



Specific forest attributes that influence forest therapy



Martina Zorić



martinazoric@uns.ac.rs



Institute of Lowland Forestry and Environment, University of Novi Sad, Serbia
www.ilfe.org

Content:

Forest Ecosystem Services

Causal relationship forest-
human health

The role of BVOCs

BVOCs research



Ecosystem services

Ecosystem Services-ES:

various benefits provided from certain ecosystem.

Who benefits?

- Humans
- Parts of certain ecosystem
- Other ecosystems.



ES provided by forests

- **Supporting**

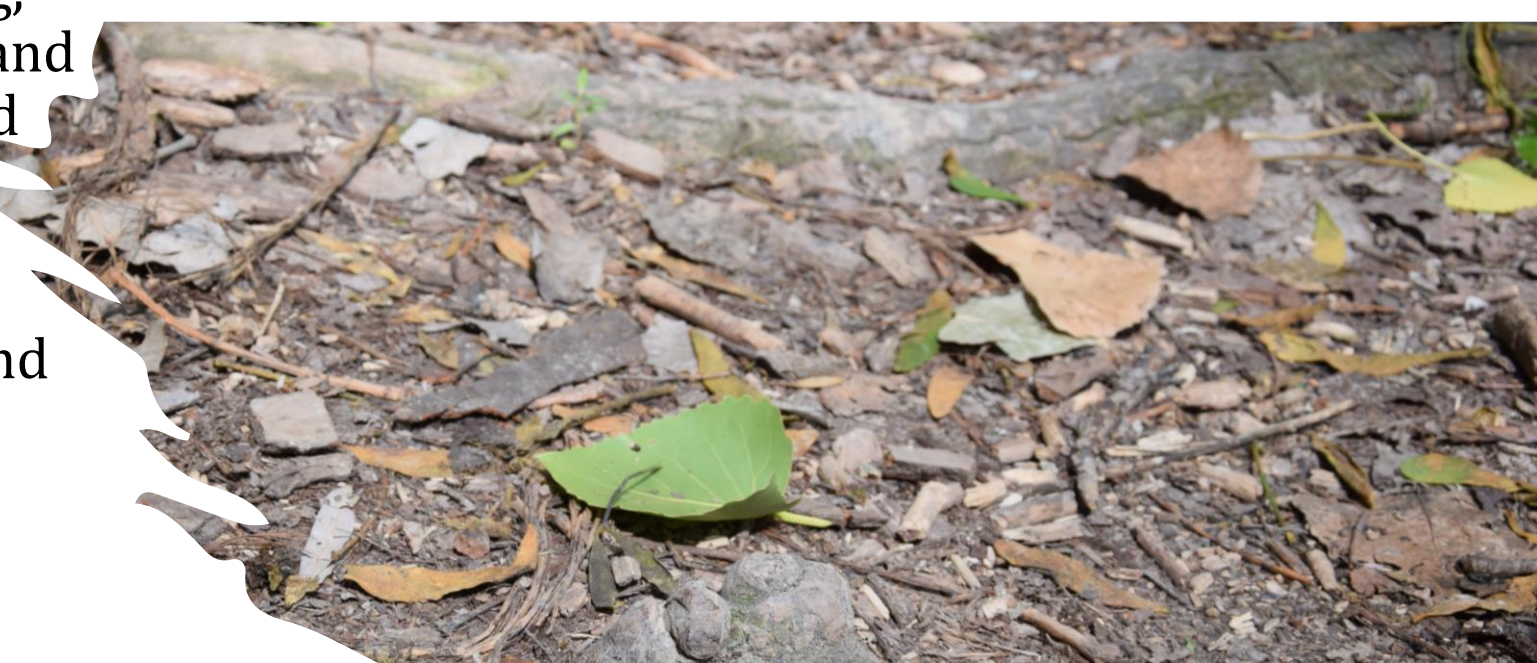
CO2 sequestration, climate regulation, water cycle regulation, and erosion control.

- **Socio-economic:**

Improved human health and well-being, space for social interaction, education and recreation, wood production, improved air quality etc.

- **Cultural**

Last, but not the least, multiple plant and animal species have high cultural, traditional and spiritual value for us.





Causal relationship forest-human health

- Final goal of research in ES is to define a value of ES of certain ecosystem
- Increase end-users and decision-makers interest
- Find methods for additional sources of funding for biodiversity and ecosystem preservation and maintenance especially forests
- One of those methods for sustainable and unobtrusive usage of forests is forest therapy



Forest attributes affecting forest therapy

- Availability to the site
- Infrastructure (hiking trails, built resting places...)
- Water surfaces availability
- Wildlife
- Type of forest (managed/unmanaged)
- Aesthetic quality
- *Tree species* —————→ *BVOCs (Phytoncides)*



International Journal of
Environmental Research
and Public Health



Article

Developing Forest Therapy Programmes Based on the Health Benefits of Terpenes in Dominant Tree Species in Tara National Park (Serbia)

Martina Zorić ^{1,*}, Jelena Farkić ², Marko Kebert ¹, Emina Mladenović ³, Dragić Karaklić ⁴, Gorana Isailović ⁵ and Saša Orlović ¹

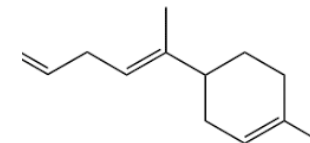
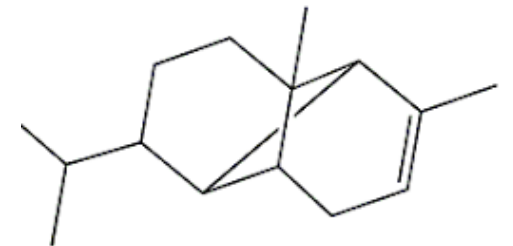
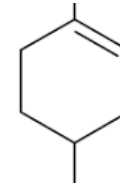
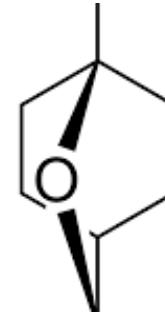
¹ Institute of Lowland Forestry and Environment, University of Novi Sad, Antona Čehova 13d, 21000 Novi Sad, Serbia; kebertm@uns.ac.rs (M.K.); sasao@uns.ac.rs (S.O.)

² Academy of Applied Studies, Bulevar Zorana Djindjica 152a, 11000 Belgrade, Serbia; jfarkic@gmail.com

³ Department of Forest Management, Faculty of Forestry, University of Novi Sad, Antona Čehova 13d, 21000 Novi Sad, Serbia

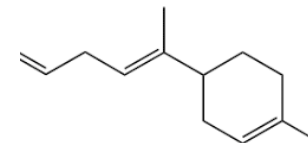
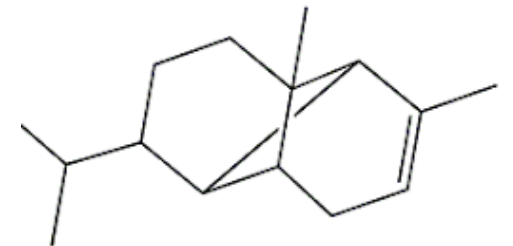
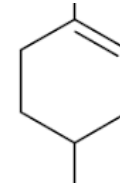
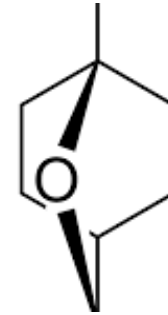
BVOCs

- Volatile organic compounds (VOCs)- **biogenic** (BVOCs) and anthropogenic (AVOCs) origin
- Air VOCs are highly reactive and dependent to environmental conditions
- BVOCs in the air include atmospheric trace gases of organic origin, such as terpenes (isoprenoids), alkanes, alkenes, aldehydes, ketones, alcohols, esters, ethers and acids
- Terpenes are the largest class of plant secondary metabolites, largely unrecognized, about 1000 new structures are being added every year.



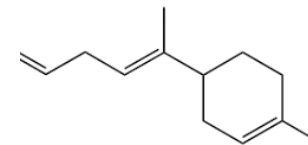
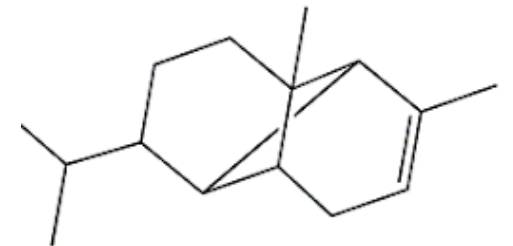
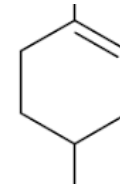
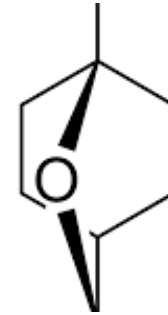
BVOCs

- BVOC (terpenes)– produced as secondary metabolites in different plant processes have wide range of roles for plants (reaction to stress, plant communication, defense...)
- Forests are recognized as a major source of these compounds
- Content and type of terpenes is characteristic for each species, and also differ between individual trees.



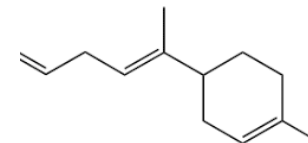
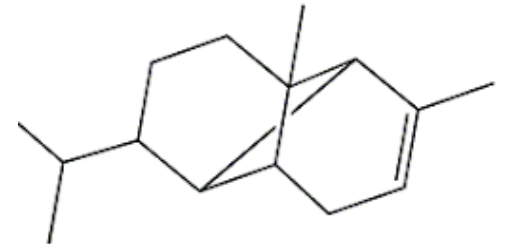
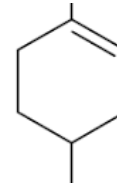
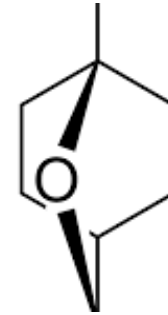
BVOCs

- Terpenes include classes of monoterpenes (MT), sesquiterpenes (SQT) and diterpenes, (C5 units difference)
- (MT) and (SQT) most abundant in plants and in the air
- Highly reactive compounds when emitted in the air,
- Their lifetime (1 min to 24h) is highly dependent on the environmental conditions and is characteristic to each specific time and place.



BVOCs

- Trees BVOCs and human health influence:
Air quality
Forest therapy
- Urban vs natural environments-using
appropriate species in terms of human health

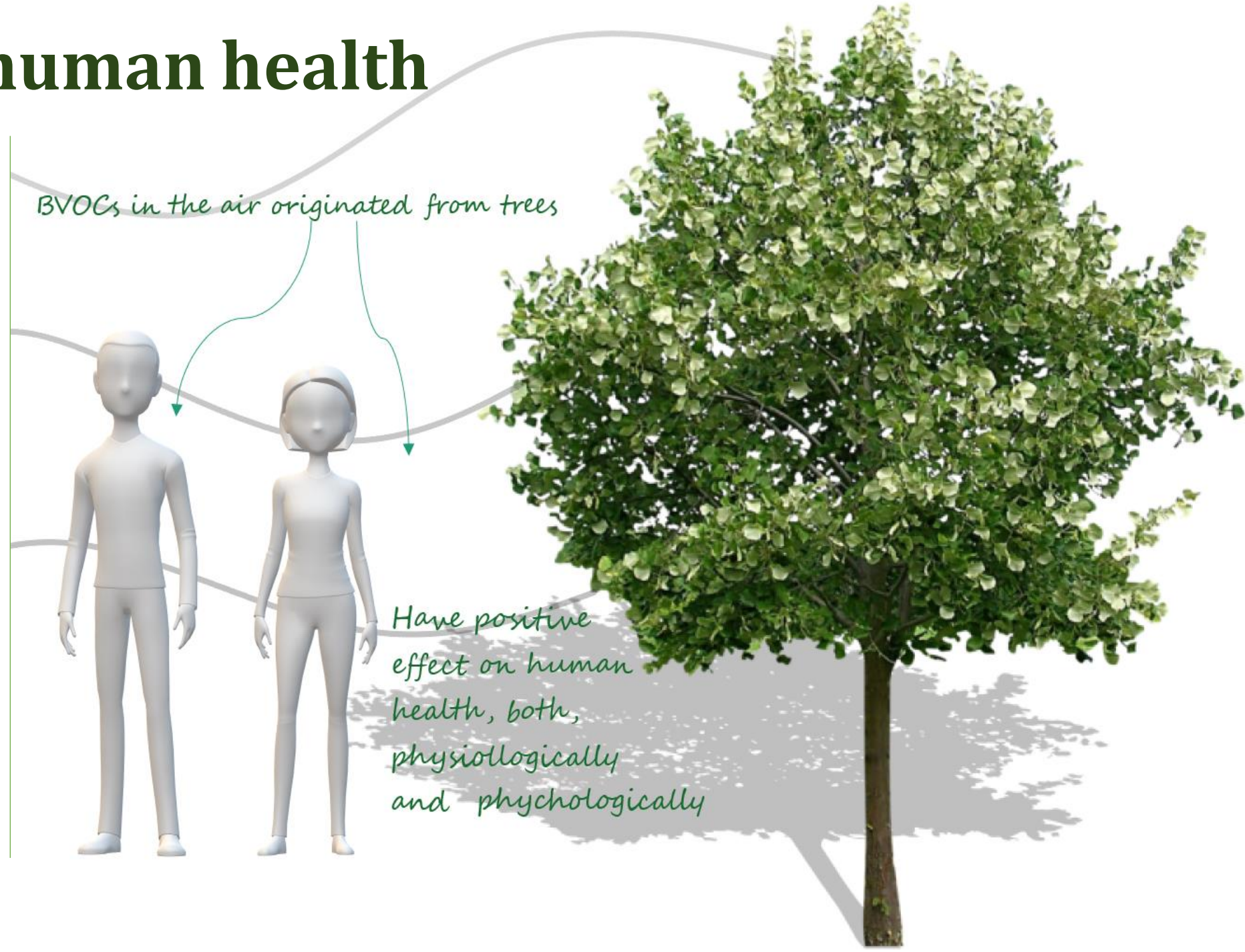


Impact of forest therapy on human health and well-being

Impact	Description of Improvement
The immune system	Observed increment of natural killer (NK) cells
Cardio-vascular system	Observed lower blood pressure and heart rate
Respiratory system	Decreased symptoms of allergies and asthma
Diabetes	Observed decrement of blood glucose values
Mental disorders	Decreased symptoms of stress, depression, and anxiety
Chronic pain	Chronic pain decrement

Forests and human health

?



Forest BVOCs -ILFEs research

- Due to the high reactivity in the air, we are analyzing the content in the plant-defining the potential of the plant to emit BVOCs
- Taking samples from different parts of the plant to ensure full coverage
- VOCs content analyzed by headspace gas chromatography/ mass spectroscopy (Headspace GC/MS Analysis)



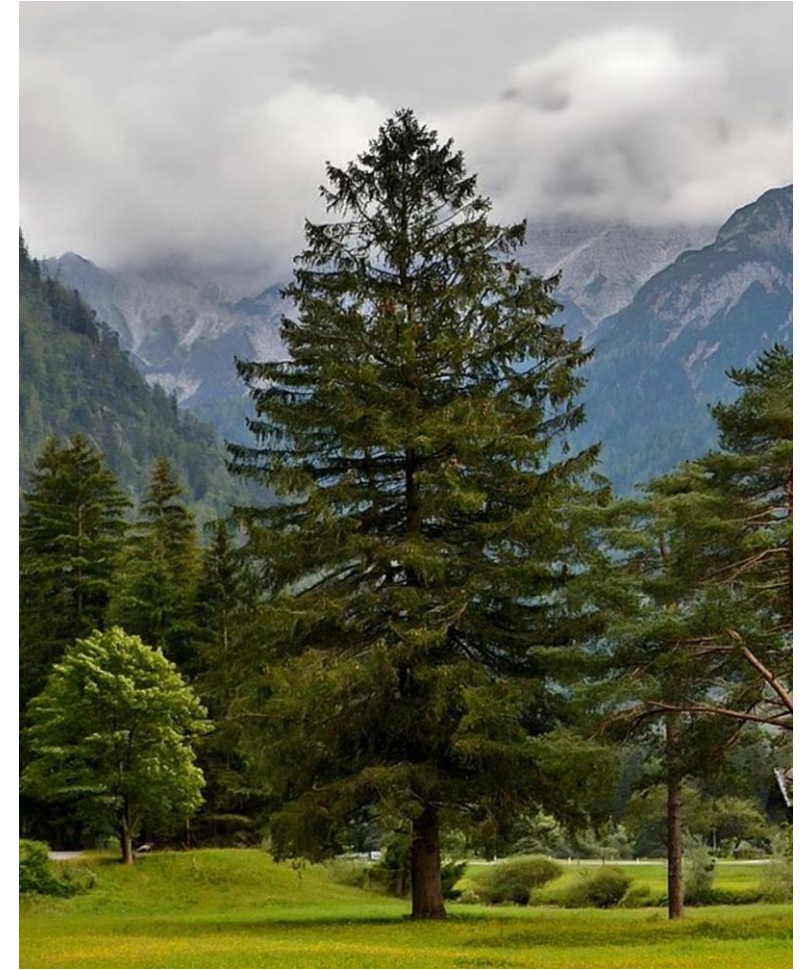
Forest BVOCs -ILFEs research



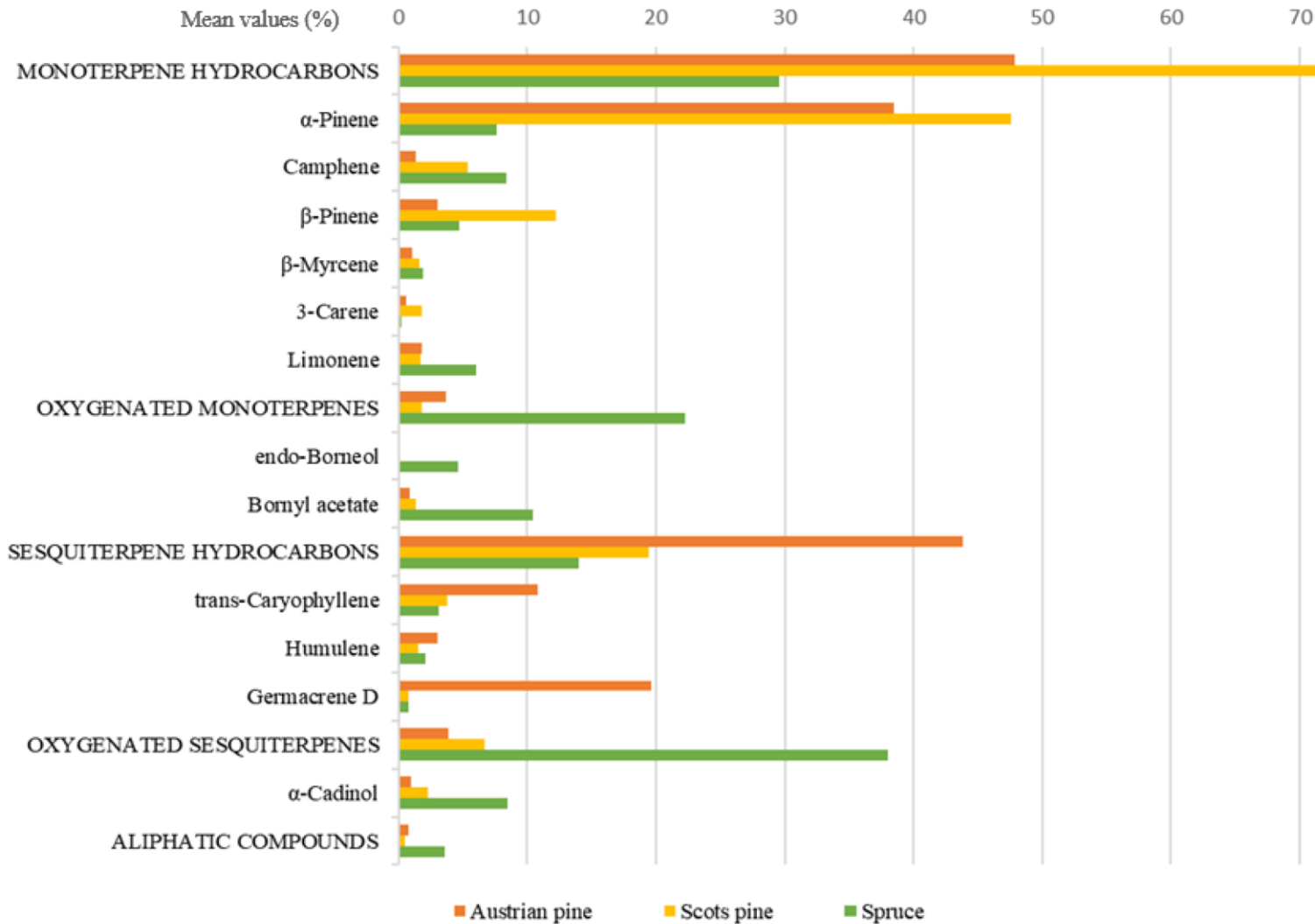
Austrian pine (*Pinus nigra*)



Scots pine (*Pinus sylvestris*)



Spruce (*Picea abies*)



Main
terpenes
detected in
the
investigated
species

Phytoncide	Effects
α-Pinene	Anti-inflammatory
	Anticancer
	Sedative
Limonene	Anticancer
	Anti-inflammatory
Terpinolene	Anticancer
	Anti-inflammatory
β-Pinene	Anti-depressant
	Anticancer
	Antimicrobial
Linalool	Anti-depressant
	Anti-inflammatory
	Antimicrobial
	Anticancer
Camphene	Anticancer
Camphor	Antiviral
	Anti-inflammatory
Citronellol	Anticancer
	Anti-inflammatory
α-Cadinol	Antiviral
	Anticancer





Article

Phytochemical Screening of Volatile Organic Compounds in Three Common Coniferous Tree Species in Terms of Forest Ecosystem Services

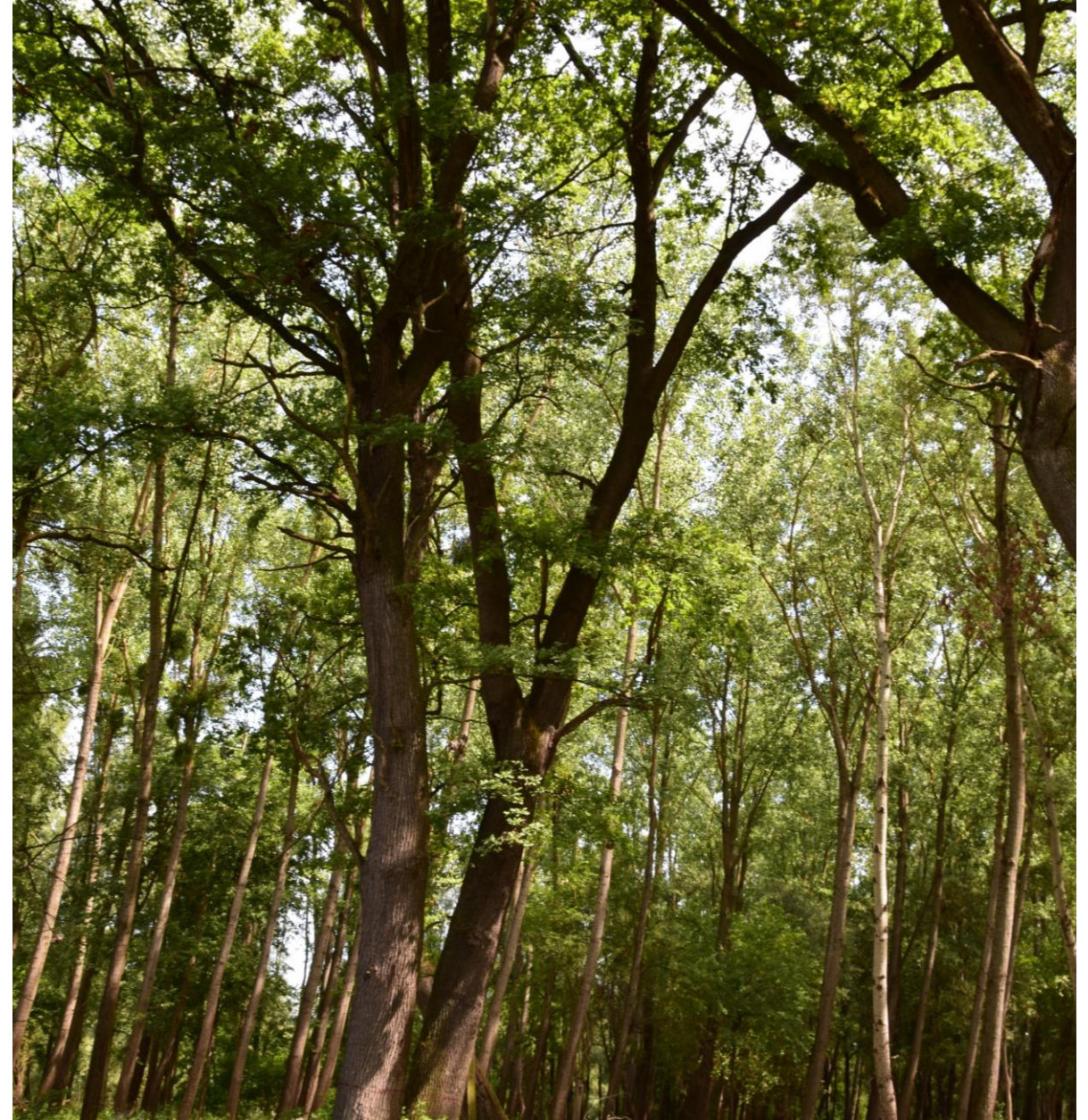
Martina Zorić ^{1,*}, Saša Kostić ¹, Nebojša Kladar ², Biljana Božin ³, Verica Vasić ¹, Marko Kebert ¹ and Saša Orlović ¹

¹ Institute of Lowland Forestry and Environment, University of Novi Sad, Antona Čehova 13d, 21000 Novi Sad, Serbia; sasa.kostic@uns.ac.rs (S.K.); vericav@uns.ac.rs (V.V.); kebertm@uns.ac.rs (M.K.); sasao@uns.ac.rs (S.O.)

² Department of Pharmacy, Faculty of Medicine, University of Novi Sad, Hajduk Veljkova 3, 21000 Novi Sad, Serbia; nebojsa.kladar@mf.uns.ac.rs

³ Center for Medical and Pharmaceutical Investigations and Quality Control, Faculty of Medicine, University of Novi Sad, Hajduk Veljkova 3, 21000 Novi Sad, Serbia; biljana.bozin@mf.uns.ac.rs

* Correspondence: martinazoric@uns.ac.rs



A large, moss-covered tree trunk dominates the foreground, leaning towards the right. The background shows a calm lake reflecting the sky and surrounding greenery. Five semi-transparent text boxes are overlaid on the image, each containing a different phrase related to forest research and sustainability. The boxes are arranged in a circular pattern around the tree trunk.

Research on trees and
forests

Increase green areas
and biodiversity

Guidelines for medical
professionals for
usage of trees and
forests for human
health improvement

Gain income from
sustainable and eco-
friendly usage of
forests

Define additional
value

Institute of Lowland Forestry and Environment,
University of Novi Sad, Serbia



Thank you



Martina Zorić



martinazoric@uns.ac.rs

