,27	12,68	33,81	74,52
Osijek	—	25,00	7,70	5,13	3,24	4,66	3,83	3,39	3,14	4,16	9,35	142,22	65,84
Ilok	51,11	30,59	7,12	6,17	4,34	4,57	3,87	3,02	2,64	4,19	10,43	19,71	65,30
Brestovac »Belje«	17,91	15,21	8,23	5,22	3,62	4,32	3,60	2,96	2,83	4,28	8,36	16,12	58,19
Rimski Šančevi	—	6,30	7,00	4,10	3,50	4,10	3,00	2,20	2,10	3,00	8,40	48,40	55,20
Palić	—	10,70	5,40	3,50	3,20	3,40	2,70	1,90	2,20	2,40	9,00	46,10	49,70

- - - arid + semiarid climate

* According to the climatological data of the Hydrometeorological Institute of the Socialist Republic of Croatia (Kirigin 1971)

Table 2. *ASS. PANICO-GALINSOGETUM*

	Degree of presence	
	subass. *typicum*	subass. *eragrostietosum*
Characteristic species of the association		
Galinosoga parviflora Cav.	V	V
Differential species of subassociation		
Cnenopodium hybridum L.	·	II
Eragrostis megastachya (Koel.) Lk.	I	I
Heliotropium europaeum L.	·	I
Eragrostis minor Host.	·	I
Reseda lutea L.	·	I
Amaranthus albus L.	·	I
Characteristic species of the alliance (*Polygono-Chenopodion*)		
Chenopodium polyspermum L.	IV	III
Oxalis fontana Bungei	III	I
Mentha arvensis L.	I	I
Stachys palustris L.	II	II
Polygonum lapathifolium L. subsp. *incanum* (F. W. Schmidt) Schübl et Mart.	I	I
Characteristic species of the order (*Chenopodietalia albi*)		
Chenopodium album L.	V	V
Echinochloa crus-galli (L.) PB.	V	V
Setaria glauca (L.) PB.	V	V
Polygonum persicaria L.	IV	III
Capsella bursa-pastoris (L.) Med.	III	II
Amaranthus retroflexus L.	III	IV
Lamium purpureum L.	III	II
Polygonum lapathifolium L.	III	III
Digitaria sanguinalis (L.) Scop.	III	III
Sonchus oleraceus L.	I	II
Euphorbia helioscopia L.	I	I
Setaria viridis (L.) PB.	I	II
Sonchus asper (L.) Hill.	I	I
Solanum nigrum L. emend Miller	I	I
Amaranthus lividus L.	I	·
Geranium molle L.	·	I
Setaria verticillata (L.) PB.	·	I
Senecio vulgaris L.	·	I
Lamium amplexicaule L.	·	I
Diplotaxis muralis (L.) DC.	·	I
Characteristic species of the class (*Stellarietea mediae*)		
Stellaria media (L.) Vill.	III	III
Veronica persica Poir.	II	I
Fallopia convolvulus (L.) A. Löve	III	II
Sonchus arvensis L.	I	II
Anagallis arvensis L.	I	I
Kickxia elatine (L.) Dum.	I	I
Conyza canadensis (L.) Cronq.	I	I

Sherardia arvensis L.	·	I
Centaurea cyanus L.	·	I
Anthemis arvensis L.	I	·
Companions		
Convolvulus arvensis L.	IV	IV
Ambrosia artemisiifolia L.	V	III
Cirsium arvense (L.) Scop.	IV	II
Equisetum arvense L.	III	II
Roripa sylvestris (L.) Bess.	III	I
Taraxacum officinale Web.	II	II
Agropyron repens (L.) PB.	II	I
Polygonum aviculare L.	II	I
Calystegia sepium L. R. Br.	I	I
Plantago major L.	II	I
Rubus caesius L.	I	III
Trifolium repens L.	I	I
Verbena officinalis L.	I	I
Potentilla reptans L.	I	I
Bidens tripartita L.	·	I
Mentha longifolia Huds. emend Harley	I	I
Portulaca oleracea L.	I	I
Ranunculus repens L.	·	I
Daucus carota L.	I	II
Glechoma hederacea L.	I	I
Achillea millefolium L.	I	I
Vicia sp.	I	I
Erigeron annuus (L.) Pers.	I	I
Ranunculus sardous Cr.	I	I
Medicago lupulina L.	I	I
Matricaria chamomilla L.	I	I
Gypsophilla muralis L.	I	I
Cynodon dactylon (L.) Pers.	I	I
Poa annua L.	I	I
Rumex crispus L.	·	I
Symphytum officinale L.	I	I
Lathyrus tuberosus L.	I	I
Pulicaria vulgaris Gartn.	I	I
Cichorium intybus L.	·	I
Panicum capillare L.	I	I
Artemisia vulgaris L.	I	I
Chondrilla juncea L.	I	I
Gnaphalium uliginosum L.	I	I
Myosotis arvensis (L.) Hill.	I	·
Prunella vulgaris L.	I	·
Lapsana communis L.	I	·
Lythrum salicaria L.	I	I
Trifolium pratense L.	·	I
Kochia scoparia (L.) Schrad.	·	I
Plantago lanceolata L.	I	·
Euphorbia esula L.	·	I
Coronilla varia L.	I	·
Carex hirta L.	·	I
Robinia pseudacacia L.	I	·
Scirpus sylvaticus L.	I	·
Potentilla anserina L.	I	·
Valeriana officinalis L.	·	I
Abutilon teophrasti Med.	·	I
Xanthium strumarium L.	·	I
Reseda lutea L.	·	I
Datura stramonium L.	·	I
Valerianella dentata (L.) Pollich.	I	·

Table 3. *ASS. PANICO-MERCURIALIETUM ANNUAE*

	Degree of presence
Characteristic species of the association	
Mercurialis annua L.	V
Characteristic species of the alliance (*Polygono-Chenopodion*)	
Chenopodium polyspermum L.	III
Galinsoga parviflora Cav.	III
Mentha arvensis L.	II
Stachys palustris L.	I
Characteristic species of the alliance (*Eragrostion*)	
Chenopodium hybridum L.	II
Hibiscus trionum L.	II
Characteristic species of the order (*Chenopodietalia albi*)	
Chenopodium album L.	V
Lamium purpureum L.	V
Amaranthus retroflexus L.	V
Setaria glauca (L.) PB.	IV
Euphorbia helioscopia L.	IV
Sonchus oleraceus L.	IV
Erodium cicutarium (L.) L. Hér.	III
Amaranthus lividus L.	II
Capsella bursa-pastoris (L.) Med.	III
Setaria viridis (L.) PB.	II
Fumaria officinalis L.	II
Diplotaxis muralis (L.) DC.	II
Solanum nigrum L. emend Miller	II
Senecio vulgaris L.	I
Polygonum persicaria L.	I
Echinochloa crus-galli (L.) PB.	I
Geranium molle L.	I
Atriplex patula L.	I
Characteristic species of the class (*Stellarietea mediae*)	
Veronica persica Poir.	V
Sinapis arvensis L.	V
Stellaria media (L.) Vill.	IV
Fallopia convolvulus (L.) A. Löve	IV
Stachys annua (L.) L.	IV
Sonchus arvensis L.	III
Anagallis arvensis L.	I
Cerinthe minor L.	I
Anagallis foemina Mill.	I
Companions	
Convolvulus arvensis L.	V
Cirsium arvense (L.) Scop.	V
Polygonum aviculare L.	V
Mentha longifolia Huds. emend Harley	IV
Calystegia sepium (L.) R. Br.	IV
Ambrosia artemisiifolia L.	IV

Taraxacum officinale Web.	III
Cynodon dactylon (L.) Pers	II
Brassica napus L.	II
Vicia sp.	II
Coronilla varia L.	II
Salvia verticillata L.	II
Agropyron repens (L.) PB.	II
Chondrilla juncea L.	I
Rumex sp.	I
Cichorium intybus L.	I
Achillea millefolium L.	I
Artemisia vulgaris L.	I
Lapsana communis L.	I
Potentilla reptans L.	I
Medicago lupulina L.	I
Lolium perenne L.	I
Lathyrus tuberosus L.	I
Ranunculus repens L.	I
Trifolium repens L.	I
Linaria vulgaris Hill.	I

Results

On the basis of phytocenological investigations of the hoe weed vegetation and analysis of the vegetational records the vegetation of the area investigated can be devided as follows:

Class: *Stellarietea mediae* (Br.-Bl. 1932) Tx., Lohm., Prsg. 1950

Order: *Chenopodietalia albi* Tx. et Lohm. 1950

Alliance: *Polygono-Chenopodion polyspermi* Koch 1926 emend Sissing 1946

Association: *Panico-Galinsogetum* Tx. et Becker 1942

Association: *Panico-Mercurialietum annuae* (Allorge 1922) Tx. 1950

Association: *Galeopsio-Sperguletum arvensis* Topić 1978

Alliance: *Eragrostion* Tx. 1950

Association: *Hibisco-Eragrostietum megastachyae* (Felföldy 1942) Tx. 1950

The association *Panico-Galinsogetum,* spread over Middle Europe (Oberdorfer 1957, Tüxen 1950) is the most widely spread and frequent association in Croatia (Fig. 1).

The floristical compound is shown in Table 2 according to 150 vegetational records.

In this area the association *Panico-Galinsogetum* could be subdivided into two subassociations: *Panico-Galinsogetum typicum* and *Panico-Galinsogetum eragrostietosum.* The differential species of the subassociation eragrostietosum are the thermophilous species of the alliance *Eragrostion.* The subassociation *typicum* is spread over the largest part of continental Croatia, while the subass. *eragrostietosum* is spread in the easternmost part of Slavonia and Baranja.

The association *Panico-Mercurialietum annuae* is distributed on the warm, south-exposed slopes within the area of *Panico-Galinsogetum* These areas are mostly covered by vineyards.

The floristic composition of the association is shown in Table 3, according to 11 vegetational records.

The association *Galeopsio-Sperguletum arvensis* is spread on the westernmost part of the area, in Gorski Kotar, mostly on potato fields.

The floristic composition is shown in Table 4 according to 14 vegetational records.

The association *Hibisco-Eragrostietum* is distributed on the warm habitats of southern and southeastern Europe (Topić 1978, Tüxen 1950), and in Yugoslavia only in the eastern part. In the investigated area this association is spread in the easternmost parts of Slavonia and Baranja.

The floristic composition is shown in Table 5 according to 36 vegetational records. Comparing the distribution of the weed vegetation mentioned and the characteristics of habitats one can conclude that the decisive factor for such phytogeographical distribution of the hoe weed vegetation in this area is the climate. The limiting factor for the failure of ass. *Hibisco-Eragrostietum* to spread westwards is lower temperature in the vegetational period, while the limiting factor for ass. *Panico-Galinsogetum* towards East is moisture, because this community exists within the area of the alliance *Eragrostion* only on wet habitats.

These investigations confirm the connection between zonal and weed vegetations. Generally, the distribution of ass. *Panico-Galinsogetum* corresponds to the distribution of zonal wood ass. *Querco-Carpinetum illyricum*, the ass. *Galeopsio-Sperguletum* with the zonal beech woods, and the distribution of ass. *Hibisco-Eragrostietum* with the distribution of the zone *Aceri tatarici-Quercion*. The area of *Panico-Mercurialietum annuae* corresponds to the extrazonal vegetation of the order *Quercetalia pubescentis*. The same regularity is obvious in relation with other types of vegetation, for example grassland (Ilijanić 1973, Ilijanić and Šegulja 1978) and ruderal (Marković 1979) vegetation.

Conclusions

Extended phytocenological investigations of the hoe weed vegetation in the continental part of Croatia allow the following conclusions:

1. The hoe weed vegetation belongs to the class *Stellarietea mediae* to the order *Chenopodietalia albi* and to the alliances *Polygono-Chenopodion* and *Eragrostion*.

2. The alliance *Polygono-Chenopodion* includes the associations *Panico-Galinsogetum* subass. *typicum*, and subass. *eragrostietosum*, ass. *Panico-Mercurialietum annuae* and ass. *Galeopsio-Sperguletum arvensis*. To the alliance *Eragrostion* in this area belongs the ass. *Hibisco-Eragrostietum*.

3. The largest area is coverd by the communities of the alliance *Polygono-Chenopodion*, while the alliance *Eragrostion* is spread only in the easternmost part. Such phytogeographical distribution is conditioned by climate differences between the western, humid, and the eastern, more arid area.

Table 4. *ASS. GALEOPSIO-SPERGULETUM ARVENSIS*

	Degree of presence
Characteristic species of the association	
Spergula arvensis L.	IV
Scleranthus annuus L.	IV
Characteristic species of the alliance (*Polygono-Chenopodion*)	
Galinsoga parviflora Cav.	III
Polygonum lapathifolium L. subsp. *incanum* (F. W. Schmidt) Schübl. et Mart.	I
Cerastium glomeratum Thuill.	I
Characteristic species of the order (*Chenopodietalia albi*)	
Chenopodium album L.	V
Capsella bursa-pastoris (L.) Med.	IV
Polygonum persicaria L.	IV
Lamium purpureum L.	III
Polygonum lapathifolium L.	III
Euphorbia helioscopia L.	I
Sonchus asper L.	I
Characteristic species of the class (*Stellarietea mediae*)	
Galeopsis tetrahit L.	V
Fallopia convolvulus (L.) A. Löve	V
Veronica persica Poir.	IV
Arenaria serpyllifolia L.	IV
Silene gallica L.	IV
Stellaria media (L.) Vill.	IV
Sinapis arvensis L.	IV
Anagallis arvensis L.	IV
Anthemis arvensis L.	III
Viola arvensis Murray	I
Companions	
Polygonum aviculare L.	IV
Cirsium arvense (L.) Scop.	IV
Ranunculus repens L.	III
Rumex acetosella L.	IV
Trifolium repens L.	III
Convolvulus arvensis L.	III
Veronica verna L.	I
Taraxacum officinale Web.	I
Vicia sp.	I
Plantago lanceolata L.	I
Holcus mollis L.	I

Table 5. *ASS. HIBISCO-ERAGROSTIETUM MEGASTACHYAE*

	Degree of presence
Characteristic species of the association	
Eragrostis megastachya (Koel.) Lk.	V
Hibiscus trionum L.	IV
Characteristic species of the alliance (*Eragrostion*)	
Heliotropium europaeum L.	III
Chenopodium hybridum L.	III
Portulaca oleracea L.	III
Amaranthus albus L.	II
Eragrostis minor Host.	II
Characteristic species of the order (*Chenopodietalia albi*)	
Chenopodium album L.	V
Amaranthus retroflexus L.	V
Setaria glauca (L.) PB.	IV
Digitaria sanguinalis (L.) Scop.	IV
Setaria viridis (L.) PB.	IV
Solanum nigrum L. emend Miller	IV
Echinochloa crus-galli (L.) PB.	IV
Sonchus oleraceus L.	II
Galinsoga parviflora Cav.	II
Capsella bursa-pastoris (L.) Med.	II
Setaria verticillata (L.) PB.	II
Diplotaxis muralis (L.) DC.	II
Sonchus asper (L.) Hill.	I
Polygonum lapathifolium L.	I
Euphorbia helioscopia L.	I
Chenopodium polyspermum L.	I
Polygonum persicaria L.	I
Lamium purpureum L.	I
Geranium molle L.	I
Senecio vulgaris L.	I
Lamium amplexicaule L.	I
Stachys palustris L.	I
Characteristic species of the class (*Stellarietea mediae*)	
Fallopia convolvulus (L.) A. Löve	IV
Stellaria media (L.) Vill.	IV
Veronica persica Poir.	III
Sonchus arvensis L.	II
Sinapis arvensis L.	II
Stachys annua (L.) L.	II
Anagallis arvensis L.	I
Kickxia elatine (L.) Dum.	I
Anthemis arvensis L.	I
Nonnea pulla (L.) DC.	I
Galium tricornutum Dandy	I

▶

Companions	
Convolvulus arvensis L.	V
Cirsium arvense (L.) Scop.	III
Lathyrus tuberosus L.	II
Taraxacum officinale Web.	II
Cynodon dactylon (L.) Pers.	II
Verbena officinalis L.	II
Rubus caesius L.	II
Ambrosia artemisiifolia L.	I
Polygonum aviculare L.	I
Chondrilla juncea L.	I
Mentha longifolia Huds. emend Harley	I
Datura stramonium L.	I
Reseda lutea L.	I
Ajuga chamaepitys (L.) Schreb.	I
Euphorbia esula L.	I
Daucus carota L.	I
Plantago major L.	I
Vicia sp.	I
Panicum capillare L.	I
Medicago lupulina L.	I
Euphorbia falcata L.	I
Robinia pseudacacia L.	I
Brassica napus L.	I
Artemisia vulgaris L.	I
Medicago sativa L.	I
Glechoma hederacea L.	I
Euphorbia peplus L.	I
Artemisia annua L.	I
Aristolochia clematitis L.	I
Agropyron repens (L.) PB.	I
Cichorium intybus L.	I
Silene alba (Mill.) E. H. L. Krause	I
Sambucus ebulus L.	I
Raphanus raphanistrum L.	I
Malva sylvestris L.	I
Calystegia sepium (L.) R. Br.	I
Rumex obtusifolius L.	I

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SAŽETAK

FITOCENOLOŠKE I FITOGEOGRAFSKE ZNAČAJKE VEGETACIJE OKOPAVINSKIH KOROVA U KONTINENTALNOM PODRUČJU HRVATSKE

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U razdoblju od 1976. do 1980. izvršena su fitocenološka istraživanja korovne vegetacije okopavina u kontinentalnom području Hrvatske s ciljem da se upozna fitocenološki i fitogeografski položaj te dotad relativno slabo istražene vegetacije u tom području.

Istraživanja pokazuju da korovna vegetacija okopavina pripada razredu *Stellarietea mediae*, redu *Chenopodietalia albi* te dvjema svezama, *Polygono-Chenopodion polyspermi* i *Eragrostion*. Sveza *Polygono-Chenopodion* rasprostranjena je na najvećem dijelu istraživanoga područja, a pripadaju joj asocijacije *Panico-Galinsogetum* (subas. *typicum* i subas. *eragrostietosum*), *Panico-Mercurialietum annuae* i *Galeopsio-Sperguletum arvensis*. Svezi *Eragrostion* pripada u istraživanom području samo asocijacija *Hibisco-Eragrostietum megastachyae*, koja je vezana za najistočniji dio Hrvatske.

Takva fitocenološka i fitogeografska raščlanjenost istraživane korovne vegetacije pokazuje značajnu pravilnost u odnosu na fitogeografsku raščlanjenost područja na temelju zonalne vegetacije Hrvatske, što je u najužoj vezi s klimatskim prilikama područja. Asocijacije *Panico-Galinsogetum* i *Panico-Mercurialietum* predstavljaju sastavni dio specifičnog vegetacijskog kompleksa zone *Carpinion betuli illyricum*, asocijacija *Galeopsio-Sperguletum* zone *Fagion illyricum*, a *Hibisco-Eragrostietum* sastavni je dio specifičnog vegetacijskog kompleksa šumostepske zone *Aceri tatarici-Quercion*.

To potvrđuje da i korovna vegetacija koja se razvija pod vrlo intenzivnim antropogenim utjecajima odražava općeklimatske prilike istraživanog područja.

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