



CROATIA



Climate and vegetation

Geographic position of Croatia- Central European-mediterranean country



Basic information about Croatia

The land area	56594 km ²
The territorial waters	31.067 km ²
Length of coast	1777 km
Number of islands, islets and reefs	1185
The highest point above the sea level	1831 m
Number of counties	21
Number of cities and municipalities	127 - 429
Population	4.290.612
Population on km ²	78,1
Number of inhabited islands	48
Language	Croatian
Script	Latin
Political system	Parliamentary democracy
GDP per capita in 2012	10203



Breaking up Croatia into Counties



Regions of Croatia

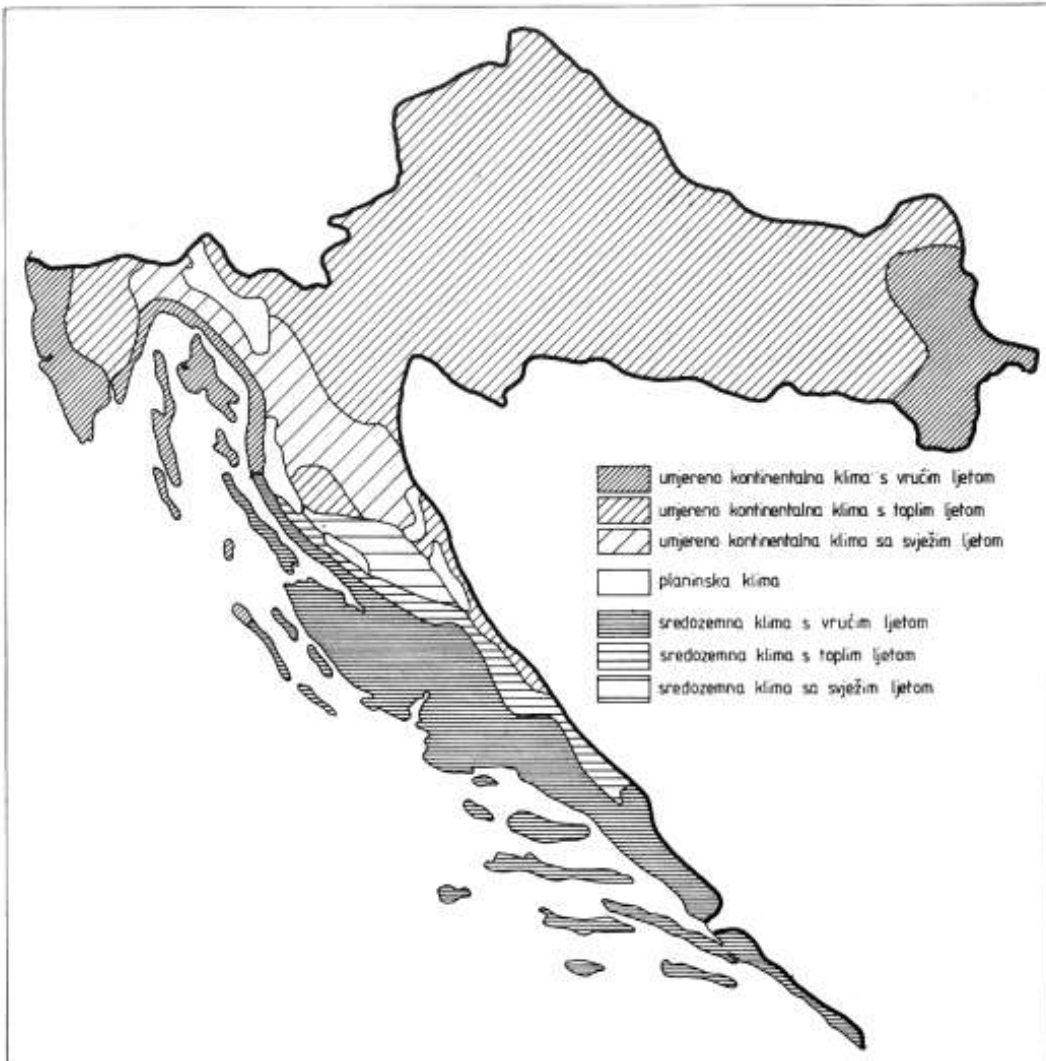
- | | |
|-----------------------------------|--|
| 1. Istria County | 10. Pozega and Slavonia County |
| 2. Rijeka County | 11. Virovitica and Podravina County |
| 3. Karlovac County | 12. Osijek and Baranja County |
| 4. Zagreb County | 13. Sisak and Moslavina County |
| 5. Krapina and Zagorje County | 14. Slavonski Brod and Posavina County |
| 6. Varazdin County | 15. Mukovar and Srijem County |
| 7. Medjmurje County | 16. Lika and Senj County |
| 8. Koprivnica and Krizevci County | 17. Zadar County |
| 9. Bjelovar and Bilogora County | 18. Sibenik and Knin County |
| | 19. Split and Dalmatia County |
| | 20. Dubrovnik and Neretva County |
| | 21. The City of Zagreb |

Natural-geographic areas of Croatia

- ▶ **Panonian-peripanonian region**(includes 55% of the territory and 66% of the population)
- ▶ **Mediterranean or Croatian coastal region**(includes 31% of the territory and 31% of the population)
- ▶ **Mountainous or Dinaric region** (includes 14% of the territory and 3% of the population)



Climate

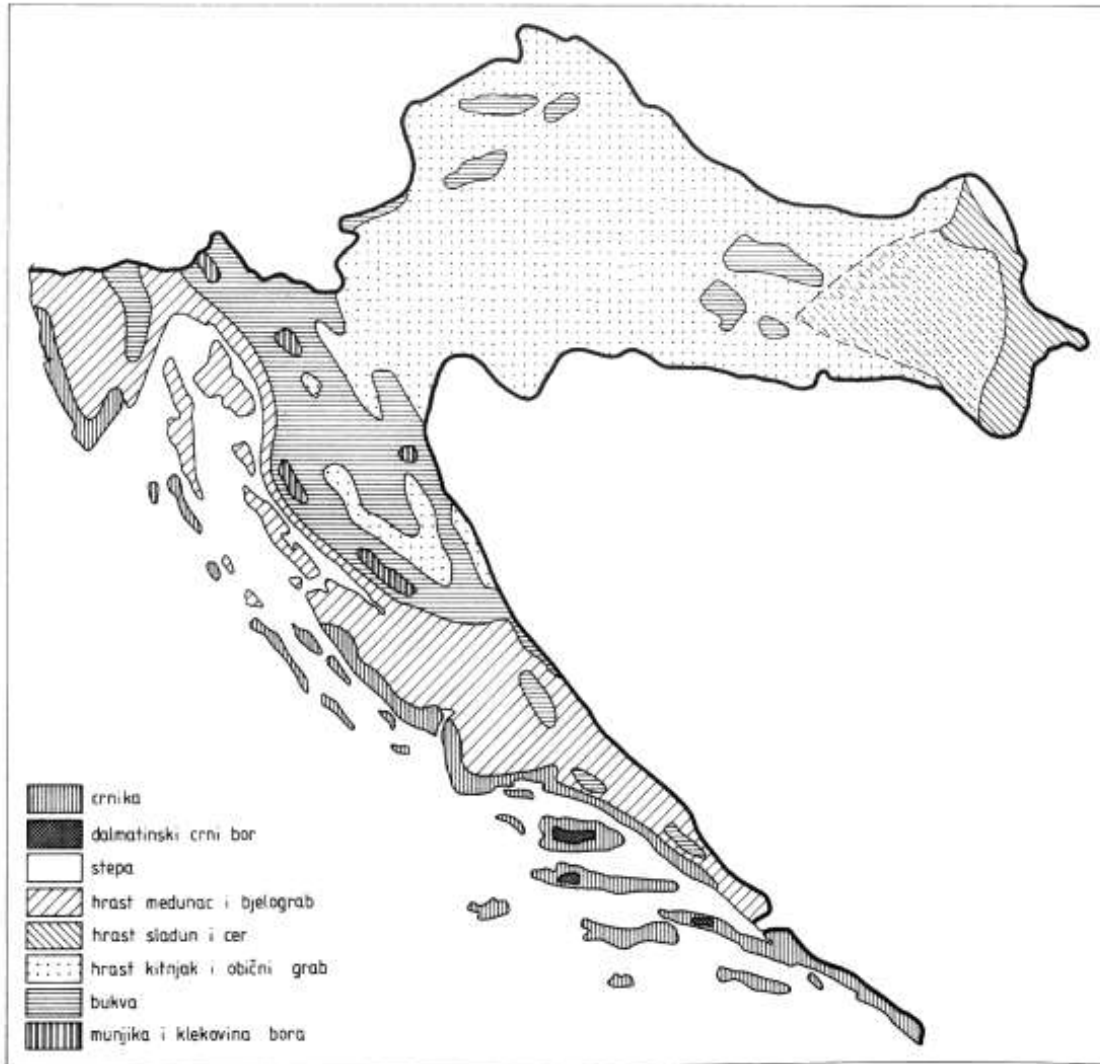


Climatic characteristics of Croatia

are a result of its location in the mid-latitude, the influence of the Mediterranean and Atlantic seas as well as the shape and relief (mountains along the coast and Panonian plain).

- moderate continental climate
- Mediterranean climate
- mountainous climate

Vegetation



Shka 8. Geografska raspodjela klimatogenih biljnih zajednica u Hrvatskoj (2)

FORESTS (climazonal vegetation)

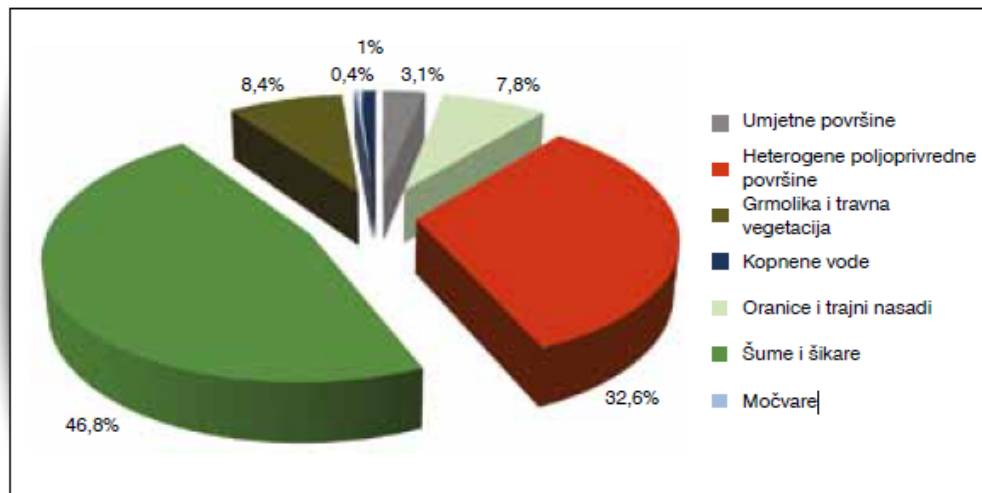
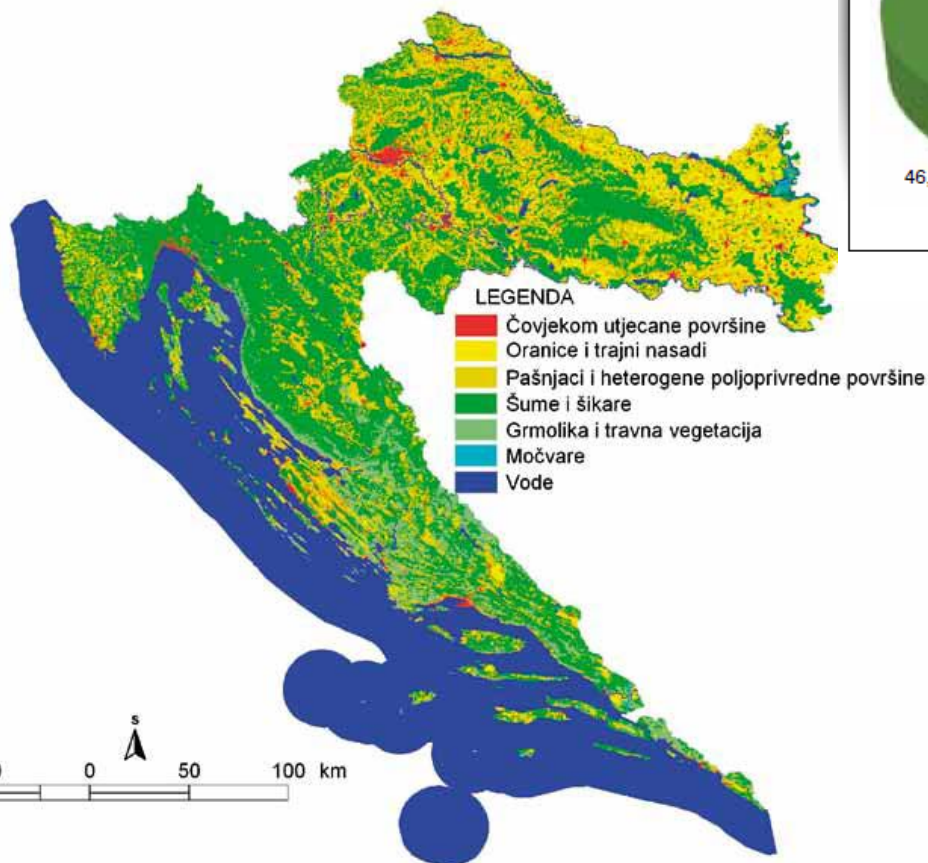
Mediterranean region covers approximately 40% of Croatia's surface, here we find 17 forest communities;

Eurosiberian-North American region covers about 60% of Croatia's surface, where there are 45 forest communities.

NON-FOREST VEGETATION

Created by human activity – lawns, meadows, pastures, underbrush

Spatial distribution of aggregate categories of land cover in the Republic of Croatia in 2006



Izvor: AZO

Vukovar-srijem County



**The most eastern part of Croatia-
Interfluves of rivers Sava i Danube,
part of Panonian plains**

Area: 2448 km²

Altitude: 78m-294m

Lowland plains

Population: 204.768

Administrative centre: Vukovar



Geological characteristics of VSC

- ▶ consists of real Panonian plains
- ▶ built mostly of tertiary and quaternary deposits, rich fertile black humus
 → the most important agricultural area (loess plains in Slavonia)
- ▶ alluvial plain formed by large Sava and Danube rivers and their tributaries
(Bosut, Biđ, Spačva, Studva, Vuka)



Climate of VSC

- **Moderately continental with cold winters and hot summers**
 - summers very hot, winters moderately cold, autumns mild and spring cool
 - average annual temperature is 11,4 °C, average annual maximum temperature is 16,5 °C, average annual minimal temperature is 6,2 °C. In the vegetation period (April until September) the average temperature is 17-18 °C
 - relatively low rainfall, with average yearly amount of 630-700 mm precipitation. The most precipitation is in the vegetation period (May, June) 50-55% of total amount, the least in September and October. Average annual relative humidity totals 75%.
 - annual average of 96 clear days, at most around 64 from April until September
 - number of snowy days during winter 21-23, number of days with wintery blankets of snow (protection of crops in low temperatures) yearly around 38 days
 - winds most often from the northwest (NW-30%) and southeast(SE-20%), also the northeast(NE-15%) and southwest(SW-14%), other winds rare
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Precipitation in mm, HMZ Gradište

godina/ mjesec	2002.	2003.	2004.	2005.	2006.	2007.	2008.	2009.	2010.	2011.	PROSIJEK PADALINA / 2002 – 2011 /
1.	9	45	77	32	28	57	32,5	59,9	74,9	36,8	45,2
2.	45	15	53	75	34	52	5,3	44,7	67,8	30,1	42,2
3.	22	2	26	47	70	87	61,4	45,2	50,3	25,3	43,6
4.	74	6	152	49	91	2	41,6	19,0	51,3	14,7	50,1
5.	92	25	125	44	39	128	47,1	24,6	98,8	47,8	67,2
6.	46	43	99	71	90	55	111,8	76,8	215,7	37,3	84,6
7.	44	43	48	134	18	33	62,7	35,7	71,1	84,1	58,7
8.	51	36	89	158	126	41	24,7	36,5	79,8	3,8	64,6
9.	69	42	46	48	11	84	76,4	1,9	84,0	16,2	47,9
10.	65	131	71	6	17	115	41,8	61,0	58,9	28,6	59,3
11.	63	48	104	19	24	98	54,5	57,1	66,1	4,5	53,8
12.	12	17	15	11	30	51	33,9	110,7	72,0	63,4	39,3
ukupno	589	453	905	694	578	803	593,7	573,1	991,3	392,6	657,3



Vegetation in VSC

- **Forests** take up 69.000 ha, that is **28% of the territory**, in the economic sense, the most valuable forest communities of oak forest with its associated species (ash, hornbeam and maple).
 - **Agricultural surface**, 150.000 ha or **62% of total area**
 - **Wetland sites, wet grasslands and pastures, and the loess cliffs** along the Danube River (25,000 ha or **about 10%** are untreated and built surfaces) barren land, but are the habitat of rare and endangered plant and animal communities
-



Agricultural production in VSC

- The soil, mild continental climate and favorable distribution of annual rainfall in this region provides quality agricultural production.
- **Agricultural areas in the County:**
 - 93,4 % arable land,
 - 3,0 % pastures,
 - 0,6 % meadows,
 - 1,3 % vineyards and
 - 1,6 % orchards.
- According to the representation in agricultural production, the main products are: corn, wheat, soybeans, sugar beets, sunflowers, barley, tobacco and vegetables.
- Cereal production occupies the most important place and up to 75% of the area while the remaining cultures such as oilseeds, sugar beet, roughage and others take up 25% of the area.
- Cropping areas are reclaimed and allow machining and high yields



Agricultural production in VSC

Surface of long-term orchards in the county

Badem	1,10	0,07
Breskva	91,41	5,66
Dunja	2,41	0,15
Jabuka	557,64	34,52
Jagoda	2,52	0,15
Kruška	43,97	2,72
Kupina	7,09	0,44
Lijeska	87,66	5,43
Malina	1,98	0,12
Marelica	36,05	2,23
Miješani nasad voćnih vrsta	22,80	1,41
Nektarine	11,52	0,71
Orah	102,73	6,36
Ostale voćne vrste	14,55	0,90
Ribiz	1,00	0,06
Šipak	0,05	0,01
Šljiva	319,94	19,80
Trešnja	7,13	0,44
Višnja	304,08	18,82
UKUPNO	1.615,63	100

Izvor: Agencija za plaćanja u poljoprivredi, ribarstvu i ruralnom razvoju

Agricultural production in VSC

Long-term vineyards in the county (ha)

Vrsta	Nasadi u punom rodu do 2007.god	Nasadi u podizanju (HZPSS)				Sveukupno
		2009.	2010.	2011.	Ukupno	
Vinova loza	1.462,74	150,00	25,00	39,00	214,00	1.676,74

Izvor: Agencija za plaćanja u poljoprivredi, ribarstvu i ruralnom razvoju i Hrvatska poljoprivredna komora-HZPSS

The area is dominated by wine variety Riesling - 60%, then traminer - 13% Franconia - 10%, Riesling - 8%, while other varieties: Chardonnay, Silvaner, Pinot Blanc, Pinot Noir, Cabernet sovignone, Merlot, Rizvanac, etc. are represented by a small percentage.

Forests in VSC

- **part of the Eurosiberian-northamerican region-**
lowest band of forest vegetation (80-150 m above sea level), the key ecological factor is water, whether floodwater (as is the case with willow and poplar forests), underground (with common oak forests), or both (with Caucasian ash and Black alder).
 - **Oak forest with gorse** *Genisto elatae-Quercetum roboris*
 - **Oak and hornbeam forest** *Carpino betuli-Quercetum roboris*
 - **Caucasian ash forest** *Leucoio-Fraxinetum* i *Pruno-Fraxinetum*
 - **Black alder forest** *Frangulo-Alnetum glutinosae*
 - **Willow and poplar forests** *Galio-Salicetum albae*
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Common oak forests

- **Oak forest with gorse** *Genisto elatae-Quercetum roboris* in areas with shorter flood periods or with high levels of underground water all year long
- **Oak and hornbeam forest** *Carpino betuli-Quercetum roboris* above the oak forests with gorse, out of reach from flood waters, on so-called beams, even though the ground is still under the influence of high underground waters it's saturated with water even in winter

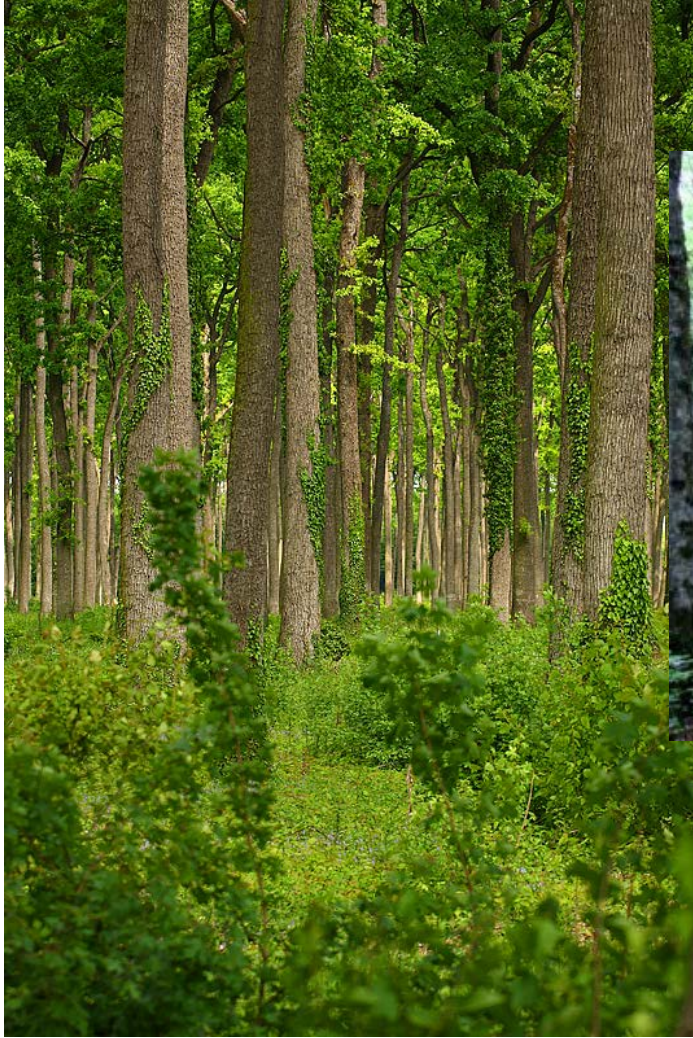


Oak forest, *Quercus robur* L.

- ▶ <http://www.youtube.com/watch?v=2S4F7pNkkDQ>



Oak forests



Oak forests

- **Oak has naturally afforested the Panonian Plain since 5000-2500 b.C. (Neolithic), at about 800 b.C. today's forest communities were shaped**
- **Up until 1702 forests were considered untouched jungles, after which more intensive exploitation begins, especially in the 19th century**
- **Slavonian oak forests**-the largest are south of Vinkovci in the Spačva and partly in the Bosut basin.
- ▶ **Spačva** – largest integrated complex of lowland forests of oak in Europe (Klepac 2000) surface of 40 000 ha



Spačva basin



Spačva basin

Habitat features:

- **high humidity**, which is very favorable for red oak as the Hygrophilous type, and underground water on an average depth of 1.5 m to 2.5 m, and surface streams, this area is named after the longest watercourse (Spačva river length 40 km).
- **average annual temperature is 10.2 ° C and 17.1 ° C in vegetation season**
- **average annual rainfall is 709 mm, while during the vegetation period it's 375 mm.** Precipitation is conveniently distributed throughout the year. In spring and autumn maximum rainfall occur.
- **soil**- mineral rich marshy soil with clay and clay-loam soils dominate.
- **altitude** is 77-90 m, with a particularly strong micro relief.

The main tree species in Spačva: Common oak, Caucasian ash, European white elm, Hornbeam and Common maple

The strongest and noblest species of trees in Slavonian forests are oak, so oaks are found in the Croatian national anthem, on the Croatian postage stamp and coin

Due to their excellent quality the Oak received the international feature **Slavonian oak**: the wood is fine, with equally thin and straight grains, golden yellow color, beautiful, durable and easy to handle. Our oak attracted the attention of Europe and the world. Foreign trading companies bought old oak groves in auctions in the 18th, 19th and early 20th century.



Ecological effect of oak forests

- ▶ **anti-erosion role-** soil conservation
- ▶ **hydrological role-** prevents marshification of the terrain and thus has a positive effect on the water in the soil. Oak trees evaporate around 42,500 litres of water per acre per day.
- ▶ **maintaining biological diversity-** a habitat of many plant and animal species- **birds**, primarily black stork (*Ciconia nigra*), tailed eagle (*Haliaeetus albicila*) and the spotted eagle (*Aquila pomarina*), as species with unfavorable status in Europe and threatened at the EU level, and nest in old, tall trees, as well as other species listed in Annex I of the Birds Directive (honey buzzard, *Pernis apivorus*; Grey Woodpecker, *Picus canus*, middle-spotted woodpecker, *Dendrocopos medius*; White-necked Flycatcher, *Ficedula albicollis*), mammals (fawn, deer, wild boar, wild rabbit, etc.)....
- ▶ **Climate regulator** – absorbs and filters the sun's radiation, decreases the difference between night and day temperatures, increases humidity, absorbs part of rainfall, upija dio padalina, transpires water into the atmosphere





Black Stork *Ciconia nigra*



Tailed Eagle
Heliaetus albicila



Spotted Eagle *Aquila pomarina*





CLIMATE CHANGES AND THE INFLUENCE ON VEGETATION

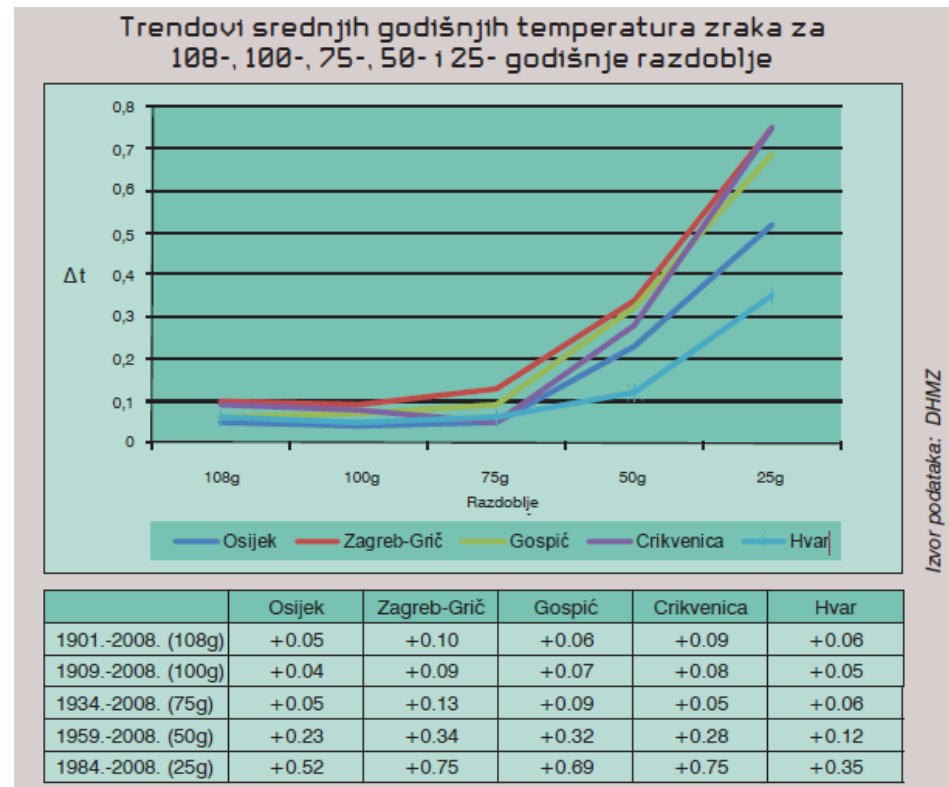
OBSERVED CLIMATE CHANGES IN CROATIA

Rise in annual air temperatures

Decade 1990-2000 the warmest in the 20th century (1901-2000 in the coastal region larger increase in annual temperatures)

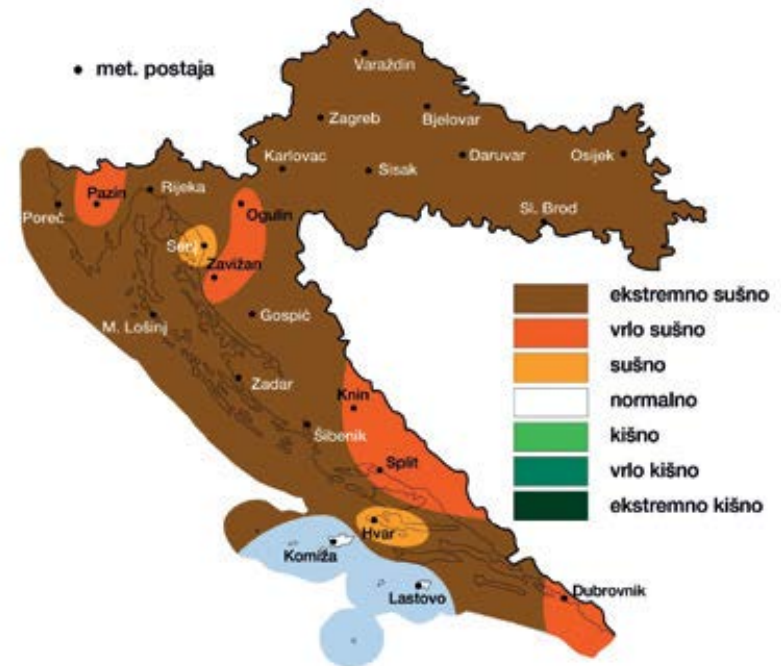
Decrease in the number of cold days and cold nights

(in the continental region)



OBSERVED CLIMATE CHANGES IN CROATIA

- **Decrease in amount of precipitation in the 20th century, (more pronounced in northern Adriatic, Dalmatian islands and eastern Slavonia).**
- **Positive trend in annual number of dry days**
- **Warming will cause less summer rainfall, but more of a decrease in the amount of snow on the ground.**



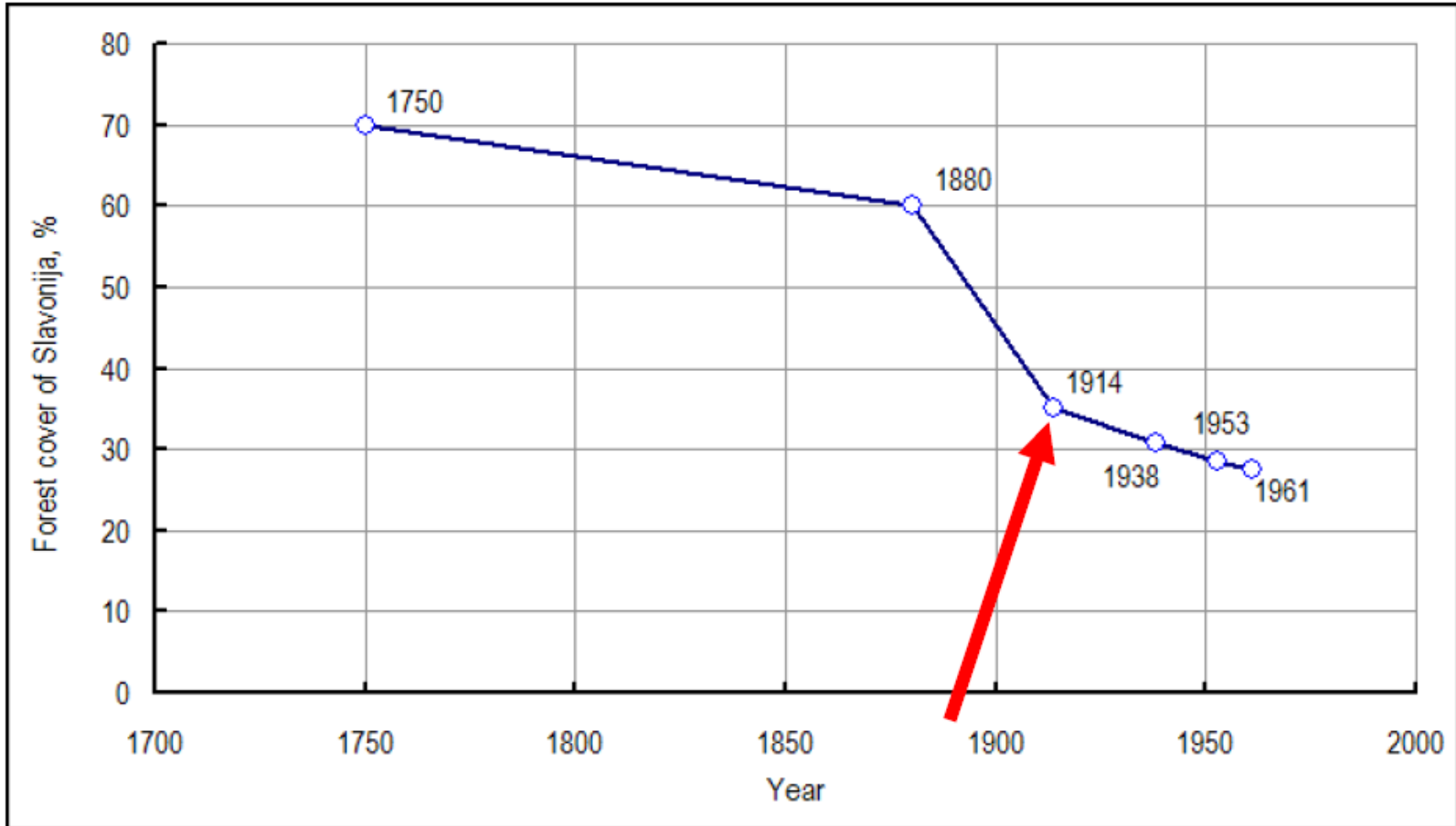
Classification of annual amounts of rainfall in 2011 in relation to the referential period 1961-1990

OBSERVED CLIMATE CHANGES IN CROATIA

- ▶ currently do not have a larger impact on agricultural production
- ▶ Greater effect on natural vegetation and biodiversity (habitat change, the vulnerability of indigenous species, and the spread of alochtonous and invasive species)



Forest coverage in Slavonia



Woodiness falls from 70% to less than 30% of the region

Drying oak, noted back in 1909, is continuing and has become stronger and more dangerous.

Causes of vulnerability

- ▶ **Extinction of the European white elm** (due to Dutch elm disease), and multiple severe attacks of pests and diseases (gypsy mothe, “zlatokraj”/*Euproctis crysorrhea* L, “kukavičji suznik”/*Malacosoma neustria* L, etc.) in the first half of the 20th century.
- ▶ **Changes in water regime-** building/embankments/dams/barriers – Building many drainage ditches around the Spačva basin, which first served as drainage for agricultural land and influence the water regime of the Spačva forest, so that in certain parts the oak would dry and move one forest unit to the other, that is from damp to dry. On the other hand, in some places, because of cutting down the oak marshification took place, since the Caucasian ash, as a pioneer species that can handle wetter marshes, is not able to transpire that amount of water as the oak does.
- ▶ **Forestry** (intensive forest waste) – Although generally well-managed forests, there can be a shortage of trees of all ages, especially the oldest ones, which in turn, though economically viable, are important for many animals that live in the hollows and lichens, which are good indicators of forest conservation. .
- ▶ **Influence of invasive species** (plants and animals) –difficulties are caused by the “čivitnjača” (*Amorpha fruticosa*), which in cut down areas make foresting oaks impossible, which in turn enables a change in the fora system, since “čivitnjača” can only grow on Caucasian ash, a invasive species like the fallow deer, mouflon (*Ovis musimon*), pheasant etc., which in a larger or smaller way cause damage to the indigenous plant and animal world.
- ▶ **Climate changes**
- ▶ **Polluting the environment-** polluted flood waters, emitted acidification (acid rain and dry residue), traffic, intensive agriculture, application of pesticides in forests, garbage dumps, etc.



Demolition of the old oak forests 18th-19th century



Average age of forests
before intensive chopping
down 150-400 years,
today it's 80-120 years

Oak forest protection

- ▶ **Special reservation of forest vegetation Lože**
protected since 1975 – intended for scientific research and education, a permanent area was set in the frame of UNESCO's program Man and biosphere (MAB9).
- ▶ **Special reservation of forest vegetation Radiševo**
protected in 1975.



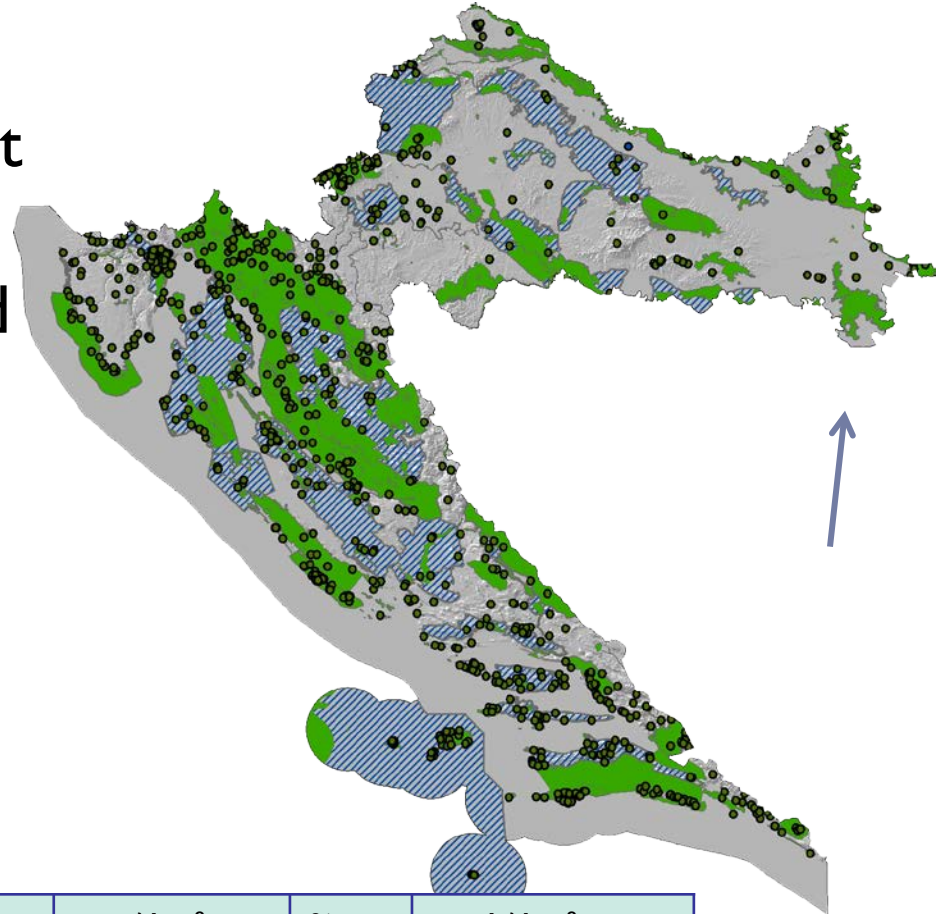
NATURA 2000 in Europe

- ▶ ecological networks of preserved areas in all of Europe - NATURA 2000 network. It is intended for conserving over 1000 rare, endangered and endemic types of wild animals and plants and around 230 natural and semi-natural habitats (**Directive about birds and Directive about habitats**)
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NATURA 2000 in Europe and Croatia

- ▶ When Croatia joins the European union in 2013, it will have to carry out directives about birds and habitats in its territory
- ▶ Chosen area in Croatia for NATURA 2000- includes the Spacva basin



	land / km ²	%	sea / km ²	%	total / km ²
Area of ecological network	26.689,78	47	12.140,48	39	38.830,26
Total RH	56.615	100	31.644	100	88.259

Invasive species- *Ambrosia artemisiifolia* L.)

- ▶ **is an annual plant** which can grow up to 150 cm high
- ▶ area of natural distribution of ambrosia(ragweed)- North America from Mexico to Canada.
- ▶ Today it is widely distributed in Europe, Asia, Australia and South America. It accidentally entered Europe in the mid- 19th century with red clover seeds and grains.
- ▶ In Croatia it was first noted in 1941 around Pitomača.
- ▶ Since the first findings to date ragweed spread almost entirely throughout Croatia, the "fiercest" hitting the central and eastern parts of Croatia.
- ▶ It occupies all open habitats that affect man, and especially large populations appear in abandoned arable fields and along their edges, along roads and railways, etc.
- ▶ grows at a speed of 6-20 km per year, spreading from "contagious" centres, among which is Croatia.
- ▶ In the last ten years its pollen concentration in the air has increased tenfold. Ragweed pollen grains are one of the strongest allergens



Invasive species- “Amorfa” - *Amorpha fruticosa* L.

- ▶ **densely branched deciduous upright woody shrub** originating from North America
- ▶ from the plant family Fabaceae (pulses)
- ▶ brought into Europe in 1724
- ▶ appeared in Croatia at the beginning of the 20th century.
- ▶ it tolerates standing water and this quality, along with rapid growth, give an advantage over the other species in this type of habitat.
- ▶ expands in lowland areas along the banks of rivers and lakes, and its light seeds are spread by flood water so weedy areas increase suddenly.
- ▶ more aggressive and more common in the continental area of Croatia
- ▶ prevents replanting of oak forests



Invasive species- Asian tiger mosquito (*Aedes albopictus* Skuse, 1894)

- ▶ mosquito species, native to Southeast Asia is the ultimate nuisance, very adaptable and unstoppable.
- ▶ was first recorded in Europe 1979 in Albania, where it probably entered with goods from China. In 1990 it was introduced into Italy, presumably in old car tires, and since then constantly spreading throughout Europe.
- ▶ The first finding in Croatia is from October 2004, when the tiger mosquito was recorded in an artificial nest in the southeastern part of Zagreb



Danger from this species is double-sided:

- tiger mosquito in direct competition displaces indigenous species of mosquitoes, and can even cause their extinction
- the tiger mosquito is an important species from the health aspect as well- it's active during the day and is an aggressive nuisance, this species transmits different viruses, of which the most well-known is dengue.

Regional extinct species

European beaver- *Castor fiber*

- ▶ largest rodent in the northern hemisphere
- ▶ lives in streams and water bodies with rich herbaceous wetland vegetation and woody plants
- ▶ herbivore's summer food are "juicy" herbaceous plants that are in the water or on the banks
- ▶ In Croatia it's a regionally extinct species which died out over 100 years ago
- ▶ Cause of extinction: probably hunting
- ▶ In 1996 it was successfully brought back to its natural habitat (reintroduced) into the Spačva basin as well(2009.)

