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Forest Bioenergy in the Protected Mediterranean Areas

Impact assessment of increase biomass use in the short, medium and long term in the protected areas

Annex 4 : Study area report – CROATIA (Zadar County)

Workpackage 3 - Testing

Activity A.3.5. - Threats and benefits of increase the biomass use in the protected areas

Deliverable D.3.5.1 – Impact assessment of increase biomass use in the short, medium and long term in the protected areas

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1 PRELIMINARY ASSESSMENT IN THE STUDY AREAS

1.1 Nature parks Velebit, Telaščica and Vransko jezero (Croatia)

Report was prepared by:

Zadar County

1.1.1 Biotic components

Short description

HR5000022 Park prirode Velebit and HR1000022 Velebit

The Velebit Nature Park encompasses the greater part of the Velebit Mountain and the valley of the karst river Zrmanja and is the largest protected area of nature in Croatia. Due to its relief and vegetation features, it is considered a true jewel among mountains. The geological structure of Velebit consisting of water permeable limestone and less permeable dolomites that had a strong impact on the creation of various geomorphological phenomena and formations of unique beauty. In addition to karrens, closed depressions created by stagnant water, sinkholes, and impressive sheer cliffs, there is a great number of caves and pits. The location and structure of the mountain enabled the development of very diverse wildlife. Dense forests, vegetation of rocks and screes, grasslands, and a great number of endemic species are its main features. To date, 2700 plant species, of which 78 endemic species have been registered, the well-known Velebit degenia being one of them. Tertiary relict species, such as Croatian sibirea, are also especially important. Various habitat types and a specific climate sustain abundant wildlife. Many fauna species that are rare and endangered elsewhere, can be found here (long-fingered bat, caperoaillie), and some endemic species as well. There are many bird species that nest here and two mammal species that are endangered elsewhere in Europe should be mentioned too: brown bear and wolf.

Some of its parts are protected as National parks: Paklenica and Sjeverni Velebit. For its natural values, UNESCO protected it as an International Biosphere Reserve, in 1978.

Regarding forest habitat types listed in the Habitats Directive (Directive 92/43/EEC) present in this Natura 2000 site, the 40 % (73 200 ha) of the site is covered with 91K0 Illyrian *Fagus sylvatica* forests (*Aremonio-Fagion*). From other target habitat types, suitable for biomass exploitation, are 5210 Arborescent matorral with *Juniperus* spp. with the coverage of 2000 ha, 91L0 Illyrian oak-hornbeam forests (*Erythronio-Carpinion*) with 2170 ha, 9410 Acidophilous *Picea* forests of the montane to alpine levels (*Vaccinio-Piceetea*) with 1693 ha and 9530 (Sub-) Mediterranean pine forests with endemic black pines with 500 ha.

Potential impacts of silvicultural and harvesting actions on abovementioned habitat types present in HR5000022 Park prirode Velebit are given in

Table 1.

Table 1 Potential impacts on target habitat types (sensu "Habitats Directive") of the Natura 2000 site HR5000022 Park prirode Velebit

Natura 2000 site:	**HR5000022 Park prirode Velebit**												
Natura 2000 Habitat Code:	**5210 Arborescent matorral with *Juniperus* spp. 91K0 Illyrian *Fagus sylvatica* forests (*Aremonio-Fagion*) 91L0 Illyrian oak-hornbeam forests (*Erythronio-Carpinion*) 9410 Acidophilous *Picea* forests of the montane to alpine levels (*Vaccinio-Piceetea*) 9530 (Sub-) Mediterranean pine forests with endemic black pines**												
Action	**Silvicultural and harvesting practices (high forest and coppice)**											**Post harvest management**	
	Thinning/Shelterwood cutting/Salvage cutting					Crown pruning		Clear cutting					
THREATS	Felling and Arrangement	Storing (Winch)	Storing (Raceways)	Yarding (Raceways)	Yarding (Tractor)	Cutting	Yarding	Felling and Arrangement	Storing (Winch)	Storing (Raceways)	Yarding (Raceways)	Yarding (Tractor)	Chipping	**INDICATORS**
direct removal of natural vegetation	II	I	II	II	II	I	I	II	I	II	II	II	I	vegetation sampling life-form spectrum /diversity indices
alteration of floristic composition	II	I	I	I	I	I	I	II	I	I	I	I	I	
reduction of protected and endemic species population	II	I	II	II	II	I	I	II	I	II	II	II	I	presence of protected and endemic species
introduction of synanthropic species	II	II	II	II	II	II	II	II	II	II	II	II	II	presence of synanthropic species
introduction of alien species	II	II	II	II	II	II	II	II	II	II	II	II	II	presence of alien species
reduction of natural regeneration	II	I	I	I	I	I	I	II	I	I	I	I	I	presence of natural regeneration
damage to natural regeneration	II	I	I	I	I	I	I	II	I	I	I	I	I	presence of damages to natural regeneration

Non-forest habitat types (heaths, grasslands, screes, fens etc.) listed in Habitats Directive are not under direct threat of biomass exploitation. Only threats possible are

spreading of invasive alien and/or synanthropic species from the intensification of transport within the Natura 2000 site.

Other habitat types that are not target habitat types for the Natura 2000 site HR5000022 Park prirode Velebit are mostly autochthonous broadleaved forests with *Quercus pubescens*, *Carpinus orientalis*, *Fraxinus ornus*, *Quercus cerris* etc. and allochthonous coniferous communities with *Pinus halepensis*. The potential impacts on harvesting actions on these habitats are given in

Table 2.

Table 2 Potential impacts on **non-target** forest habitat types of the Natura 2000 site HR5000022 Park prirode Velebit

Natura 2000 site:	**HR5000022 Park prirode Velebit**												
Natura 2000 Habitat Code:	**Allochthonous coniferous reforestation (*Pinus halepensis*) Autochthonous broadleaved reforestation (*Ostryo-Quercetum pubescentis* (Ht.) Trinajsti 1979, *Querco – Carpinetum orientalis* H-i 1939., *Fraxino orni – Quercetum cerris* Stefanovi 1971)**												
Action	**Silvicultural and harvesting practices (high forest and coppice)**											**Post harvest management**	
	Thinning/Shelterwood cutting/Salvage cutting					Crown pruning		Clear cutting					
THREATS	Felling and Arrangement	Storing (Winch)	Storing (Raceways)	Yarding (Raceways)	Yarding (Tractor)	Cutting	Yarding	Felling and Arrangement	Storing (Winch)	Storing (Raceways)	Yarding (Raceways)	Yarding (Tractor)	Chipping	**INDICATORS**
direct removal of natural vegetation	I	I	I	I	I	I	I	II	I	II	II	II	I	vegetation sampling life-form spectrum /diversity indices
alteration of floristic composition	I	I	I	I	I	I	I	II	I	II	II	II	I	
reduction of protected and endemic species population	I	I	II	II	II	I	I	II	I	II	II	II	II	presence of protected and endemic species
introduction of synanthropic species	II	II	II	II	II	II	II	II	II	II	II	II	II	presence of synanthropic species
introduction of alien species	II	II	II	II	II	II	II	II	II	II	II	II	II	presence of alien species
reduction of natural regeneration	I	I	I	I	I	I	I	II	I	II	I	II	I	presence of natural regeneration

damage to natural regeneration	I	I	I	I	I	I	I	II	I	II	II	II	I	presence of damages to natural regeneration

Target habitat types of the Natura 2000 site HR5000022 Park prirode Velebit support populations of rare and endangered animal species (including target species from Habitats Directive (Directive 92/43/EEC)) on which harvesting practices can have potential negative impact. HR5000022 Park prirode Velebit is an important site for saproxylic beetles *Morimus funereus*, *Rosalia alpina* and *Lucanus cervus*, for all three large carnivores (*Lynx lynx*, *Ursus arctos* and *Canis lupus*) and for bat populations. It supports important *Miniopterus schreibersii*, *Myotis blythii*, *Myotis capaccinii*, *Myotis emarginatus*, *Myotis myotis*, *Rhinolophus euryale*, *Rhinolophus ferrumequinum* and *Rhinolophus hipposideros* nurseries and migration site. Regarding forest habitat types, forests are considered important feeding and roosting site for *Myotis bechsteinii* and *Barbastella barbastellus*. HR5000022 Park prirode Velebit is also a Special Protection Area (SPA): HR1000022 Velebit established in compliance with the Birds Directive (Directive 2009/147/EC), and is also part of Natura 2000 network. HR1000022 Velebit site comprises the Velebit mountain with diverse habitats (forest, open, rocky and mixed habitats). Majority of important bird species inhabit forests: fir-beech in northern part and beech in southern part. Very important are spruce forests (Štirovača, Lomska duliba etc.), as well as black pine and hop-hornbeam forests. It is one of the most important breeding area of Capercaillie, Pygmy and Tengmalm's Owl, White-backed Woodpecker and Ortolan Bunting in Croatia.

The most negative and long-term impact/threat of biomass exploitation on animal communities present in target habitat types of the Natura 2000 site HR5000022 Park prirode Velebit are decrease of the availability of trophic resources and thus decrease of habitat suitability.

Table 3 Potential impacts on forest animal communities present in the target habitats of the Natura 2000 site HR5000022 Park prirode Velebit

Natura 2000 site:	**HR5000022 Park prirode Velebit**													
Natura 2000 habitat codes	**5210 Arborescent matorral with *Juniperus* spp. 91K0 Illyrian Fagus sylvatica forests (*Aremonio-Fagion*) 91L0 Illyrian oak-hornbeam forests (*Erythronio-Carpinion*) 9410 Acidophilous Picea forests of the montane to alpine levels (*Vaccinio-Piceetea*) 9530 (Sub-) Mediterranean pine forests with endemic black pines**													
Action	**Silvicultural and harvesting practices (high forest and coppice)**												**Post harvesting management**	**INDICATORS**
	Thinning/Shelterwood cutting/Salvage cutting					Crown pruning		Clear cutting						
THREATS	Felling and Arrangement	Storing (Winch)	Storing (Raceways)	Yarding (Raceways)	Yarding (Tractor)	Cutting	Yarding	Felling and Arrangement	Storing (Winch)	Storing (Raceways)	Yarding (Raceways)	Yarding (Tractor)	Chipping	
Noise	II	II	II	II	II	II	II	II	II	II	II	II	II	Birds (Non-Strigiformes)
Soil compaction	I	I	I	I	I	I	I	I	I	I	I	I	I	Ground-active beetles
Decrease of habitat suitability	II	II	II	II	II	II	II	II	II	II	II	II	II	Xylobiont and Saproxylic beetles; Birds (Strigiformes)
Decrease of the availability of trophic resources	II	II	II	II	II	II	II	II	II	II	II	II	II	Xylobiont beetles; Birds (non-Strigiformes)
Casualties	I	I	I	I	I	I	I	I	I	I	I	I	I	Monitoring of carcasses

HR5000025 Vransko jezero i Jasen and HR1000025 Vransko jezero i Jasen

Vransko jezero is the largest natural lake in Croatia. It is located in the central part of the Dalmatian coast. The lake represents a geomorphological rarity of karst region since it is a crypto-depression filled with mild salted water that sustains a specific community of water species.

The Park area is characterized by a high degree of biological and landscape diversity as it represents an unusual combination of Mediterranean karst and wetland area. It is one of the most important bird habitats in Croatia. The north-western border of the lake lies in the zone of intensive flooding, providing a habitat for a great number of waterfowl for which reason it has been protected as a special ornithological reserve. Here is also located the largest reed bed area of Vrana Lake, in which Purple Herons and Pygmy Cormorants nest in a mixed colony, making this area a unique bird site of the Adriatic coast. To date 251 bird species have been registered, of which 102 nests here, the rest being migratory species that use the park area as a resting or wintering place along their migratory routes. Due to 87 wintering bird species with more than 100.000 specimens, the area is one of the most important European wintering sites. More than 140 migratory bird species from Central and North Europe rest here. The daily population in the Park sometimes reaches 1.000.000 birds during autumn migration season, and for this reason the Park has been listed as an Important Bird Area of Europe (IBA). The whole Park area has also been declared a RAMSAR site in 2013.

Another important biological feature of the Park is the diversity of fish, especially Mediterranean subspecies of the Roach.

At the Vrana Lake flooded meadows are present in the ornithological reserve, in the narrow belt between wetland vegetation and agricultural land, and larger areas are developed in Jasen area. In these wet meadows several species of orchids are recorded and as well as the endemic Illyrian Iris (*Iris illyrica*). These meadows are the nesting and feeding areas of a large number of bird species during floods or when the water is withdrawn. The main here represented community is a community of thermophilic high wet grasslands *Trifolio-Hordeetalia*.

Although standing water body covers 51 % of the site area, there is a coverage in broad-leaved deciduous woodland and mixed woodland which do not represent target habitat types of the Natura 2000 site. Nevertheless, those could be the important habitats for other important animal and plant species.

Table 4 Potential impacts on non-target forest habitat types of the Natura 2000 site HR5000025 Vransko jezero i Jasen

Natura 2000 site:	**HR5000025 Vransko jezero i Jasen**													
Habitat names	**Autochthonous broadleaved reforestation (*Fraxino orni – Quercetum ilicis* H-i 1956, 1958), *Querco ilici – Pinetum halepensis* Loisel 1971, *Rhamno-Paliuretum* Trinajsti 1995, *Querco pubescentii – Carpinetum orientalis* H-i 1939) Allochthonous coniferous reforestation (*Pinus halepensis*)**													
Action	**Silvicultural and harvesting practices (high forest and coppice)**												**Post harvest management**	
	Thinning/Shelterwood cutting/Salvage cutting					Crown pruning		Clear cutting						
THREATS	Felling and Arrangement	Storing (Winch)	Storing (Raceways)	Yarding (Raceways)	Yarding (Tractor)	Cutting	Yarding	Felling and Arrangement	Storing (Winch)	Storing (Raceways)	Yarding (Raceways)	Yarding (Tractor)	Chipping	**INDICATORS**
direct removal of natural vegetation	I	I	I	I	I	I	I	II	I	II	II	II	I	vegetation sampling life-form spectrum /diversity indices
alteration of floristic composition	I	I	I	I	I	I	I	II	I	II	II	II	I	
reduction of protected and endemic species population	I	I	II	II	II	I	I	II	I	II	II	II	II	presence of protected and endemic species
introduction of synanthropic species	II	II	II	II	II	II	II	II	II	II	II	II	II	presence of synanthropic species
introduction of alien species	II	II	II	II	II	II	II	II	II	II	II	II	II	presence of alien species
reduction of natural regeneration	I	I	I	I	I	I	I	II	I	II	I	II	I	presence of natural regeneration
damage to natural regeneration	I	I	I	I	I	I	I	II	I	II	II	II	I	presence of damages to natural regeneration

From animal communities present in the target habitats of the site HR5000025 Vransko jezero i Jasen the most important are the bird communities. HR5000025 Vransko jezero i Jasen Natura 2000 site is also a Special Protection Area (SPA): HR1000025 Vransko jezero i Jasen established in compliance with the Birds Directive (Directive 2009/147/EC), and is also part of Natura 2000 network. Animal communities that use habitats such as deciduous temperate woodland, Mediterranean and sub-Mediterranean shrubland and woodland could be impacted through lowering of habitat suitability and availability of trophic resources which could impact species reproduction and nesting activities in forests and shrubs with silvicultural and harvesting practices.

Table 5 Potential impacts on animal communities of the Natura 2000 site HR5000025 Vransko jezero i Jasen and HR1000025 Vransko jezero i Jasen

Natura 2000 site:	**HR5000025 Vransko jezero i Jasen HR1000025 Vransko jezero i Jasen**													
Action	**Silvicultural and harvesting practices (high forest and coppice)**												**Post harvesting management**	
	Thinning/Shelterwood cutting/Salvage cutting					Crown pruning		Clear cutting						
THREATS	Felling and Arrangement	Storing (Winch)	Storing (Raceways)	Yarding (Raceways)	Yarding (Tractor)	Cutting	Yarding	Felling and Arrangement	Storing (Winch)	Storing (Raceways)	Yarding (Raceways)	Yarding (Tractor)	Chipping	**INDICATORS**
Noise	I	I	I	I	I	I	I	I	I	I	I	I	I	Birds (Non-Strigiformes)
Soil compaction														Ground-active beetles
Decrease of habitat suitability	II	II	II	II	II	II	II	II	II	II	II	II	II	Xylobiont and Saproxylic beetles; Birds (Strigiformes)
Decrease of the availability of trophic resources	II	II	II	II	II	II	II	II	II	II	II	II	II	Xylobiont beetles; Birds (non-Strigiformes)
Casualties	I	I	I	I	I	I	I	I	I	I	I	I	I	Monitoring of carcasses

HR4000002 Park prirode Telašćica and HR1000035 NP Kornati i PP Telašćica

Telašćica Nature Park is an area of unique landscape beauty characterized by contrasts where gentle coastline with peaceful beaches stretches along the inner coast of the Telašćica bay while steep rough cliffs protect it from the open sea, or where Aleppo pine-trees and holly oak woods oppose to the scarce vegetation of the more exposed dry rocky grasslands. Vineyards and olive groves are still a common sight in this area, as well as are the meadows and hillsides rich with Mediterranean vegetation with more than 300 species of flora and equally rich fauna. Marine life is rich in biodiversity with over 450 species of fauna and over 300 species of flora recorded in the area.

The most distinctive features of this site are the unique bay of Telašćica, which is one of the safest, the most beautiful and the largest harbours in the Adriatic, that includes 25 small bays and 69 km of the well-indented coastline; the cliffs of the island of Dugi otok (called Stene), rising up to 161 m above the sea level and falling down vertically up to 90 m below the sea level; and the salt lake Mir.

Target habitat types for this Natura 2000 site are non-forest habitat types and they are not under direct threats of biomass exploitation. Only threats possible are of spreading of invasive alien and/or synanthropic species from the intensification of transport within the Natura 2000 site.

Only woody habitat type in this Natura 2000 site is Aleppo pine (*Pinus halepensis*) forest with *Quercus ilex*. Potential impacts on this habitat type are given in the

Table 6.

Table 6 Potential impacts on non-target habitat type of the Natura 2000 site HR4000002 Park prirode Telašćica

Natura 2000 site:	**HR4000002 Park prirode Telaš ica**													
Forest categories not included in the "Habitats Directive"	**Allochthonous coniferous reforestation (*Pinus halepensis* forest with *Quercus ilex*) Autochthonous broadleaved reforestation (*Querco ilici – Pinetum halepensis* Loisel 1971)**													
Action	**Silvicultural and harvesting practices (high forest and coppice)**												**Post harvest management**	
	Thinning/Shelterwood cutting/Salvage cutting					Crown pruning		Clear cutting						
THREATS	Felling and Arrangement	Storing (Winch)	Storing (Raceways)	Yarding (Raceways)	Yarding (Tractor)	Cutting	Yarding	Felling and Arrangement	Storing (Winch)	Storing (Raceways)	Yarding (Raceways)	Yarding (Tractor)	Chipping	**INDICATORS**
direct removal of natural vegetation	I	I	I	I	I	I	I	II	I	II	II	II	I	vegetation sampling life-form spectrum /diversity indices
alteration of floristic composition	I	I	I	I	I	I	I	II	I	II	II	II	I	
reduction of protected and endemic species population	I	I	II	II	II	I	I	II	I	II	II	II	II	presence of protected and endemic species
introduction of synanthropic species	II	II	II	II	II	II	II	II	II	II	II	II	II	presence of synanthropic species
introduction of alien species	II	II	II	II	II	II	II	II	II	II	II	II	II	presence of alien species
reduction of natural regeneration	I	I	I	I	I	I	I	II	I	II	I	II	I	presence of natural regeneration
damage to natural regeneration	I	I	I	I	I	I	I	II	I	II	II	II	I	presence of damages to natural regeneration

Regarding animal communities, HR4000002 Park prirode Telašćica site contains one of the largest *Myotis emarginatus* and *Rhinolophus ferrumequinum* nursery in the Mediterranean biogeographical region in Croatia. Natura 2000 site HR4000002 Park prirode Telašćica is also part of a Special Protection Area (SPA): HR1000035 NP Kornati

i PP Telašćica established in compliance with the Birds Directive (Directive 2009/147/EC), and is also part of Natura 2000 network.

Animal communities that use Aleppo pine forests with *Q. ilex* in this site (e.g. *Bubo bubo*, *Circaetus gallicus*, *Lanius collurio*, *Lanius minor, Myotis emarginatus, Rhinolophus ferrumequinum etc*) could be impacted from harvesting and silvicultural practices in those habitat types.

Table 7 Potential impacts on animal communities of the Natura 2000 site HR4000002 Park prirode Telašćica

Natura 2000 site:	**HR4000002 Park prirode Telaš ica**													
Action	**Silvicultural and harvesting practices (high forest and coppice)**												**Post harvesting management**	
	Thinning/Shelterwood cutting/Salvage cutting					Crown pruning		Clear cutting						
THREATS	Felling and Arrangement	Storing (Winch)	Storing (Raceways)	Yarding (Raceways)	Yarding (Tractor)	Cutting	Yarding	Felling and Arrangement	Storing (Winch)	Storing (Raceways)	Yarding (Raceways)	Yarding (Tractor)	Chipping	**INDICATORS**
Noise	I	I	I	I	I	I	I	II	II	II	II	II	I	Birds (Non-Strigiformes)
Soil compaction														Ground-active beetles
Decrease of habitat suitability	I	I	I	I	I	I	I	II	II	II	II	II	I	Xylobiont and Saproxylic beetles; Birds (Strigiformes)
Decrease of the availability of trophic resources	I	I	I	I	I	I	I	II	II	II	II	II	I	Xylobiont beetles; Birds (non-strigiformes)
Casualties	I	I	I	I	I	I	I	I	I	I	I	I	I	Monitoring of carcasses

1.1.2 Abiotic components

Short description

Regarding forest types and silvicultural and harvesting practices in Croatia, shelterwood cutting has greater influence on abiotic indicators due to numerous factors. Some of them are: more wood is felled (30-50 percent of growing stock per cut); trees are bigger meaning that heavier machinery needs to be used; yarding bigger trees have greater influence on soil and litter, etc. Only positive influence regarding selected indicators are that shelterwood cutting leaves more deadwood, but then fire risk is bigger.

Because of that, first grade is representing influence of thinning and salvage cutting and another grade is for shelterwood cutting. Also, the selected color is representing reversibility of thinning and salvage cutting and for shelterwood cutting the reversibility is for one magnitude greater (if short term is selected for thinning, than it is medium term for shelterwood cutting, and so on).

Clear cutting could have more severe influence, even irreversible for some indicators, since these forest types are growing on step terrain and/or have shallow soils on rocky bed. Clear cutting in Croatia is only allowed for regeneration of Alnus, Populus or Salix forest/stands.

Abiotic components: potential impacts on habitats (according to Directive 92/43/EEC) and tree plantations

Natura 2000 Habitat Code:	**Velebit** **5210** Arborescent matorral with Juniperus spp. **91K0** Illyrian Fagus sylvatica forests (Aremonio-Fagion) **91L0** Illyrian oak-hornbeam forests (Erythronio-Carpinion) **9410** Acidophilous Picea forests of the montane to alpine levels (Vaccinio-Piceetea) **9530** (Sub-) Mediterranean pine forests with endemic black pines **Allochthonous coniferous reforestation** (Pinus halepensis) **Autochthonous broadleaved reforestation** (Ostryo-Quercetum pubescentis (Ht.) Trinajsti 1979, Querco – Carpinetum orientalis H-i 1939., Fraxino orni – Quercetum cerris Stefanovi 1971) **Vransko jezero** **Autochthonous broadleaved reforestation** (Fraxino orni – Quercetum ilicis H-i 1956, 1958), Querco ilici – Pinetum halepensis Loisel 1971, Rhamno-Paliuretum Trinajsti 1995, Querco pubescentii – Carpinetum orientalis H-i 1939) **Allochthonous coniferous reforestation** (Pinus halepensis) **Telaš ica** **Allochthonous coniferous reforestation** (Pinus halepensis forest with Quercus ilex) Autochthonous broadleaved reforestation (Querco ilici – Pinetum halepensis Loisel 1971)

Action	**Silvicultural and harvesting practices (high forest and coppice)**												
	Thinning/Shelterwood cutting/Salvage cutting					Crown pruning		Clear cutting				**Post harvesting management**	
Threat	Felling and Arrangement	Storing (Winch)	Storing (Raceways)	Yarding (Raceways)	Yarding (Tractor)	Cutting	Yarding	Felling and Arrangement	Storing (Winch)	Storing (Raceways)	Yarding (Raceways)	Yarding (Tractor)	Chipping	**INDICATORS**
Reduction of deadwood	I/0	0/I		0/I	I/II			III	III	III	III	III		Deadwood
Reduction of litter cover	I/II	0/I		0/I	I/II			III	III	III	III	III		Litter
Reduction of litter height	I/II	0/I		0/I	I/II			III	III	III	III	III		
Reduction of SOC	I/II	0/I		0/I	I/II			II	II	II	II	II		Soil Organic Carbon (SOC)
Presence of Rill erosion	I/II	0/I		0/I	I/II			III	III	III	III	III		Erosion
Presence of Interrill erosion	I/II	0/I		0/I	I/II			III	III	III	III	III		
Presence of Gully erosion	I/II	0/I		0/I	I/II			III	III	III	III	III		
Increase of Soil Bulk Density	I/II	0/I		0/I	I/II			II	II	II	II	II		Soil Bulk Density
Fuel model features	I/II	0/I		0/I	I/II			III	III	III	III	III		Fire risk

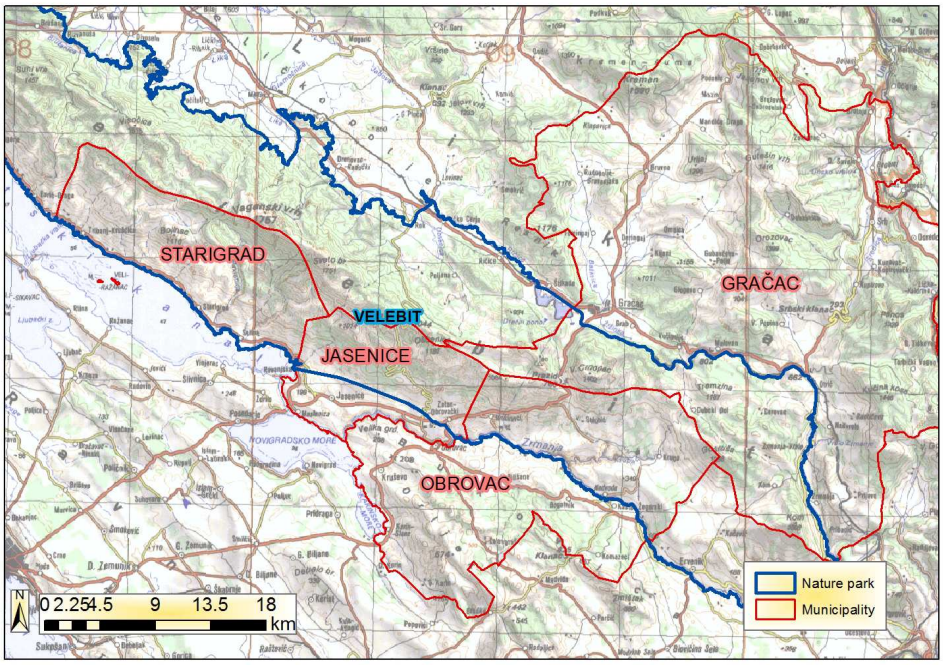
1.1.3 Social, economic and demographic components and ecosystem services

Short description

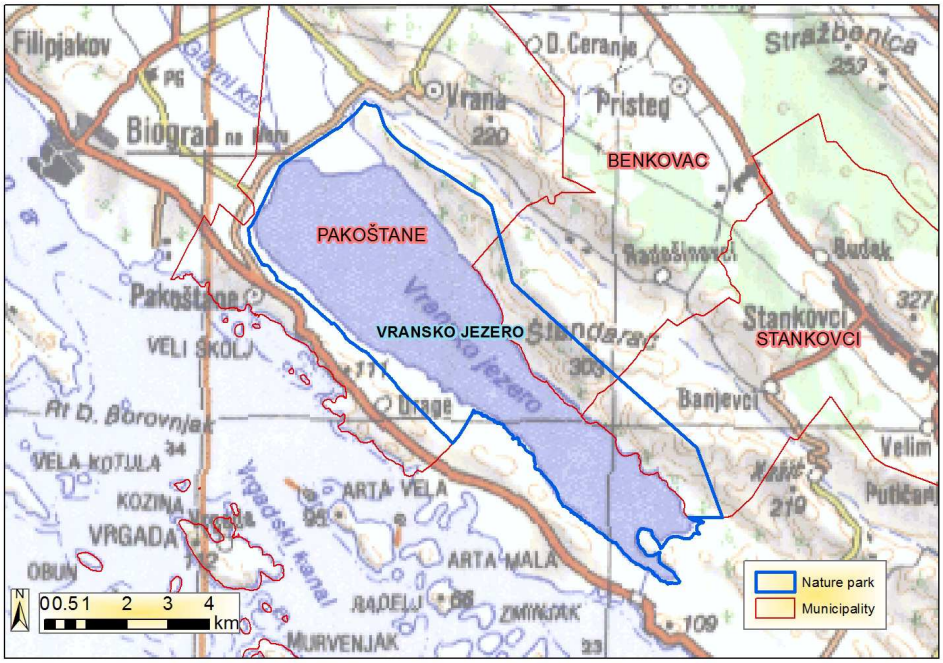
Population density in this County is 44.4 inhabitants per km2 (16th of 21 in Republic of Croatia). Also, this number is largely influenced by City of Zadar and other cities since municipalities in other parts of the County (hinterland and islands) are well below this average. Regarding municipalities that have pilot areas inside them (Table 11, Picture 1-3) situation is very different. Municipalities inside Nature park Telašćica have 13,69 inhabitants per km2. For municipalities inside NP Vransko jezero population density is 25,73 inhabitants per km2, and Velebit has only 7,85 inhabitants per km2.

Table 11. Municipalities inside pilot areas (only for Zadar County)

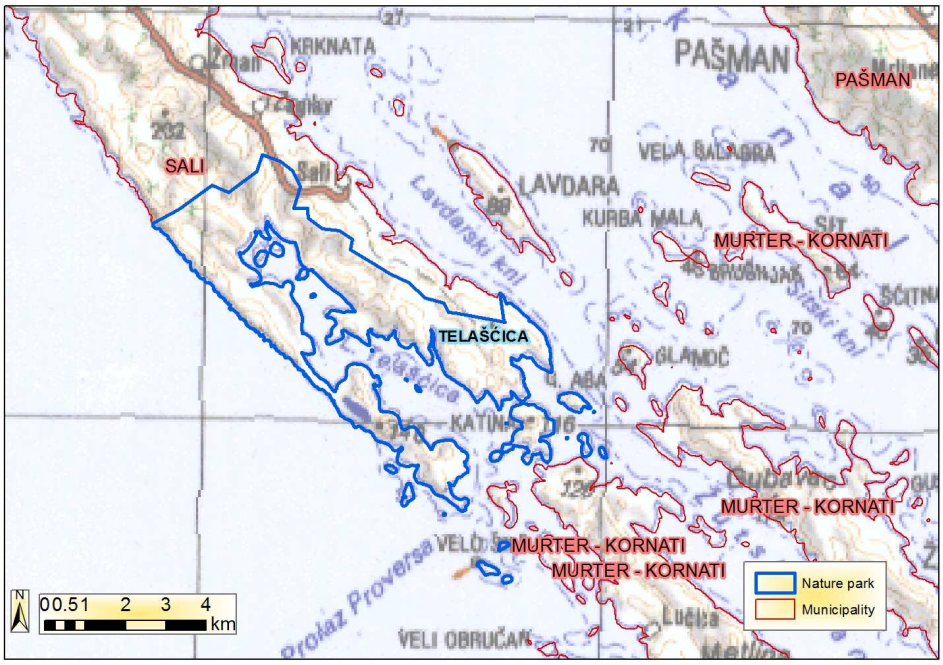
Pilot area	Municipality (Zadar County)	Area of the municipality (ha)	Percentage of municipality in pilot area
Velebit	Gra ac	95706	18,31
	Jasenice	12192	67,82
	Obrovac	35297	40,73
	Starigrad	17085	99,89
Vransko jezero	Pakoštane	8420	46,62
	Benkovac	51387	0,90
	Stankovci	6843	6,40
Telaš ica	Sali	12435	20,35



Picture 1. Municipalities inside nature park Velebit (only Zadar County municipalities)



Picture 2. Municipalities inside nature park Vransko jezero



Picture 3. Municipalities inside nature park Telašćica

Energy from biomass on (County level) was used in industrial sector with share of 12,09 % in total energy used and regarding households that share is 42,30 % (mainly from firewood).

Only in municipalities inside Nature park Velebit are companies that are involved in felling and skidding (2 out of 293 in total in Republic of Croatia) plus 10 crafts (individual firms).

Regarding wood processing and marketing 14 companies involved in (out of 1414 in total in Republic of Croatia) plus 38 crafts (individual firms).

Firms involved in bioenergy production and distribution are mostly companies that are producing energy from sun and wind and only 3 out of them 10 had income in 2016 since other wind- and solarfarms are currently in pre-built phase and activities.

Satellite acitivities are mainly consist of hotels and reastaurants since most of invleved municipalities are also located at the Adriatic coast. There are only 3 companies involved in hunting and trapping and related services, but one in PP Telaščica is for education related to hunting and other two are companies that are managing hunting areas. One hunting area is outside pilot areas, and other is only partly located in southern part of Nature park Velebit.

For crafts, data on employment and net income are not available, so labour productivity, number of workers and net income was calculated on the basis of limited liability companies.

Data presented for "**Per capita family income**" indicator is based on the average salary of the employed person since data of the family income is not available. This indicator is very hard to calculate since reat diversity of work status, mariage status, number of person in family, etc.

Socio-Demographic Indicators' Table (Base Values)

Socio-Demographic Indicators	Value Before operations						
	Unit of measure	NP Velebit	NP Vransko jezero	NP Telaš ica	Year	Source	territorial reference*
Population	number of inhabitants	12587	17152	1698	2011	CBS	Involved municipalities
Population structure	% of population aged under 15 years	15	19	8	2011	CBS	Involved municipalities
	% of population aged 15-64 years	63	63	56			
	%population aged 65 years and over	22	18	36			
Per capita family income	mean value of per capita income for resident families close to the protected areas	625 Euro**			2015	Financial agency	County
Unemployment rate	% of persons in work age who are unemployed	21,15	8,80	8,90	2013	Croatian Employment Service	Involved municipalities
Educational level	% of persons who have an upper secondary degree	53,27	50,55	46,24	2011	CBS	Involved municipalities
Energetic self-sufficiency	% of consumed energy provided by the biomass plant on the total energy consumed	12,09			2012	Energy efficiency action plan of Zadar County	County
	* Specify the territory to which the available data refers to (ie, municipality/municipalities, and/or province in the study area etc..)						

** per employed person on county level, based on Croatian national bank exchange rate at 14.12.2017.

Socio-Economic Indicators' Table (Base Values)

Socio-Economic Indicators		Value Before operations						
		Unit of measure	NP Velebit	NP Vransko jezero	NP Telaš ica	Year	Source	territorial reference*
Total firms**	firms involved in the biomass harvesting and extraction	Number of firms	12			2017	Chamber of economy, Chamber of trades and crafts	Involved municipalities
	firms involved in processing and marketing of wood	Number of firms	42	10		2017	Chamber of economy, Chamber of trades and crafts	Involved municipalities
	firms involved in bioenergy production and distribution	Number of firms	7	3		2017	Chamber of economy	Involved municipalities
	firms involved in satellite activities	Number of firms	22	18	15	2017	Chamber of economy	Involved municipalities
Legal form**	firms involved in the biomass harvesting and extraction	% of individual firms, companies, and cooperatives	84-16-0			2017	Chamber of economy, Chamber of trades and crafts	Involved municipalities
	firms involved in processing and marketing of wood	% of individual firms, companies, and cooperatives	79-21-0	50-50-0		2017	Chamber of economy, Chamber of trades and crafts	Involved municipalities
	firms involved in bioenergy production and distribution	% of individual firms, companies, and cooperatives	0-100-0	0-100-0		2017	Chamber of economy, Chamber of trades and crafts	Involved municipalities
	firms involved in satellite activities	% of individual firms, companies, and cooperatives	0-95-5	0-89-11	0-100-0	2017	Chamber of economy, Chamber of trades and crafts	Involved municipalities
Net income**	firms involved in the biomass harvesting and extraction	mean value of net income	69.301 EUR			2016	Croatian financial agency	Involved municipalities
	firms involved in processing and marketing of wood	mean value of net income	73.613 EUR			2016	Croatian financial agency	Involved municipalities

	firms involved in bioenergy production and distribution	mean value of net income	921.605 EUR			2016	Croatian financial agency	Involved municipalities
	firms involved in satellite activities	mean value of net income	263.220 EUR			2016	Croatian financial agency	Involved municipalities
Labour Productivity (LP)**	**firms involved in the biomass harvesting and extraction**	Mean value of LP	30.100 EUR			2016	Chamber of economy, Croatian financial agency	Involved municipalities
	firms involved in processing and marketing of wood	Mean value of LP	32.874 EUR			2016	Chamber of economy, Croatian financial agency	Involved municipalities
	firms involved in bioenergy production and distribution	Mean value of LP	4.608.028 EUR				Chamber of economy, Croatian financial agency	Involved municipalities
	firms involved in satellite activities	Mean value of LP	55.500 EUR				Chamber of economy, Croatian financial agency	Involved municipalities
Workforce**	**firms involved in the biomass harvesting and extraction**	Number of workers	9			2016	Croatian financial agency	Involved municipalities
	firms involved in processing and marketing of wood	Number of workers	5	7		2016	Croatian financial agency	Involved municipalities
	firms involved in bioenergy production and distribution	Number of workers	1	1		2016	Croatian financial agency	Involved municipalities
	firms involved in satellite activities	Number of workers	86	82	59	2016	Croatian financial agency	Involved municipalities
Workforce Age**	**firms involved in the biomass harvesting and extraction**	Mean value of age of workers						
	firms involved in processing and marketing of wood	Mean value of age of workers						
	firms involved in bioenergy production and distribution	Mean value of age of workers						
	firms involved in satellite activities	Mean value of age of workers						

Type of contracts**	**firms involved in the biomass harvesting and extraction**	Number of employees with fixed-term contract and permanent contract						
	firms involved in processing and marketing of wood	Number of employees with fixed-term contract and permanent contract						
	firms involved in bioenergy production and distribution	Number of employees with fixed-term contract and permanent contract						
	firms involved in satellite activities	Number of employees with fixed-term contract and permanent contract						
Position or job**	**firms involved in the biomass harvesting and extraction**	Number of skilled and unskilled employees						
	firms involved in processing and marketing of wood	Number of skilled and unskilled employees						
	firms involved in bioenergy production and distribution	Number of skilled and unskilled employees						
	firms involved in satellite activities	Number of skilled and unskilled employees						
R&D Investments***	**firms involved in the biomass harvesting and extraction**	A - Mean value of turnover destined in the research and development activity; B - number of patents developed; C - number of employees employed in the research & development activity						

	firms involved in processing and marketing of wood	A - Mean value of turnover destined in the research and developmen t activity; B - number of patents developed; C - number of employees employed in the research & developmen t activity						
	firms involved in bioenergy production and distribution	A - Mean value of turnover destined in the research and developmen t activity; B - number of patents developed; C - number of employees employed in the research & developmen t activity						
	firms involved in satellite activities	A - Mean value of turnover destined in the research and developmen t activity; B - number of patents developed; C - number of employees employed in the research & developmen t activity						
introduction*	**firms involved in the biomass harvesting and extraction**	Mean value of number of the adopted certification s						

	firms involved in processing and marketing of wood	Mean value of number of the adopted certifications						
	firms involved in bioenergy production and distribution	Mean value of number of the adopted certifications						
	firms involved in satellite activities	Mean value of number of the adopted certifications						
Tangible Resources**	**firms involved in the biomass harvesting and extraction**	Mean value of machineries and equipment of firms						
	firms involved in processing and marketing of wood	Mean value of machineries and equipment of firms						
	firms involved in bioenergy production and distribution	Mean value of machineries and equipment of firms						
	firms involved in satellite activities	Mean value of machineries and equipment of firms						

*Specify the territory to which the available data refers to (ie, municipality/municipalities, and/or province in the study area etc..)
** For each phase of supply chain consider the firms operating close to the protected areas, and identified by the following NACE Codes (Rev.2):

- biomass harvesting and extraction 02.1; 02.2; 02.4;
- processing and marketing of wood 16.1; 16.2; 46.13; 46.73.1; 49.41;
- bioenergy production and distribution 35.1;
- satellite activities 02.3; 01.7; 91.04; 55.1; 56.1.

*** Insert at least one of the three indicators.
As above, for each phase of supply chain consider the firms operating close to the protected areas, and identified by the following NACE Codes (Rev.2):

- biomass harvesting and extraction 02.1; 02.2; 02.4;
- processing and marketing of wood 16.1; 16.2; 46.13; 46.73.1; 49.41;
- bioenergy production and distribution 35.1;
- satellite activities 02.3; 01.7; 91.04; 55.1; 56.1.

Ecosystem Services

For the begining, we will display the overview of general data needed for the calculations.

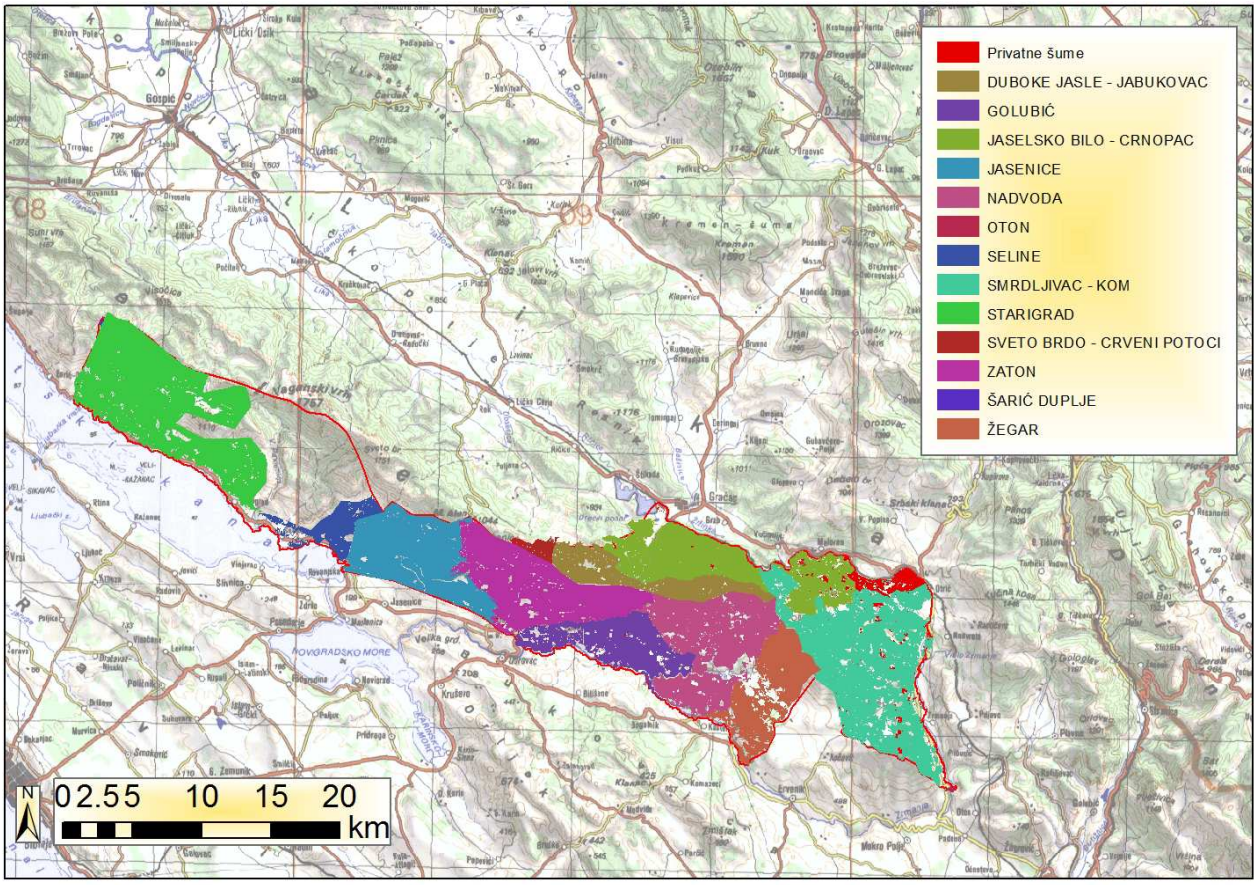
Table 14 and picture 1 are depicting forest areas in state and private ownership from relevant forest management plans inside pilot areas in Zadar County.

According to data from Advisory agency, at pilot areas are some private owned forested areas for which FMPs are not created yet. Inside nature park Telaščica there are 66 ha of degraded forests (maquis and garigue), whilst in the Velebit nature park are approximatelly 231 ha of private owned forests for which FMPs are not created yet.

Table 14. Managed forest areas in pilot areas

Pilot area	Management unit	Forest area (ha)	Total woodstock (m^3)	Total yearly yield (m^3)	Prescribed 10-year cut (m^3)
Telaščica	ZADARSKI OTOCI	746.94	9520	289	0
Telaščica ukupno		**746.94**	**9520**	**289**	**0**
Vransko jezero	BIOGRAD	155.92	7158	317	0
	DONJI KRŠ	993.08	0	0	0
	VRANA	355.19	0	0	0
	NOVIGRADSKO-BENKOVAČKE ŠUME*	6.04	900	24	
Vransko jezero ukupno		**1510.23**	**8058**	**341**	**0**
Velebit	ŽEGAR	2864.12	0	0	0
	DUBOKE JASLE - JABUKOVAC	2281.09	16995	348	0
	GOLUBIĆ	2801.74	850	40	0
	JASELSKO BILO - CRNOPAC	4813.58	477011	9505	42177
	JASENICE	4376.02	44203	605	30
	NADVODA	4830.21	0	0	0
	ŠARIĆ DUPLJE	8.31	363	4	0
	OTON	17.85	0	0	0
	SELINE	1183.98	980	39	0
	SMRDLJIVAC - KOM	8598.35	163345	2446	6080
	STARIGRAD	8163.64	135883	5098	505
	SVETO BRDO - CRVENI POTOCI	262.34	9494	139	1400
	ZATON	5014.63	53985	1684	0
	GRAČAC - OSREDCI – PRIBUDIĆ*	279.57	23608	387	2283
	MUŠKOVCI – ZELENGRAD*	16.34	860	22	87
Velebit ukupno		**45511.77**	**927577**	**20317**	**52562**
Sveukupno		**47768.94**	**945155**	**20947**	**52562**

*Management unit of private-owned forests



Picture 1. Spatial distribution of state and private owned forests[1] in Zadar County part of nature park Velebit

As can be seen from table 14 and 15, only in nature park Velebit felling and forest exploitation is prescribed. Table 15 displays woodstock, yield and prescribed felling according to management classes and pilot areas.

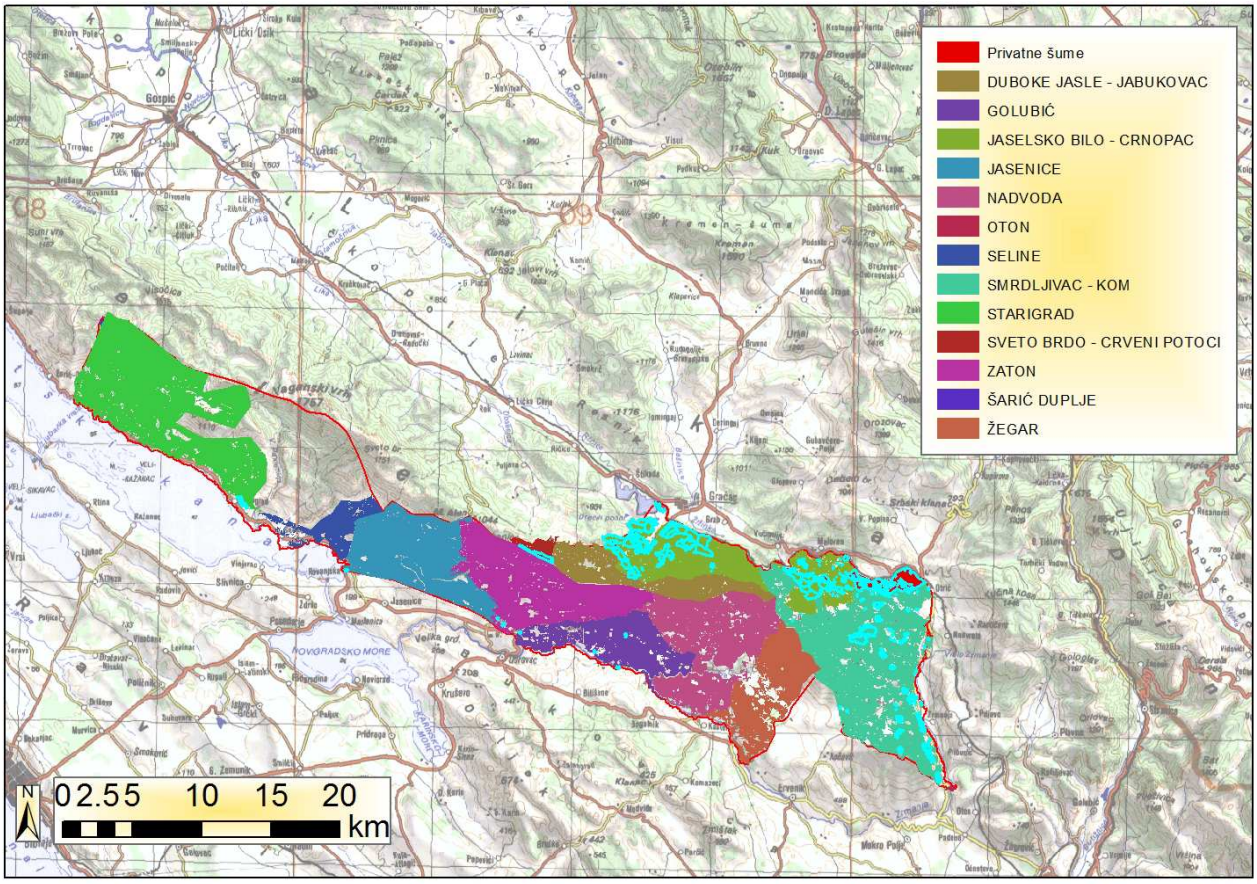
Table 15. Woodstock, yield and prescribed felling according to management classes and pilot areas

Pilot area	Management class	Forest area (ha)	Total woodstock (m^3)	Average woodstock (m^3/ha)	Total yearly yield (m^3)	Average yearly yield (m^3/ha)	Prescribed 10-year cut (m^3)
Telaščica	Aleppo pine seed forest	253.05	9520	37.62	289	1.14	0
	Maquis	54.8	0	0.00	0	0.00	0
	Garigue	66.53	0	0.00	0	0.00	0
	Non-overgrown productive forest area	372.56	0	0.00	0	0.00	0

[1] Area in northwest park of nature park Velebit without depicted forests is National park Sjeverni Velebit

Telaščica total		**746.94**	**9520**	**12.75**	**289**	**0.39**	**0**
Vransko jezero	Aleppo pine seed forest	75.98	7158	94.21	317	4.17	0
	Stone pine seed forests	9.38	900	95.95	24	2.56	0
	Maquis	1403.31	0	0.00	0	0.00	0
	Garigue	7.43	0	0.00	0	0.00	0
	Non-overgrown forest area	5.33	0	0.00	0	0.00	0
	Fallow land	8.8	0	0.00	0	0.00	0
Vransko jezero total		**1510.23**	**8058**	**5.34**	**341**	**0.23**	**0**
Velebit	Mediterranean cypress	16.78	1229	73.24	35	2.09	0
	Aleppo pine seed forest	40.49	4143	102.32	171	4.22	535
	Black pine seed forest	329.82	23034	69.84	1197	3.63	0
	Silver fir seed forest	475.74	97859	205.70	1480	3.11	3025
	Aleppo pine plantation	86.69	748	8.63	46	0.53	0
	Black pine plantation	213.63	15597	73.01	245	1.15	1779
	Common beech seed forest	2557.34	491492	192.19	9958	3.89	30554
	Pubescent oak seed forest	86.16	5171	60.02	78	0.91	379
	Turkey oak seed forest	180.59	15705	86.96	274	1.52	1631
	Common beech coppice	1896.69	219483	115.72	5512	2.91	14572
	Pubescent oak coppice	9.57	158	16.51	3	0.31	12
	Hop hornbeam coppice	106.66	7092	66.49	209	1.96	0
	Common hornbeam coppice	14.03	1878	133.86	34	2.42	0
	Turkey oak coppice	858.05	43988	51.27	1075	1.25	75
	Thicket	23333.47	0	0.00	0	0.00	0
	Shrubbery	2881.85	0	0.00	0	0.00	0
	Non-overgrown productive forest area	11304.91	0	0.00	0	0.00	0
	Non-overgrown non-productive forest area	440.99	0	0.00	0	0.00	0
	Fallow land	678.31	0	0.00	0	0.00	0
Velebit total		**45511.77**	**927577**	**20.38**	**20317**	**0.45**	**52562**
total		**47768.94**	**945155**	**19.79**	**20947**	**0.44**	**52562**

In Croatia according to existing legislative, woodstock is not measured and displayed for degraded forms of forests (thickets, shrubbery, maquis, garigue). Regarding nature park Velebit, almost 95 % of prescribed felling is planned in beech forest that are located on northeast (continental) side of Velebit mountain (picture 2), since on the southwest (maritime) side of the Velebit mountain degraded forests are prevailing with smaller areas of pine plantations or oak coppices.



Picture 2. Highlighted areas are representing management compartments in which felling is prescribed

The Wood Commercial Use Value (Vt)

The Fuelwood Use Value (Vf)

For calculation of these indicators folowing data is needed:

- Ammount of prescribed felling in next 10 years-Table 15
- Data about asortment ratio in felled trees- from FMP for Republic of Croatia (table 16.) where are enlisted ratios of accomplished asortments (logs, technical

wood, fuelwood, woodwaste) in last 10-year cycle. We will use ratio according to main tree species in management class since that species is prevailing

- Wood price-From official price list of Croatian forests ltd. (average price for all quality categories of logs, technical wood and fuelwood) (http://portal.hrsume.hr/images/dok/proizvodi/cjenik_glavnih_sumskih_proizvoda_201801.pdf)

Table 16. Ratio of asortments according to tree species/management classes

Species	Logs		Technical wood		Fuelwood		Wood waste
	%	average price (HRK/m³)	%	average price (HRK/m³)	%	average price (HRK/m³)	%
Aleppo pine	25.06	412	14.98	320	44.97	131	15
Silver fir	45	434	1	351	33	131	21
Black pine	27.44	412	14.19	320	43.37	131	15
Common beech	29.70	413			50.95	209	19.35
Pubescent oak					89	197	11
Turkey oak					89	197	11

These indicator will be calculated only for nature park Velebit (Table 17 i 18) since only there the felling is prescribed, whilst in other pilot areas is not due to degradation of forests and unfavorable conditions in the environment.

Table 17. Commercial wood value (excluding wood waste)

Management class/tree species	Forest area (ha)	Prescribed 10-year cut (m³)	Average year cut (m³)	Total value of logs	Total value of technical wood	Total value of fuelwood	Total value of wood (HRK)
Aleppo pine seed forest	40.49	535	53.5	5523.73	2564.58	3151.72	11240.02
Silver fir seed forest	475.74	3025	302.5	59078.25	1061.78	13077.08	73217.10
Black pine plantation	213.63	1779	177.9	20112.09	8078.08	10107.34	38297.51
Common beech seed forest	2557.34	30554	3055.4	374778.42		325355.80	700134.22
Pubescent oak seed forest	86.16	379	37.9	0.00		6645.01	6645.01
Turkey oak seed forest	180.59	1631	163.1	0.00		28596.32	28596.32
Common beech coppice	1896.69	14572	1457.2	178741.61		155170.67	333912.28

Pubescent oak coppice	9.57	12	1.2			210.40	210.40
Turkey oak coppice	858.05	75	7.5			1314.98	1314.98
Total	**6318.26**	**52562**	**5256.2**	**638234.10**	**11704.43**	**543629.30**	**1193567.83**

Table 18. Value of wood if all felled wood is used as fuelwood (excluding wood waste)

Management class/tree species	Forest area (ha)	Prescribed 10-year cut (m3)	Average year cut (m3)	Total value of fuelwood (HRK)
Aleppo pine seed forest	40.49	535	53.5	5957.93
Silver fir seed forest	475.74	3025	302.5	31305.73
Black pine plantation	213.63	1779	177.9	19809.17
Common beech seed forest	2557.34	30554	3055.4	515013.64
Pubescent oak seed forest	86.16	379	37.9	6645.01
Turkey oak seed forest	180.59	1631	163.1	28596.32
Common beech coppice	1896.69	14572	1457.2	245623.45
Pubescent oak coppice	9.57	12	1.2	210.40
Turkey oak coppice	858.05	75	7.5	1314.98
Total	**6318.26**	**52562**	**5256.2**	**854476.60**

From Table 17 and 18 it is evident that the value of the annual available wood mass if commercially used is 1,193,567.83 HRK (160,300.82 EUR) and if were used as fuel wood value is 854,476.60 HRK (114,759.54 EUR)

The Wood Energy Production Value (Ve)

Table 19 shows the parameters used for calculating this indicator, but the price of produced energy depends on a lot of parameters such as the distance of transport, the cost of building an energy conversion plant, the size of the plant and of course the efficiency of the powerplan,t hence it is not listed. Grilli et al (2015), merely state that energy price can be used, but they also did not calculate it (probably for the reasons stated).

Table 19. Used parameters (Handbook of fuels from wood biomass, REGEA, 2008)

Management class/tree species	Density of semi-dried wood (13% moisture)	Energy value MJ/kg	Value of produced energy
Aleppo pine seed forest	810	19,2	
Silver fir seed forest	470	19,2	
Black pine plantation	560	19,2	
Common beech seed forest	750	18,4	
Pubescent oak seed forest	760	19	
Turkey oak seed forest	760	19	
Common beech coppice	750	18,4	
Pubescent oak coppice	760	19	
Turkey oak coppice	760	19	

It should be noted that the energy potential presented in the following table represents the theoretical potential. The technical potential, ie the level of practical exploitation of this potential, will depend on the efficiency of the plant for the production of useful energy (heating plants, power plants or cogeneration plants).

Table 20. Calculation of available energy from wood

Management class/tree species	Forest area (ha)	Prescribed 10-year cut (m^3)	Average year cut (m^3)	Ammount of available biomass (without woodwaste)	Available energy (MJ)
Aleppo pine seed forest	40.49	535	53.5	45.48	832032
Silver fir seed forest	475.74	3025	302.5	238.98	2729760
Black pine plantation	213.63	1779	177.9	151.22	1912781
Common beech seed forest	2557.34	30554	3055.4	2464.18	42164520
Pubescent oak seed forest	86.16	379	37.9	33.73	547276
Turkey oak seed forest	180.59	1631	163.1	145.16	2355164
Common beech coppice	1896.69	14572	1457.2	1175.23	20109360
Pubescent oak coppice	9.57	12	1.2	1.07	17328
Turkey oak coppice	858.05	75	7.5	6.68	108300
Total	**6318.26**	**52562**	**5256.2**	**4261.72**	**70776521**

It is evident that an average of 70,776.52 GJ of energy from biomass is available annually (for the next 10 years) if all of the felled wood are used as energy wood.

The Sequestered Carbon Value (Vc)

When calculating this indicator, the mean values of BEF factor (1.05 and 1.15 for conifers, 1.2 for broadleaved trees) and Shoot-to-Root (for conifers 0.23-0.46 depending on wood stock; 0.24-0.43 for broadleaved trees depending on wood stock) according to LUCF Sector Good Practice Guidance, will be used.

The price of CO_2 in the Republic of Croatia, according to the available data for 2013-2015, averaged 45.51 HRK / t (NN 105/14, 96/15, decision for year 2015. at http://www.mzoip.hr/doc/odluka_o_visini_jedinicne_naknade_za_2015_godinu_1.pdf) .

This indicator will also be calculated for nature park Velebit only. The yield percentage of felled wood will be calculated from available data on total wood stock and total yield.

Table 21. Calculation of the possible yield from felled wood

Management class/tree species	Forest area (ha)	Total woodstock (m^3)	Average woodstock (m^3/ha)	Total year yield (m^3)	Average year yield (m^3/ha)	yearly percentage of yield	Average year cut (m^3)	Yearly yield of felled wood
Aleppo pine seed forest	40.49	4143	102.32	171	4.22	4.13	53.50	2.21
Silver fir seed forest	475.74	97859	205.70	1480	3.11	1.51	302.50	4.57
Black pine plantation	213.63	15597	73.01	245	1.15	1.57	177.90	2.79
Common beech seed forest	2557.34	491492	192.19	9958	3.89	2.03	3055.40	61.90
Pubescent oak seed forest	86.16	5171	60.02	78	0.91	1.51	37.90	0.57
Turkey oak seed forest	180.59	15705	86.96	274	1.52	1.74	163.10	2.85
Common beech coppice	1896.69	219483	115.72	5512	2.91	2.51	1457.20	36.60
Pubescent oak coppice	9.57	158	16.51	3	0.31	1.90	1.20	0.02
Turkey oak coppice	858.05	43988	51.27	1075	1.25	2.44	7.50	0.18
Total	**6318.26**	**927577**		**20317**			**5256.20**	**111.70**

Table 22. Calculation of CO_2 value that could be sequstered from felled wood

Management class/tree species	Yearly yield of felled wood	Aboveground biomass	Belowgroung biomass	Yearly ammount of sequestered CO_2 from athmosphere by felled wood (HRK)
Aleppo pine seed forest	2.21	2.54	0.57	260.01
Silver fir seed forest	4.57	4.80	1.05	489.03
Black pine plantation	2.79	3.21	1.29	375.72
Common beech seed forest	61.90	74.29	14.86	7444.39
Pubescent oak seed forest	0.57	0.69	0.25	77.82
Turkey oak seed forest	2.85	3.41	1.00	368.33
Common beech coppice	36.60	43.91	9.51	4461.94
Pubescent oak coppice	0.02	0.03	0.01	3.10
Turkey oak coppice	0.18	0.22	0.08	24.95
Total	**111.70**	**133.10**	**28.61**	**13505.30**

According to the presented, felled wood could annualy sequester CO2 in ammount of 13,505.30 HRK (1,813.81 EUR).

The cost of Replacing the Protective Function (Vp)

In the area of nature park Velebit, the prevailing model of management is selection management and un-evenage management, achieving that the soil is always covered with canopies and regeneration is performed on smaller surfaces. Likewise, prescribed felling is prescribed only in some management compartments (106 of 1602) ie at approximately 1800 ha.

For the purpose of this calculation, we will be considering as the felling is concentrated ie. Performing clearcutting. Observing the average wood stock of this area (approximately 146 m3 / ha) and the amount of planned average annual felling (5,256.20 m3) in some theoretical conditions when performing clear felling, each year about 36 hectares of forest would be clearcutted in the area of nature park Velebit.

This data will be used to calculate the replacement cost of the protective function, alongside with the amount of the cost of converting the broadleaved stand in karst areas (8,881.53 EUR / ha- NN 45/2016, Annex 1, page 44). The annual interest rate will be used according to Grilli et al (2017) in the amount of 2%. Also, these stands will only be considered as indirectly protective, as they are not located near the inhabited places, hence the investment time is 15 years (according to Grilli et al, 2017).

Consequently, the annual cost of replacing the protective function of the theoretical 36 ha of the area cleared per year would be EUR 4,751.36.

The Cultural Service Value (Vs)

The chosen method for this indicator is the number of visitors per year. As all other indicators were calculated for nature park Velebit, in Table 23 we also show only values for that pilot area.

Table 23. Ammount of visitors by years in nature park Velebit

Year	2013.	2014.	2015.	2016.	2017.
Total	35317	32030	37202	43091	49889

REFERENCES

Hrvatska agencija za okoliš i prirodu (2017): web portal Informacijskog sustava zaštite prirode "Bioportal". Dostupno na http://www.iszp.hr/gis. Pristupljeno: prosinac, 2017.

Topić, J., Vukelić, J. (2009): Priručnik za određivanje kopnenih staništa u Hrvatskoj prema Direktivi o staništima EU. Državni zavod za zaštitu prirode. Zagreb.

The IUCN Red List of Threatened Species™ website (http://www.iucnredlist.org/)

Zakon o šumama (NN 140/05, 82/06, 129/08, 80/10, 124/10, 25/12, 68/12, 148/13, 94/14) / *The Forest Law – Official Gazette, no. 140/05, 82/06, 129/08, 80/10, 124/10, 25/12, 68/12, 148/13, 94/14;*

Zakon o zaštiti prirode (NN 80/13) / *The Nature Protection Act – Official Gazette, no. 80/13;*

Zakon o zaštiti okoliša (NN 80/13, 153/13, 78/15) / *The Environmental Protection Act – Official Gazette, no. 80/13, 153/13, 78/15;*

Uredba o ekološkoj mreži (NN 124/13) / *Regulation on the Ecological Network – National Gazette, no. 124/13;105/15*

Akcijski plan energetske učinkovitosti Zadarske županije 2015. – 2017/Zadar County Action plan of energy efficiency 2015. – 2017

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