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LANGUE DURÉE OF MORE-THAN-HUMAN-SOCIALITY OF GORSKI KOTAR FORESTS AND CONTEMPORARY ENVIRONMENTAL CHALLENGES

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The article analyzes contemporary environmental challenges in the forests of Gorski Kotar through the prism of more-than-human sociality. It delves into the impact of human forest management dating back to the 19th century which initiated a complex series of adaptations of plants and insects to new circumstances. This has led to contemporary environmental issues, such as the fir moth infestation and the correlated damage from ice storms.

The sociality of Gorski Kotar forests is approached from the perspective of dynamic relationships between species that create a forest meshwork of social relationships, including the fir moth, beech, fir, and humans. This perspective also includes nature's response to changes in environmental conditions (climate change), and a critical description of human activities because they frame the subject of research (forest management). The text shows that certain forest disasters, such as an infestation of the fir moth (including the correlated damage from ice storms), occur as a result of a complex set of interconnected relationships between several species that were initiated several centuries ago. The text also asserts that if humans wish to remain a part of the vital forest ecosystem, they must align their interests and techniques with other forest inhabitants and start to consider the ecological, economic, and symbolic values of the forest with equal importance.

Keywords: *forest, Gorski Kotar, environment, Thurn Taxis, more-than-human-sociality*

"The forest was always here, within arm's reach, as an open treasury used by people (often too much) when circumstances forced them to do so. The forest has always renewed itself after such excessive engagement and ensured its people the possibility to live on this […] land" (Rauš 1992:9). Đuro Rauš, a forestry expert and scientist, used these words as an

introduction to his edited *opus magnum* "Forests in Croatia," a book that in various articles brings together topics related to forestry science and other fields, including the inspirational impact of forests on poets and painters. Rauš's words echo people's general perception of the forest (at least in our part of the world, central and east Europe) as something *given* (to us) to manage and care for, a task which we have, more often than not, performed poorly. In this mode of thinking, *we act* upon a forest, and if we are careful, it will regenerate, allowing us to repeat our actions. Within this mindset, we always question what and in which way we act upon the forest for our utilitarian purposes, and the only thing that is traditionally acknowledged as the *forest's acting* upon us is its impact on our emotional, aesthetic, and artistic sides.[1] Indeed, in the book mentioned above, one chapter is titled "Feuilleton about the tree and the forest" dedicated to artwork inspired by the forest (Peić 1992:297).

This article takes on another perspective when dealing with the major part of forests in the Gorski Kotar region of Croatia, which was historically managed by the Thurn Taxis family. It discusses forest management dating back to the 19th century in Gorski Kotar, and relates it to the forest calamities that were caused by infestations of the fir moth (including its correlation with damages caused by ice storms), while exploring some recent ideas from anthropology and ecological humanities. This field is based on the idea of organicism, which emphasizes connectivity and mutual interdependence, paying particular attention to multispecies sociality (Morton 2013; Domańska 2015). It takes a relational approach and considers things in their interconnectedness, rather than as separate entities (Kirksey and Helmreich 2010; Tsing 2013). I see the aforementioned calamities as a part and a result of the complex set of relations that have been set in motion several centuries ago and encompass both human and non-human spheres. Encompassing both the human and non-human spheres means avoiding the dualism that sets humanity and nature at opposite poles, against which William Cronon warns in his critique of the term "wilderness" in Western thought (Cronon 1995). Cronon argues that "people should always be conscious that they are part of the natural world, inextricably tied to the ecological systems that sustain their lives" (Cronon 1995:17).[2] The

[1] The perspective of acting upon the forest for utilitarian purposes, and the forest's impact on non-utilitarian social values is mirrored in traditional sciences associated with plants, which are focused on their utilitarian uses (such as indigenous uses of plants (ethnobotany), the material role of plants as objects of commerce (economic botany), the use of plant medicines (medical botany), and forestry sciences), as well as on traditionally excepted non-utilitarian social values associated with plants (aesthetic, symbolic, linguistic, mythological) (For further information, see Ryan 2012:102).

[2] The inseparability of humanity and nature led Timothy Morton to advocate for discarding the concept of nature altogether, as it is not "natural," but rather an artificial (human) construct (Morton 2009:64).

separation of humanity and nature has, according to Jason Moore, encouraged a way of thinking about history that privileges what humanity does to nature (Moore 2015:5). This is evident in the quote from Rauš above, where he echoes how we often only consider our actions on the forest, without acknowledging the forest as an active participant beyond its reaction to our actions. In his "Introduction" to Capitalism in the Web of Life, Moore explains how the narrative of modernity, industrial civilization, and capitalism follows the trajectory of emerging from and exploiting Nature, causing harm to it, and now facing the impending revenge of Nature. This has encouraged a historical perspective that focuses on the negative impacts of human activity on nature, leading to the popularity of apocalyptic narratives in environmental and scholarly circles (Moore 2015:5). Moore continues to acknowledge an alternative approach that emphasizes the interconnected relations that create various forms of human-nature interactions. In this view, "history" is the story of a "double internality": humanity-in-nature/nature-in-humanity, highlighting the intertwined nature of human activities and the broader web of life, which includes humans (ibid.). In this sense, I am describing the intertwined nature of one particular human activity – forest management – and some elements of the broader web of forest life – trees and insects – from the second half of the nineteenth century to the present date. For the purposes of our topic, I am paraphrasing Kirsten Hastrup's words (2014) saying that the forest is implicit in social, intellectual, and economic human life, which again is complicit in the makings of the forest.[3] I shall call all these intertwining relations in the forest scene a forest meshwork[4] of social relations. Within this vast meshwork, I focus on fir and beech trees and their interconnections with humans, climate, and one specific insect, the fir moth. The focus on trees allows me to think about forests as ecosystems essential for coping with environmental and social contemporary uncertainties, which is an approach associated with dendrocriticism (Ryan 2022:190).

In short, I am relating contemporary environmental challenges in Gorski Kotar forests with forest management practices dating back to the 19th century, which initiated a complex series of adaptations and actions of plants and insects enabled by new circumstances. This does not mean that the environmental issues described here are unique to Gorski Kotar. The fir moth infestations were not recorded only in Gorski Kotar. This insect is a typical monophagous pest whose distribution in Europe coincides with the area of the

[3] To describe the multi-species co-creation of the common milieu, Kirsten Hastrup emphasizes that today anthropology takes nature as "implicit in social and intellectual life, which is again complicit in the makings of nature" (Hastrup 2014:5).

[4] I use the term "meshwork" as Tim Ingold intended, that is, as a vision of the inseparability of things from their surroundings in the net consisting of lines of flow (Ingold 2010:11). We can imagine lines of flow as traces that human and non-human activities leave behind in a lived space.

common fir. More significant damage throughout history was recorded in Germany and the Czech Republic, while in Croatia, the most significant damage was caused in the area of Gorski Kotar, Medvednica, and Macelj, and it was also recorded in Bosnia and Herzegovina (Lacković 2018). Freezing rains are also not limited to Gorski Kotar. In northern temperate forests, ice storms are a common disturbance agent, although climate change may alter their occurrence patterns (Klopčić et al. 2020). Forest management practices introduced to Gorski Kotar by the Thurn Taxis family were widespread in the 19th century, as they were imported from Germany to many European countries (Posavec et al. 2011). Finally, climate change is a global phenomenon irreducible to one region. Therefore, Gorski Kotar is treated here as a particular place influenced by humans, but not controlled by them, or a "patch" as Tsing et al. call it, which together with other globally spread patches make the planetary form of the Anthropocene (Tsing et al. 2024). I am approaching this particular place by researching a complex set of interconnected relationships of several species in a certain ecosystem and historical period.

For the purposes of this research, I observed the forests of Gorski Kotar during walks with my guides and interlocutors over a period of two years (2022-2024) and conducted 19 interviews to date. As my interlocutors had different professions and interests, the walks had different focuses. Three times I was accompanied by two foresters, one currently working for the state-owned company Hrvatske šume d.o.o. (Croatian Forests, Limited Liability Company), while the other used to work as a forester in Gorski Kotar and is now retired. Thanks to them, I gained an insight into the forest structure of parts of the ex-Thurn Taxis manorial estate, as well as into its immense size. Once I took a walk with an arboriculture expert who owns a private firm focused on tree care. He showed me damaged and ill-stricken trees and explained the relations between trees and their surroundings. I also took a walk with a hunter and game warden from the hunting society "Tetrijeb" in Čabar to better understand multispecies interdependence. During these walks, I followed the guides on their regular tours of the forest, they were not organized specifically for me, but were adapted to my interests and inexperience. It was agreed that I keep the identities of all my interlocutors hidden, as it helped them to speak more freely on subjects involving, among other things, their organization's policy on safeguarding forests. In addition, I engaged with residents of Gorski Kotar who have close connections with the forest, whether through personal interests such as herb collecting, or as professionals who own family farms and are involved in activities like mushroom and berry cultivation and sales, and harvesting and selling of wild plants like wild garlic *(Allium Ursinum)*. These individuals are from Delnice, Čabar, Crni Lug, Lokve, and Brod na Kupi. In this paper, I bring excerpts from my interviews with the now retired forester and the arboriculture expert. Furthermore, I consulted forestry literature

that deals with forestry methods in Gorski Kotar, fir moth infestations, and the impact of climate change on forests. I also used existing ethnographic publications connected to the issues I deal with in this paper.

CHANGEABLE FOREST LANDSCAPE AS SEEN THROUGH EMERGING AND DISSOLVING TECHNIQUES

Gorski Kotar is a mountainous region in western Croatia characterized by a harsh climate and heavy precipitation, with features of the Karst Alpine formation. This is a sparsely populated region: dispersed population, many small settlements, and the absence of more developed regional centers have become limiting factors for the socio-economic development of Gorski Kotar (Lajić and Klempić Bogadi 2010:193). Over the past 20 years, the region has seen a decline of over seven thousand residents due to limited employment opportunities. As of 2023, out of 256 settlements, 45 were uninhabited, and only 3 settlements had more than 1000 inhabitants.[5] Gorski Kotar is predominantly covered in forests, which comprise 75% of the territory. Most of the forests in the area are composed of a mixture of silver fir *(Abies alba Mill.)* and common beech *(Fagus sylvatica L.)* trees. Around 60-80% of these trees are evergreen, while the remaining 20-40% are deciduous. It is worth noting that up until a century ago, this ratio was inverted (Klepac 1997:17; Forest Management Plan Objectives and Starting Points for the Period from 01/01/2016 to 31/12/2025).[6] The high-altitude karst forests in this landscape have made it difficult for people living in the area to cultivate crops and raise cattle for profit (Frančišković 1927:409). As a result, locals have always relied on the forest for their primary source of income. Stjepan Frančišković reports that common occupations in the past included a hauler, a sawmill worker, and a woodman (ibid.). According to historical records, people have been living and working in the forest environment since the end of the 16th century, when the Frankopan aristocratic family gradually established settlements, moving inward from the outer edges of the forest. Prior to that, the forest was nearly impenetrable (Frančišković 1981:485). Upon entering the forest, humans altered the existing forest environment in such a way that it started to include not only a variety of non-human entities with their agencies, but also people with their own policies and agencies.

[5] https://www.novilist.hr/rijeka-regija/gorski-kotar/broj-stanovnika-gorskog-kotara-se-u-70-godina-prepolovio-u-cak-45-naselja-ljudi-vise-uopce-nema/

[6] "Forest Management Plan Objectives and Starting Points for the Period from 01/01/2016 to 31/12/2025", URL: https://poljoprivreda.gov.hr/istaknute-teme/sume-112/sumarstvo/sumskogospodarska-osnova-2016-2025/250

I am looking at this ever-developing cluster of social relations through the ways people have been interacting with the forest, where forest management stands out as the most noticeable way of engagement. Although forest management, as a branch of forestry, includes various practices (administrative, legal, economic, scientific, and technical), I am mostly concerned with techniques used in the management of timber production and in the cultivation of forests. I use the term "techniques" in reference to Tim Ingold's perspective. He states that developing specific techniques within a particular environment shapes both the environment and the people, uniting them into a single whole: "Through their experiences of dealing with [these] various components of the environment, persons develop with specific aptitudes and sensibilities, that is as bearers of techniques. Reciprocally, through the deployment of their technical skills, people actively constitute their environments. But in this mutually constitutive interrelation between persons and environment there is no absolute dichotomy between human and non-human components" (Ingold 2002:321). The technique of forest management that the Thurn Taxis family introduced in Gorski Kotar, and which I will describe further on, contributed in its own specific way to shaping the forest meshwork of social relations, along with other techniques of other forest inhabitants. According to Ingold, technical relations are embedded in social relations, and can only be understood within this relational matrix, as one aspect of human sociality (Ingold 2002:314). As this paper discusses multispecies sociality, I would like to emphasize something that is already included in Ingold's view of mutually constitutive interrelation between persons and environment and inclusion of the world of nature into an unbounded sphere of intimate sociality (Ingold 2002:43, 321).Within this unbounded sphere of social relations, techniques can be defined as ways of dealing with different components of the environment through which not only human persons, but all living beings develop specific abilities and sensitivities. Trees and insects can also be regarded as bearers of techniques that make them what they are and shape their environment, including all beings that constitute it. In his book "How Forests Think," Eduardo Kohn describes how relationships between all beings, including those that are non-human, through the process of sign interpretation, define beings as they are. All living beings react to sensory inputs that they perceive as signs and adjust themselves accordingly (Kohn 2013). Similarly, other scholars have studied sensory ecologies with a focus on plants to better understand how they interact with other beings in their life-world (Gagliano et al. 2017; Lawrence 2021; Hall 2011; and Ryan 2012). In this sense, plants are bearers of techniques as well. They perceive signs from the environment and adjust accordingly, by developing particular techniques. The same is true for all forest inhabitants. Cronon emphasizes that besides humans, every other creature has its specific interests (Cronon 1995). To satisfy their interests, all creatures develop techniques, just as humans do. If we consider all living beings as bearers of techniques and acknowledge that

the environment also consists of living beings, we can see that humans are shaped by the techniques of these other beings as well. Thus, we can say that the meshwork of forest relations is made up of multi-species bearers of emerging and dissolving techniques that shape the shared environment.

I will start with techniques used in the forest management of Gorski Kotar over the past couple of centuries that have initiated processes of re-reading signs by the forest inhabitants. There are two main types of forest management: selective and regular. Selective forest management is recognized as the most acceptable management approach, especially in circumstances emphasizing the multi-functionality and ecological significance of forests on a global level (Teslak et al. 2016). This type of management results in mixed forests that are predominantly composed of trees of varied ages. The selective management technique involves harvesting only mature and commercially viable trees over a 20 to 40-year cycle, instead of clearcutting entire forests. This allows trees to regenerate and thrive. Forests grown with this technique are not monocultures: the main components of such forests in Gorski Kotar are silver fir and the common beech. On the other hand, a regular forest is a type of an even-aged forest that is created through a specific forest management approach in which trees are of similar size, age, and height, and are usually monocultures. This technique facilitates easier and more cost-effective clearing of large areas of trees in the forest, but it depletes the ecosystem.

Today, state-owned forests in Gorski Kotar (77,5% of total forested areas) are mainly managed using the selective technique, while privately-owned forests (22,5%) are mainly managed using the regular technique.[7] Because of the prevalent selective forest management in Gorski Kotar, forest experts used to hail those forests as a model for forest management for a long time (Frančišković 1927:410–412) until, during the second half of the 20th century, concerns arose about the drying out of silver fir due to the fir moth (Šafar 1951; Šafar 1961:1; Šafar 1968:439). Additionally, there was growing concern about pollution caused by harmful substances like industrial gases and nitrogen compounds coming from nearby and distant industrial plants. These pollutants affected the air, water, and soil, leading to environmental degradation and causing acid rain and snow. This caused people to talk about the declining state of Gorski Kotar's forests, describing

[7] Slavko Matić and Damir Delač published data about forests in the municipalities of Delnice, Čabar and Vrbovsko (all of them were previously parts of the Thurn-Taxis manorial estate) which show that out of the total forest and woodland area, 22.5% is privately owned (Matić and Delač 2008:123). Selective forests make up about 30% of the area owned by private entities, while regular forests, defined by tree species and stand characteristics, make up the remaining 70% (Matić and Delač 2008:126). Unlike privately owned, state-owned forests have an almost entirely selective structure (Matić and Delač 2008:128).

it as their twilight (Pleše-Lukeža 1997). It was later observed that the microclimate had changed, stand canopy density had reduced and forest gaps had appeared because of silver fir dieback and the frequent salvage-cutting operations carried out to address the problem of the dying silver fir trees (Ugarković et al. 2018; Ugarković et al. 2019). Finally, occurrences of non-native and native forest pests reproducing more frequently than before [such as the fir moth] are now reliably linked to some aspects of climate change in certain areas (Anić 2019a:184–185). It should be emphasized that there is a connection between forest management techniques and the susceptibility of forests to climate change. In the "Conclusions" section of the 2018 scientific meeting Forest Management in the Context of Climate Change and Natural Disasters, Igor Anić stated that there should not be, and there is no alternative to consistent selection management for all fir-beech forests (Anić 2019a:188). According to his explanation, the ice storms that occurred in Gorski Kotar over the last two decades caused significant damage owing to the *insufficient selective structure* created by forest management in the past and the low intensity of fir tree regeneration. Anić asserted that, to the greatest extent, the forests did not have an optimal selection structure. This means that the trees lack varied ages, and the species ratio is changing too fast due to the dieback of silver fir. A significant share of extensively managed private forests should be added to that. Thus, it seems that the hailed selective forests of Gorski Kotar are not so selective after all. In the second part of the paper, I will explain how the insufficient selective structure that Anić is referring to came about.

How have human techniques over the centuries changed the forest and simultaneously the livelihood of people? How has the forest acted upon people who live in and of it? And how have dynamic relations between species in the Gorski Kotar landscape created a meshwork of a unique character or "unintentional multispecies design," as Anna Tsing calls it (Tsing 2013:37)? The story begins with two noble families, the Frankopans and the Zrinskis, who began settling in Gorski Kotar in the late 16th century. They had the exclusive right to trade in wood, and Nikola Frankopan sold wood and charcoal in Italy through his Adriatic ports in Bakar, Bakarac, and Kraljevica. To facilitate this trade, the Frankopans built roads connecting Gorski Kotar with the sea. The forests of Gorski Kotar were utilized for various purposes such as sawn timber, split lumber, charcoal, and potash used in glass production in Sušice, Crni Lug, and Lokve (Klepac 1997:37, 106). In 1651, Nikola Zrinski established a blast furnace in Čabar to smelt iron ore, which required a significant amount of charcoal. A mill and sawmill were also built in Čabar and Lokve. The regular production process in these facilities required a large workforce, so Zrinski resettled people who had previously moved out to Carniola due to Turkish raids (Frančišković 1981:485–488). This marked the start of a progression where formerly impenetrable forests were gradually divided by roads, settled around

manufacturing hubs, and the zones bordering these hubs and along the roads began to be deforested. The population in Gorski Kotar found their professions evolving alongside the new production sites, including haulers, sawmill workers, and woodmen. Many were engaged in the trade by selling wood they themselves harvested from the forests (Kruhek 1981:290). Their entire way of life was influenced by the proximity of the forest. Carpentry and wood processing, along with cattle breeding, were the main features of their lifestyle since settling in the area. They were skilled in sawing and hewing beams and logs, making roof boards and shingles, building wooden houses, and other wood processing tasks. These skills made them renowned beyond Gorski Kotar, and they often travelled outside their region to work in groups known as "kumpanije" (Crnić 1981).[8]

Over the centuries, skilled woodworking and strength became one of the main features of regional identity building, exemplified by the 18th-century legend about the good giant Petar Klepac. Petar Klepac, a frail boy, gained the ability to uproot trees, lift heavy objects, and repel enemies after encountering supernatural forces (Moric and Perinić Lewis 2018:136). There are many versions of the legend,[9] and I will summarize one of them. One day, while walking through the forest, Petar Klepac came across some fairies resting in the sun. To protect them from the sun, he built them a shelter. In return, the fairies granted him immense strength, which he used to build a log cottage for his mother (Klepac 1997:37). In the beginning of the paper, there was mention of how humans tend to view themselves as the ones who act upon the forest, but we often fail to recognize the ways in which the forest actually acts upon humans, except for non-utilitarian social values. However, in the legend of Petar Klepac, we can see evidence of the forest acting upon people. We can argue that the fairies in the legend represent the forest itself, which shaped humans to be strong and skilled with wood. Through this legend, people show an understanding that the forest had a significant impact on their self-perception as well as on the development of their woodworking techniques. Let us revisit Ingold's idea once more: technique is embedded in the experience of specific subjects while shaping specific things (Ingold 2002:315). This implies that the experience of woodworking, the production of charcoal, lumber splitting, and other such activities is what shapes, besides the environment, the subjects involved in these activities. In this interdependent relationship between individuals and their environment, there is no clear distinction between human

[8] Gorski Kotar has a history of both seasonal emigration and immigration. People from the coastal region, like Primorje and Kastavština, used to come to Gorski Kotar for seasonal work in the forests. This included jobs like coal mining, lime mining, and woodworking. These workers would spend several months in the mountains, engaging in activities such as burning lime and crafting wood to make items like oars, masts, and beams (Gotthardi-Pavlovsky 1981:341–342).

[9] For an elaborate analysis of the legend and insight into its versions see Moric and Perinić Lewis 2018.

and non-human elements (Ingold 2002:321). Besides themselves, people in the process of timber and charcoal production shape the forest, which is as alive as any ecosystem and is intertwined with people in a meshwork of social relationships, and as such shapes them back. Again, through the legend of Petar Klepac, people show an understanding of how the forest (through its personification in supernatural beings) shapes them back.

FOREST MESHWORK OF SOCIAL RELATIONS

During the time of the Zrinskis and Frankopans, forests were used with little impact, for the purposes explained above. The forest was home to a small population, and the people lived with and for the forest. Logging was done in an unplanned manner and was primarily used for the needs of craftsmen, the aristocracy, and the local population.

After the failed 1671 Zrinski-Frankopan Conspiracy against Vienna, the Habsburg court took control of the forests in Gorski Kotar. These forests either became state property or were given to aristocratic families with close ties to the court, such as the Perlases, Batthyanys, and Paravićs. Ownership of the manorial estates changed hands between noble families until they were acquired by the German noble family Thurn Taxis in 1872 and the Hungarian noble family Ghyczy in 1866 (Frančišković 1981:491; Klepac 1997:46; Karaman 1989:175–205; Šafar 1981:499). I will focus on the Thurn Taxis' forestry approach in their manorial estate with the center in Delnice, which covers a majority of the forest area in Gorski Kotar. They owned the property between 1875 and 1938, and it was divided into six forest areas of administration: Brod na Kupi, Skrad, Delnice, Crni Lug, Lokve, and Zalesina (Frančišković 1927:463). The estate consisted of 31,112.25 acres of land, with 30,785 acres covered in forest (Prusac 2023:24). These forests were a combination of fir and beech, typical for Gorski Kotar. In a document from the time of the Batthyany family, who owned the forests before the Thurn Taxis family, it was noted that in 1867, only 33% of the total wood mass was fir. By 1907, this proportion had increased to 54%, and by the end of the second decade of the twentieth century, it had further risen to 66% (Frančišković 1981:492). This demonstrates how the ratio of fir to beech changed significantly during the Thurn Taxis administration. This is because they implemented practices from the German, specifically Bavarian, forestry school which, having adopted the Pressler theory, prioritized profitable evergreen trees (spruce and fir) over less profitable deciduous ones (beech) (Klepac 1997:108).[10]

[10] Before the Thurn Taxis administration, no specific management technique was implemented, but beech was heavily used from the 17th to the first half of the 19th century to produce coal,

The Pressler theory was introduced to forest management in Germany in 1858, with the aim of increasing profitability. To achieve this, the theory proposed logging low-age trees, reducing the time of forest patrol, and maximizing the net land revenue. To further save time, it incorporated the artificial establishment of forest stands, which led to the creation of pure spruce and fir stands. In today's terms, Pressler's theory did not entirely support techniques for selective forests, nor for regular ones. Forests were still mixed (a feature of selective forests), but the forest stands contained only one species (a feature of regular forests). In general, if continued, the application of this theory would result in regular forests. Indeed, in Germany, this practice resulted in the beginning of even-aged monocultures. However, as time passed, it became clear that instead of the wood supplies increasing, they were actually decreasing. The young and middle-aged stands began to suffer from insects and fungus, and the ground started to degrade (Posavec et al. 2011:458).

At the Thurn Taxis manorial estate in Gorski Kotar, the Pressler theory led to the profitable growth of conifers such as spruce and fir trees, while less profitable beech trees were removed. Beech was heavily used (45,300 cubic meters were felled annually) until 1890, then there was a decrease in felling, followed by an increase again (28,300 cubic meters) until the beginning of the Second World War (Frančišković 1981:492). The former forest overseer at the Thurn Taxis estate, Professor Dr. Nenadić, wrote in favor of large-scale felling of beech trees in his book "Osnove šumarstva" (Basics of Forestry), which was the most popular book on forestry at the beginning of the 20th century (Klepac 1997:108). "Beech is and will remain the least profitable type of forest tree. Pure beech forests *have no right to survival and development,* even if they manage to grow timber trees in one century. Such beech trees sell well, but their price lags far behind the price of oak and fir. […] So why should we grow beech in places where fir can grow […]" (Nenadić 1924, in Klepac 1997:108).[11] This attitude towards beech lasted until well into the 20th century, which caused a change in the composition of the forests in Gorski Kotar in favor of conifers.

potash, oars, and heating (Šafar 1968:441–445). General regulations on forests began to be passed in the 18th century. On November 22, 1765, the Austro-Hungarian empress Maria Theresa published a legal document containing 55 articles. It is considered as the first law on forests in Croatia, the first instruction for forest management and the first forestry textbook. It introduced permanent or sustainable forest management. On December 3, 1852, Francis Joseph I passed the Law on Forests, which laid the foundation for modern forestry in Croatia. It expressly prescribed that no forest land may be taken away or converted into other uses, thus legalizing the principle of sustainability in forestry (Anić et al. 2012:170).

[11] Emphasis by me. Note how Nenadić treats trees as objects and subjects simultaneously in the same passage. On one hand, trees are objects that can or cannot be sold in the market, and on the other hand, they are subjects with acknowledged or not acknowledged right to survival. Unfortunately, the same dilemma of human stance towards plants in contemporary everyday thinking remains resonant.

It was later found that the application of Pressler's theory to local circumstances was not appropriate, as it led to events such as the failure of artificially cultivating spruce and interfered with the natural rejuvenation of fir trees (Frančišković 1927a:463). The natural rejuvenation of fir was obstructed (among other things) due to the absence of a layer of leaves (from deciduous trees), moss, and ferns covering the forest floor. This layer is essential for creating fertile ground, regulating the water regime in the forest floor, reducing erosion, preventing excessive evaporation, and soil leaching. The absence of this layer essential for the rejuvenation of fir was caused by the extraction of deciduous beech. In addition to large-scale felling done according to the described management policy, beech trees were systematically cut down even earlier, from the 17th to the first half of the 19th century. Beech was used to produce coal, which was necessary for iron production, potash for glass fabrication, oars, and heating (Šafar 1968:441–445). Due to the extensive logging of beech trees over all this time, the growth of fir trees had been promoted. The previous combined techniques of fertilizing and using soil nutrients, as well as managing the water regime that beech and fir trees were practicing, were not suitable to the new tree ratio. In a word, human techniques deeply interfered with techniques that trees were using in their life-world.

The attitudes of forest experts towards beech trees were adversely affected by the calculations of net land revenue until the 20th century. This is because humans' assessment of trees is based on techniques developed to maximize profits from tree growth. According to Šafar (1968:447), beech stands have a slower growth rate compared to conifers. As a result, periods between patrols in beech stands must be longer than those in conifer stands, which causes a slower turnover of invested capital. Additionally, beech trees have a lower percentage of technical roundwood than conifers, and the costs of processing beech wood are higher. Furthermore, using beech wood requires greater knowledge and experience, and young beech growth needs to be nurtured more intensively than the growth of conifers. We can see in Šafar's description how human techniques arise from two sources: on the one hand, there is a way of being (growing, aging) a beech or a conifer, and on the other hand there is a way of being a human who survives or advances by manipulating that beech or a conifer, though always constrained to the tree's way of being. Human technique is a relation between the environment, including living organisms, and human assessment of the usefulness of that environment. The things that are considered useful tend to change as time passes, and so do techniques. Although all techniques change the environment, those guided by the human concept of usefulness do that often in a harmful way.

This is also true for the continuation of our story. Although the Zagreb School of Forestry, established in 1921, promoted natural dynamics and renewal in forest

management (Baričević 2021:19), after 1945, forest management in Yugoslavia became unified for all forests (selective and regular). This led to a decline in wood supply in selective forests due to excessive felling (Serdarušić 1997:1). In 1961, Dušan Klepac devised a new methodology for managing selective forests, and among them were fir-beech forests that are particularly hard to recover due to a lack of ideal selective structure of varied ages. The fundamental concept in the theoretical model of selective management is that the amount of timber periodically harvested should match the volume of new growth in the entire forest. Instead of logging an entire forest every year, in Croatia, logging is conducted every 10 years on a tenth of the total forest area. It is crucial to accurately assess the growth of tree stands because the amount of timber harvested should ideally match the regrowth in forests with an optimal selective structure. However, in fir and beech forests in Croatia, an ideal structure is rarely achieved. Consequently, harvesting an amount of timber equal to the current increase will not facilitate the transformation process in parts of the forest that possess characteristics of a single-period structure. This is why Klepac adjusted the model to also consider the regrowth of the stand (Teslak et al. 2023:23). From an economic and ecological point of view, the ratio of the mixture is deemed favorable if the proportion of common fir in the selected stand is 60 to 80%. In that case, the share of beech would be from 20 to 40% with the individual addition of other types of trees (Forest Management Plan Objectives and Starting Points for the Period from 01/01/2016 to 31/12/2025, 2016-2025:702). Even though the practice has been in place for the past sixty years and continues, the results have not met expectations due to inconsistent application in operational practices (Teslak et al. 2023:23). More intensive felling in beech-fir forests is encouraged due to various circumstances such as increased demand for wood, and a growing market economy (Teslak et al. 2023:32). In short, despite all the theoretical research and developing management models for selective forests, demand for wood and market opportunities consistently prevails, resulting in an inconsistent management approach.

A forest expert who worked all his life as a forester in Gorski Kotar and is now retired presented an example of this approach. During one of our walks through the forest (Autumn 2023), he recalled how the forest management after the Second World War further devastated the forests of Gorski Kotar.

> "At the beginning of the 1960s, when I started working in Gorski Kotar, the average wood mass or the amount of live wood standing on one hectare was about 450 cubic meters. However, before the Second World War, the mass was over 600 cubic meters. This was because immediately after the war we cut three-thirds of the forest increment. Thurn Taxis used to cut one-third of the increment and left the remaining two-thirds of the increment for

the principal amount to rise. Despite this, he was called an exploiter and a devastator! After the Second World War, in the late 1940s and early 1950s, there were two exploitative logging operations in the Gorski Kotar forests. The Americans arrived with cable cars and selected the best trees left by Thurn Taxis. These were the highest quality trees, and the rest of the forest was left untouched. The trees were cut so that the trunks could be pulled out using the cable cars. The remaining parts of the trees were left scattered around the forest. According to old foresters, the forest looked like a tornado had passed through it."

The forester proceeded to explain that the forest used to have a set of tree crowns that made it very dark at noon, but this changed when the best trees were removed, allowing a lot of light to enter, which significantly changed the environmental conditions.

Human activities such as building roads and power plants have also had an impact on the environment. In the 1970s, the Bakar coke plant in the Adriatic coastal area and the Plomin coal-fired thermal power plant in Istria started operating, releasing pollution into the air currents that carried it to Gorski Kotar. Additionally, in the 1950s, two large water reservoirs were created in the area, lake Lokve and lake Fužine, which drastically changed the land and water bodies in the region. As a result, the microclimate of Gorski Kotar was completely disrupted, and all the climate postulates that were previously valid were turned upside down. The construction of the dam and artificial lakes also had a major effect on the organization of space. This included the construction of bypass roads, changes in practices and lifestyle, as the lakes flooded parts of several villages and sections of the Lujzijana road. Among the inhabitants of Gorski Kotar, this led to the emergence of new meanings, memories, and emotions, which Morana Jarec deals with by connecting affects and infrastructural spaces in Gorski Kotar (Jarec 2019). Finally, global climate changes are manifesting themselves in the Southeast European region as longer and more intense heat waves and drought. These changes have been evident in the mean annual temperature increase and rainfall decrease throughout the 20th century. In Croatia, the temperature has increased from +0.02°C to +0.07°C every ten years. This trend has intensified in the 21st century, with heat waves and drought occurring in 2002, 2003, 2007, 2008, 2011, and 2012 (EEA2012, in Ugarković et al. 2021:312).

The techniques of deriving value from the forest not only affect the relationship between humans and the forest, but also insert new relations between trees themselves. As previously mentioned, in the last two centuries, there has been a significant change in the proportion of beech and fir trees, with fir trees now outnumbering beech trees. This shift has had a negative impact on soil regeneration, as I explained earlier. Moreover,

after the Second World War, extensive felling resulted in the canopy structure opening up, which altered the stand microclimate and had a significant impact on ecological factors. In sum, more or less the entire biogeocenosis has changed. But, concerning the interplay between the trees themselves, the impact of outnumbering the beech by the fir, as well as the response of the fir trees, is intriguing. According to Šafar, the spread of fir caused by humans' excessive removal of beech subsequently led to their physiological weakening and poor resistance to harmful influences of abiotic and biotic factors (Šafar 1969:26). Fir trees were spreading because there was free space left behind by the felled beech trees, but at the same time, the conditions for growing changed, causing weaker growth. Fir trees did not develop techniques fast enough to combat the changed conditions. For that reason, fir trees were not rejuvenating enough and sprouted poorly. Again, Šafar explains that this led to insufficient resistance of fir to harmful influences, and the creation of a better ecotope for the biotic potential of the fir moth *(Argyresthia fundella F.R.)* (Šafar 1968:449). The fir moth is a type of insect that burrows into fir needles and feeds on them from the inside out. During their growth, each larva can destroy up to 20 needles on average. This results in the discolored needle turning brown and losing its ability to carry out photosynthesis. When a fir tree faces a strong attack, it can lose a large number of needles, reducing its overall capacity for photosynthesis. This can cause a decline in growth and physiological weakness. In some cases, if the attack is severe, it can even lead to the death of the fir tree (Lacković 2018:6). In our case, more trees became vulnerable to the fir moth as more light and heat entered the stands, causing an infestation that lasted for decades and is still reoccurring. The lack of successful techniques to combat the changed conditions on the side of fir trees gave the opportunity to another species to thrive (Androić and Klepac 1969:9). As fir trees became more abundant, they grew weaker, allowing the fir moth to satisfy its interests with less interference, which may not align with those of other creatures in the forest. In the 1950s and 1960s, the fir moth, which has always been present in these forests as an indifferent member of the biosphere, found its moment and became an epidemiological factor that, together with the climate change that was taking place, caused the drying of fir trees.

Due to pollution from industrial plants, forest management techniques, and climate and microclimate change, trees were getting weaker and the fir moth was able to reproduce more easily. This resulted in the loss of tree crowns and stunted growth of attacked trees when they did not completely dry out. During one of my walks in the late summer of 2023 near Crni Lug, an arboriculture expert and I came across a group of about twenty fir trees with about half of their needles completely brown. He explained:

> "The loss of trees is directly correlated to the percentage of needles that are lost over the years. A complete canopy is one that has 100% of its needles

intact, and the degree of absence is rated as '0'. A canopy that lacks 50% of its needles is rated as grade '3'. If 75% of the needles are missing, it is rated as grade '4'. In such cases, we can immediately predict that the tree will dry up in a year or two. For instance, we have data on fir trees from 1990 to 2000. In 1990, the absence rate '0' was 12%, while in 2000 it was 0%. Over the years, the number of treetops of type '3' and '4' has increased. This means that 68% of the affected trees will dry up in the next 10 to 15 years" (conversation held in late Summer 2023).

When trees are attacked, they are unable to produce seeds, which makes it impossible for them to regenerate naturally. In thinned-out areas, the soil is exposed to weathering, which is particularly noticeable on the limestone substrate, as in Gorski Kotar. This can lead to physical, biochemical, and microbiological changes in the soil, which reduce its ability to regenerate and make it challenging to restore the affected stands (Androić and Klepac 1969:9). This is because due to the absence of any obstacles, precipitation can now easily reach the soil, which leads to the creation of small streams. These streams carry away the part of the soil that has the best quality, including raw and decomposed humus. This layer of biological matter is home to hundreds and thousands of living organisms that thrive in a unique microclimate underneath the canopy of an old forest. However, when a flood occurs in this soil layer, everything is washed away, and there is no substrate for trees to grow. In general, weak trees are more vulnerable not only to insect attacks but also to weather conditions. In the mid-1990s, a part of the forest was devastated by ice, resulting in the beech trees being left without a crown. Only the most vital trees could survive such conditions by secondary branching. Due to the extensive damage, the canopy was opened even more. In 2014, another ice storm hit and killed evergreen species such as fir and spruce (Uredništvo Šumarskog lista 2014:5). Their canopy can withstand rain, but it cannot withstand ice on every branch. This means that the forest lost even more trees. According to the already mentioned forester from Gorski Kotar, "during the Thurn Taxis time, one hectare had approximately 600 cubic meters of live wood. However, as of now, the same area only has about 250 cubic meters left" (conversation held in Autumn 2023).

In present times, the forest continues to respond to human actions, albeit without submitting to human control. This is evident in the current resurgence of the beech. The decline of fir trees, caused by various practices and interactions within the forest ecosystem, has led to a resurgence and increase in beech trees. The severe felling of beech trees and the promotion of fir and spruce during the Turn Taxis period described in this paper, which was a widespread practice in European forestry at that time, have

resulted in the drying of the fir trees and the current aggressive spread of beech in the fir-beech forests of Gorski Kotar. This leads to the question of whether beech is starting to reclaim its habitats and displacing the fir due to the current less humid habitat conditions (Matić and Delač 2008:122). This reversal of the previously established process has resulted in a significant rise in the proportion of beech in selective forests over the last 30 years, decreasing their economic value (Teslak et al. 2023:32). Today, the state forests of Gorski Kotar are managed by the state-owned company Hrvatske šume, and the management technique they use for the beech-fir forests is Klepčev's selective forest management system described earlier. This is an adaptable system, theoretically thought to adjust to changes in the forest stands. It was introduced because the forestry profession understood the problems of previous forest management and recognized the forest as a living ecosystem that needs constant correction of management techniques with regard to its condition. Indeed, different sub-models of Klepčev's system are continuously developed according to various stand conditions.[12] At the same time, Klepčev's system is not consistently applied in practice, mainly due to market opportunities (Teslak et al. 2023:23). Once the forest stand is inappropriately thinned out, several decades need to pass for it to regain the desired age and species tree ratio. In simple terms, theory and practice do not align.

"Desired age and species tree ratio for selective forests" is a human concept. It refers to forest management which involves the cultivation, protection, and utilization of forests while maintaining a balance between human needs and environmental protection. Since humans participate in the forest meshwork of social relations, it is a justified concept. Humans have their interests (they rely heavily on wood products, for example) that need to be considered along with the interests of other species in the forest. As long as human interests are aligned with the cultivation and protection of the forest, they are not inherently negative. Nevertheless, the forests of Gorski Kotar are facing a situation that goes against the balance between human needs and environmental protection. The first three goals in the document "Forest Management Plan Objectives and Starting Points for the Period from 01/01/2016 to 31/12/2025" issued by the Croatian Ministry of Agriculture[13] are: maintaining and appropriately improving forest ecosystems, preserving the health and vitality of the forest ecosystem, and promoting the productive functions of the forest (FMPOSP 2016-2025:53-54). Ecological balance and the forest's capacity

[12] See "Forest Management Plan Objectives and Starting Points for the Period from 01/01/2016 to 31/12/2025"

[13] "Forest Management Plan Objectives and Starting Points for the Period from 01/01/2016 to 31/12/2025", URL: https://poljoprivreda.gov.hr/istaknute-teme/sume-112/sumarstvo/sumskogospodarska-osnova-2016-2025/250

to support human needs are cited in the FMPOSP 2016-2025 document side by side as imperatives. This is an important notion for the perspective of more-than-human sociality represented in this text. Namely, humans, trees, and other forest inhabitants live off and with it together. The forests of Gorski Kotar have coexisted with humans for centuries, shaping and being shaped by them. Together they "co-produce manifold configurations of humanity-in-nature, organisms and environments" (Moore 2015:5). For these configurations to thrive, various interests of different species should be satisfied. The FMPOSP 2016-2025 document demonstrates that humans are aware of this. However, the current state of Gorski Kotar forests presents a different reality. The forests are experiencing a decline, which threatens to undermine the ecological balance and compromise the forest's capacity to support human needs.

Humans have at least three different perspectives when it comes to evaluating forests, which significantly complicates matters. These three perspectives are economic, ecological, and symbolic, and as we have seen in this text, they always overlap. The economic value of Gorski Kotar forests is currently decreasing due to the resurgence of beech trees. Specifically, as mixed stands of fir and beech are converted into pure beech stands, both the economic value of these forests and their biological diversity have decreased significantly (Matić 2001:303). As for symbolic value, the forestry profession is particularly proud of these forests because this is where the work of the forestry profession in Croatia, as well as the world, started (Uredništvo Šumarskog lista / Editorial board of Šumarski list 2001:307). The first forests, surveys, maps, and economic bases were made here, thus providing data that can be a good guiding thought when researching the current phenomenon of fir drying caused by climate change and air pollution and the spread of beech in its habitats (ibid.). Ecological value is strongly expressed in contemporary forestry experts' view that forests are a means, and forestry is a tool for reducing the consequences of climate change (Anić 2019a:186). The overlapping of these three perspectives is apparent when considering the economic perspective, which has historically been dominant, but has recently been strongly influenced by the ecological perspective. This is because healthy forests with vital ecosystems can better support human needs and therefore have higher economic value. The symbolic perspective has historically been related to identity building, but is now also intertwined with the ecological perspective, as the selective forests of Gorski Kotar have become a symbol of Croatian forestry, proud of its selective forest management recognized as the ecologically most acceptable management approach. This three-fold stance towards forests highlights the significance of choosing forest management techniques with care.

As I have shown in this text, up until recently the economic value of forests was at the forefront of the three-fold view on forest value. The market price of beech is lower than

that of fir. Initially, fir was forcefully introduced in the forest management in Gorski Kotar due to this fact. Now, with the resurgence of beech, this same fact is concerning because it devalues the forests. The task is now to reorganize the three-fold view and consider the ecological, economic, and symbolic values of the forest on equal terms. Anić shows how this can be achieved in Conclusions of the Scientific Meeting Forest management in the context of climate change and natural disasters, when he states that "only by responsible management of the entire forest ecosystem, putting forest tending, regeneration and protection at the forefront, and *moving away from looking at the forest as a source of timber or passively protected nature*[14] will we be able to preserve our forest treasure, and use it as an ally in reducing the effects of climate change" (Anić 2019a:192). This one sentence encapsulates the balanced three-fold view of forests: ecological and economic (responsible management of the entire forest ecosystem), and symbolic (our forest treasure). Regarding forest calamities, responsible management mentioned in the same document refers to finding and implementing "in every forest ecosystem, regardless of its purpose and owner, such forest management procedures that will prevent damage to forests as the forest ecosystem will be prepared and have strong defence mechanisms" (Anić 2019a:191).

The scientific community specializing in forestry agrees with these conclusions. However, as argued by Teslak et al. (2023:23), in the practice of forest management, the economic perspective in forest valuation still tends to outweigh the other two. Humans still need to align their interests with other creatures in the forest.

* * *

We can see now how all subjects of our story – trees, humans, fir moths – are relationally produced. Each of them has its pathway that meets others in the forest, thus creating it as it is. Histories of trees, humans, and moths come together in a forest, making it a place of more-than-human sociality. Every species has its own interests and has developed specific techniques for survival and growth according to these interests, which are interconnected in such a way that one species can benefit from another's techniques, or may need to adjust to their consequences. The dynamic of trees, forest communities, and human-forest assemblages simultaneously creates a microclimate and depends on it. When a tuned relationship between species is disturbed, natural phenomena such as ice storms can cause more damage than they would otherwise. The

[14] Emphasis by me.

forests of Gorski Kotar have been shaped by centuries of human presence and almost two hundred years of human management, but they are not designed by humans. The independent activities of nonhuman elements prevent such design. When a particular area is heavily influenced by humans but is not under their control, according to Tsing et al. (2024), it is considered a typical Anthropocene space. This categorizes the forests of Gorski Kotar as one of the areas affected by the Anthropocene, which, when combined with other similar areas around the world, forms its planetary manifestation.

Environmental challenges as the result of multi-species relations are noticeable in Gorski Kotar, in which humans started to strongly interfere almost two hundred years ago, by removing beech trees and growing conifers. Fir trees spread but became weaker. In addition, humans introduced new water accumulations and industrial plants, which led to air and soil pollution, as well as changes in the microclimate. With fewer trees, more light and heat entered the forest, creating ideal conditions for the spread of the fir moth, which further weakened the already fragile fir trees. In these circumstances, when an ice storm hit the forest, it caused severe damage. Today, the susceptible fir tree is once again being replaced by a stronger beech tree, changing once more the economic value and ecological balance of the forest. The forestry profession acknowledges the challenges of previous forest management and sees the forest as a complex ecosystem that requires ongoing adjustments in management techniques to maintain its health. Different sub-models of Klepčev's system are continuously being developed based on various stand conditions. However, the practical application of Klepčev's system is inconsistent, mainly due to market opportunities. Inappropriate thinning of a forest stand can take decades for the desired age and species tree ratio to be restored. The FMPOSP 2016-2025 document emphasizes the need for ecological balance and the forest's ability to meet human needs, alongside the historical focus on forests' economic value. The three-fold view of forests (economic, ecological, and symbolic) now requires reorganization to consider the ecological, economic, and symbolic values of the forest as equally important. If humans wish to remain a part of the vital forest ecosystem, they must align their interests and techniques with other creatures in the forest.

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Langue durée više-nego-ljudske-društvenosti šuma Gorskog kotara i suvremeni ekološki izazovi

Sanja Puljar D'Alessio

Članak analizira suvremene okolišne izazove u šumama Gorskoga kotara kroz prizmu više-nego-ljudske društvenosti. Početna je točka analize ljudsko upravljanje tim šumama od 19. stoljeća koje je iniciralo kompleksan niz prilagodbi biljaka i insekata na nove okolnosti, što je rezultiralo suvremenim okolišnim problemima poput najezde jelina moljca, uključujući njegovu korelaciju sa stupnjem štete od ledenih kiša.

Društvenosti goranskih šuma pristupa se iz perspektive dinamičnih odnosa među vrstama koji stvaraju šumsku mrežu društvenih odnosa (jelin moljac, bukva, jela, ljudi), te kroz odgovor prirode na promjene okolišnih uvjeta (klimatske promjene), i to korištenjem kritičkoga opisa ljudskih aktivnosti jer one uokviruju predmet istraživanja (gospodarenje šumama). U tekstu se pokazuje kako određene šumske nepogode, poput najezde jelina moljca (uključujući i stupanj povezane štete od ledenih kiša), nastaju kao rezultat složenoga skupa međusobno povezanih odnosa više vrsta, koji su pokrenuti prije nekoliko stoljeća. U tekstu se također ustvrđuje, ukoliko ljudi žele ostati dijelom vitalnoga šumskoga ekosustava, da moraju uskladiti svoje interese i tehnike s ostalim stanovnicima šume i početi razmatrati ekološke, ekonomske i simboličke vrijednosti šume s jednakom važnošću.

Ključne riječi: *šuma, Gorski kotar, okoliš, Thurn Taxis, više-nego-ljudska društvenost*