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Potential for monetisation and utilisation of wood raw material from pioneer tree species stands in the Czech Republic

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Abstract: Pioneer tree species in the Czech Republic include birch, alder and aspen. From an economic point of view, birch seems to be the most promising. Greater use of timber from pioneer tree species in higher value-added products is currently limited by the low stocks of birch, alder and aspen in forest stands. A price survey was carried out in the Western Highlands region in the central part of the Czech Republic to obtain basic information on the prices of assortments of pioneer tree species. The prices of five assortments of raw timber were surveyed for the period 2019–2023. Very few of the prices of pioneer tree species were found for assortments of II and IIIC; these assortments are not actually produced and, therefore, not traded by the respondents. For the roundwood assortments (quality II, IIIAB), it cannot be clearly stated that any of the preparatory timber species (birch, alder, aspen) always achieved a higher price during the observed period. Only in 2023 was it possible to see higher prices for quality IIIAB assortments of alder. Birch of quality V had the highest price of the observed prices for this timber assortment for the pioneer tree species during the period under review. When using a system approach, considering the information on the prices of the timber assortments is also important for deciding on the optimal species composition of the regenerating forest stands. In the case of the Czech Republic's commercial tree species, this information is available at the national level. However, the situation is quite the opposite for the timber assortments of pioneer tree species, where information on their prices is completely lacking. This confirms the fact that the market for assortments of timber from pioneer tree species in the Czech Republic is basically non-existent, the main reason being the low volume of these assortments placed on the market.

Keywords: alder; aspen; birch; price investigation; timber market

Considered mankind's first-ever source of energy, wood is still of great importance to human society and fulfils several important roles in various fields (Sreevani 2018). Today, it is used in many forms, especially in construction, furniture, paper and pulp production, to make musical instruments, household items, toys, packaging materials and other products. Globally, it is also of great value as an energy source (Hájek et al. 2024).

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Europe's forests are the largest natural ecosystem supporting biodiversity in Europe. Given the impacts of climate change, the role of forests is becoming increasingly important, both in providing forest ecosystem services (e.g. soil protection, water regulation, habitat for animals) and as a source of materials for the industrial and energy sectors (Hemery et al. 2010). Wood as a renewable resource plays a particularly important role in the business sector, where its use and valuation need to be optimised. A sustainable innovation approach contributes to the efficient management of this material and promotes its importance (Potkány et al. 2018).

Data from the Ministry of Agriculture of the Czech Republic (MoA 2023) show that in the period 2001–2022, a significant increase in the volume of harvested spruce bark wood began to occur since 2016. In 2016, 4.21 million cubic metres (m^3) of spruce bark-beetle wood was harvested. The culmination of this volume occurred in 2020, when 21.90 million m^3 of spruce bark-beetle wood was harvested, with the total volume of timber harvesting in the Czech Republic reaching 35.75 million m^3. The volume of timber harvesting before the bark beetle calamity mostly ranged between 15 and 17 million m^3 per year. This means that the area of forest land that needed to be restored began to increase significantly. The area of natural and artificial forest regeneration increased by more than 100% in some years of the calamity period.

The above situation led to the fact that previously less commonly used tree species began to be used in forest regeneration in the Czech Republic, especially silver birch (*Betula pendula* Roth), then also black alder (*Alnus glutinosa* L.) and European aspen (*Populus tremula* L.). Forest managers began to perceive these tree species as pioneer trees for the traditional main production tree species in the Czech Republic (spruce – *Picea abies* L., beech – *Fagus sylvatica* L., oak – *Quercus petraea* L., pine – *Pinus sylvestris* L.). In addition, some forest managers began to view birch, alder and aspen as target tree species in regenerated forest stands on calamity clearings.

Although these species are not always at the forefront of the wood industry's interest and may be considered to be of lower use and value, they are valuable resources due to their specific characteristics. In this context, there is a strong need to consider wider cultivation of these species and new approaches to forest management in commercial forests, thus generating valuable products for future markets (Dubois et al. 2020). In general, mixed broadleaved species are an important component of diverse forest resources, not least because these species often produce high-value timber. In addition, by increasing the species diversity of forests, dispersed broadleaf trees can make an important contribution to protecting against risks such as pests, pathogens, fire or habitat loss, while diversifying forest management activities (Hemery et al. 2010).

Connections with the establishment and cultivation of birch stands in the Czech Republic are also investigated (e.g. Souček et al. 2019; Martincová, Leugner 2020). Efforts to change the species composition of forest stands are currently significantly related to addressing the impacts of climate change. In the conditions of the Czech Republic, the economic and production effect of tree species change as a result of adaptation to climate change was investigated by Remeš et al. (2020).

The available literature related to the topic of this article is mainly focused on the use of birch, alder and aspen wood. Specific information on economic aspects, such as current market prices or information and analysis of the timber market for these species, is limited or completely lacking. The reason for the lack of information on timber prices and trade in birch, alder and aspen timber may be due to their lower representation and share in the total timber supply in forest stands in the Czech Republic (Máslo et al. 2023), and the associated lower economic importance compared to other commercially attractive species (e.g. spruce, pine, beech, oak). Birch, alder and aspen are often considered more as pioneer tree species, and their role in the forestry sector is more associated with non-productive functions or specific uses than with significant wood production for the commercial market. The inclusion of these species in forest management and their use in the timber market could be enhanced by the growing demand for certified wood raw materials, especially in segments requiring sustainable sourcing (Dudík, Riedl 2015). In general, the development of raw wood prices is influenced by several factors. Among the most important are imperfections in the timber market, uncertainties in timber supply caused by climate change and calamities, and constraints resulting from the natural growth of trees in line with long-term ecological concerns. Technological advances,

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production costs, policy agendas and legal constraints also affect the quantity of timber available on the market (Hlaváčková et al. 2015).

Birch. In Europe, two commercially important birch species occur naturally: the silver birch (*Betula pendula*) and the white birch (*Betula pubescens*) (Hynynen et al. 2010). In the Czech Republic, the silver birch dominates this genus and occurs naturally in most of the territory, except for the highest mountain areas and typical floodplain forests (Buriánek et al. 2021). Cultivation of birch in the Czech Republic is marginal, but there are already efforts to make more economic use of this tree species (Dudík et al. 2021). It accounts for less than 2% of the total wood supply in forest stands in the Czech Republic (Máslo et al. 2023). However, in northern and eastern Europe, for example, birch is the most important deciduous tree for forestry. In the Baltic states, it accounts for 17–28% of the total volume of silvicultural material, while in the Nordic countries, it accounts for 11–16% (Hynynen et al. 2010). For example, in Finland, which is considered one of the leaders in the forest bioeconomy (Palátová et al. 2022), birch is the most represented broadleaf tree (Hynynen et al. 2010).

Silver birch is a typical pioneer species with low ecological requirements and high ecological tolerance. It can thrive in a wide range of climatic and soil conditions (Buriánek et al. 2021). In Europe, birch is mostly scattered in mixed forests dominated by coniferous species or grows in pure stands as a pioneer tree during early stages of succession, for example after clear-cutting or windstorms (Hemery et al. 2010; Dubois et al. 2020). It usually regenerates naturally, but when the goal is to produce high-quality timber, artificial planting is preferred (Hynynen et al. 2010).

The importance of birch may increase in the future due to its high adaptability and ability to recolonise forest areas after large-scale disturbance. Other strengths of birch include its high productivity and vigorous growth in young stands, strong natural regeneration potential, improved soil recovery, aesthetic appearance, and interesting wood properties (Dubois et al. 2020; Buriánek et al. 2021). Birch stands grown in a 50–60-year rotation can be an economically viable and competitive alternative to traditional commercial tree species such as spruce and pine in the Czech Republic. The use of birch in forest regeneration, especially through natural regeneration, results in lower forest establishment costs (e.g. compared to beech) and a significantly shorter regeneration period allows for earlier timber sale revenues (Dudík et al. 2021).

Alder. The Czech Republic is home to naturally occurring black alder (*Alnus glutinosa*), speckled alder (*Alnus incana*) and green alder (*Alnus alnobetula*). Black alder and speckled alder are fast-growing pioneer tree species with a relatively short lifetime and smaller stature. Both species are used as pioneer tree species. Green alder has soil reclamation and soil protection functions and is used in mountain areas affected by anthropogenic influences. The alders stabilise watercourses with their root system, filter water and provide a suitable environment for aquatic organisms, thus strengthening the water-management function of the forest. Their leaf litter enriches the soil with nutrients. Moreover, alders are unusual among European trees because they fix nitrogen. The main difference between black and speckled alder is the soil requirement: black alder prefers wet to muddy soils, whereas speckled alder needs an aerated substrate without stagnant water (Claessens et al. 2010; Sloup 2015). Alder contributes 2.3% to the total timber supply in forest stands in the Czech Republic (Máslo et al. 2023).

Black alder is a commercially important species of alder growing throughout most of Europe. It is found from Scandinavia to the Mediterranean and North Africa. A warmer climate in the future is expected to allow it to spread to the north to Scandinavia and Russia, while other parts of Europe may be adversely affected by declining rainfall. The fungus *Phytophthora alni*, the most damaging pathogen of alder, is considered a significant threat to alder and has been spreading in European watercourses since the 1990s. The fungus is transmitted by zoospores produced in river water and spreads especially during floods (Hemery et al. 2010; Houston Durrant et al. 2016).

Black alder has considerable production potential, especially when young, and can serve as a source of biomass due to its potential for pruning. In the 1980s, species of the genus *Alnus* were tested for short-rotation biomass production. The best results were obtained by crossing *Alnus rubra* × *A. glutinosa* and *Alnus cordata* × *A. incana*. Yet, *Alnus* scored lower than *Eucalyptus*, *Populus* and *Salix* due to sensitivity to moisture stress and the difficulty of growing outside of ideal sites (Claessens et al. 2010; Houston Durrant et al. 2016).

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Aspen. European aspen (*Populus tremula*) is a medium-sized, strongly heliophilous tree with a long and slender trunk. This species is native to the cool temperate and boreal regions of Europe and Asia. It is the second most widespread tree species in the world after the Scots pine (*Pinus sylvestris*). It has a wide natural range due to its high tolerance to different climatic and habitat conditions, including frost, shade, humidity and wind. It is a pioneer tree in the broadest sense. Aspen is a fast-growing and short-lived species, characterised by its high ability to rapidly colonise new habitats, especially in the process of natural succession, i.e. on clearings without competing vegetation. It grows on a wide variety of soils but thrives best on moist, organically rich soils. It is most often found scattered in the middle of conifer-dominated landscapes (Caudullo, de Rigo 2016; Čížková et al. 2020).

In Czech forestry, aspen has long been considered a weed tree species and systematically destroyed, but due to the bark beetle calamity and the need for changes in forest management, it is being slightly reintroduced into forest stands during forest regeneration. Aspen is mainly a reclamation and strengthening tree, its commercial importance is limited. Its primary role is to provide habitat for the cultivation of target tree species while fulfilling several non-productive functions. Aspen is highly valued for its essential ecological benefits and is considered a keystone species in this regard, hosting more species than any other boreal tree. Aspen is inhabited by epiphytic mosses, lichens, pathogens, herbivores, and many species of mammals and birds. Many aspen-dependent species are listed on the IUCN Red List of Threatened Species (Caudullo, de Rigo 2016; Čížková et al. 2020). However, like other poplars, aspen can be attacked by leaf rust (*Melampsora* spp.) causing severe defoliation, while older and larger trees can be affected by stem rot (Savill 2013). Data from the third cycle of the National Forest Inventory 2016–2020 (Máslo et al. 2023) does not provide information on the stock of European aspen in forest stands. This implies that European aspen wood stocks will be lower than birch and alder, i.e. European aspen stocks will be included in the 'other broadleaf softwoods' group.

MATERIAL AND METHODS

The potential for the use of wood raw materials from silver birch (*Betula pendula* Roth), black alder (*Alnus glutinosa* L.) and European aspen (*Populus tremula* L.) in the Czech Republic is processed using a literature search based on publicly available information from literary sources. Data on the current volumes of wood raw materials of these tree species that are placed on the market and used were collected. Information on the areas of use of wood of the investigated tree species was also collected, especially about products with higher added value. Information obtained from interviews with representatives of 5 wood-processing companies in the Czech Republic was also used, with the lowest volume of wood raw materials at the input of the addressed wood processing companies being 60 thousand m^3 per year.

The area of wood prices and trade in this raw material in the Czech Republic was addressed through a literature search based on publicly available information from literary sources. Since the information obtained in this way on the prices and market for birch, alder and aspen wood was not satisfactory, a price survey was carried out in the first quarter of 2024 using personal interviews with a randomly selected sample of 19 respondents in the Western Highlands region, which represents the forested central region of the Czech Republic. The considered wood species also included beech (*Fagus sylvatica* L.). Birch wood is often compared to beech wood due to similar wood properties (Dudík et al. 2018).

The price of raw wood assortments in quality classes II (logs for peeled veneer production), IIIA/B, IIIC (logs for sawmill processing), V (wood for pulp production), and VI (firewood) was determined by personal interviewing of a sample of respondents – dimensional and qualitative requirements for raw wood assortments result from the national Recommended Rules for Measuring and Sorting Wood in the Czech Republic from 2008 (Wojnar 2007). The price of the assortments refers to the roadside and does not contain the value-added tax. Prices were investigated based on answers from respondents in individual quarters of the period 2019–2023. The average price for each quality class and quarter was calculated as a simple arithmetic mean of the investigated prices from each respondent. The average price for each quality class and quarter for the entire price survey (i.e. for all respondents) was again calculated as a simple arithmetic mean. When calculating the average prices of raw wood assortments,

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the weight representing the volume of wood sold was not considered. The Czech Statistical Office also calculates the average prices of wood for hardwood assortments in this way (simple arithmetic mean) – see its methodological notes (CSO 2024). Furthermore, the beech wood prices by individual assortments determined by the price survey (and converted to average annual prices) were compared with the average annual beech prices published by the Czech Statistical Office (CSO 2019–2023) – for this purpose, the CSO average price was calculated from the published prices of beech wood assortments for forest owners and non-owners.

The quarterly prices of the individual timber assortments obtained from the price survey were converted from Czech crowns (CZK) to EUR according to the average quarterly foreign exchange market rate published by the Czech National Bank (CNB 2024). Similarly, the annual prices published in the article were converted into EUR at the average annual exchange market rate (CNB 2024).

RESULTS AND DISCUSSION

The potential of using wood raw material. Information on the use of wood raw materials from birch, alder and aspen in the Czech Republic results from publicly available information. On the one hand, information is available on the possibilities of using the mentioned wood species from the point of view of the physical and mechanical properties. In terms of future potential for use, we must also consider the available amount of wood raw materials placed on the market. In the Czech Republic, current information is available on the volume of wood raw materials that are used for processing into products with higher added value – this mainly concerns raw wood assortments for sawmill processing (this information is not available for poplar either). However, a significant volume of wood raw materials ends up in assortments of lower quality classes (V and VI), where the genus and species of wood species are very often not distinguished from an operational point of view. The market is often enough with a distinction between coniferous, deciduous hardwood and deciduous softwood, e.g. firewood or wood chips. Based on interviews with wood processors, a potentially interesting annual volume of wood raw material of one wood species placed on the market in the Czech Republic of at least 100 thousand m^3 of roundwood assortments appears to be interesting. Then, it may make sense to invest in the innovation of production technologies that will enable the processing of wood raw materials from pioneer tree species into products with higher added value. The situation is simpler in this respect for wood raw material from birch, because existing companies processing beech roundwood assortments usually have no problem processing birch roundwood assortments. The estimation of potential and future possibilities is significantly hampered by the rapid development of products with a share of wood, which can also include composite materials. This may be the case, for example, of wood-plastic composite materials. In some composite materials, lower-quality wood raw material can also be used – i.e. raw wood assortments of lower quality class. Then the estimate of the potential for future use of wood raw material measured by the production of roundwood assortments may not be entirely correct. This aspect of the potential for the use of wood raw material requires further research.

Birch. Birch wood is widely used in various industries, and its quality remains high even when the tree grows rapidly. The market for birch wood suitable for turning is limited, but trees with good shape offer a much wider range of applications. Birch wood is used for furniture, veneers, parquet, tools, musical instruments and toys. In construction, cross-laminated and glued laminated timber (CLT and GLT) from birch is highly valued for its strength and aesthetic qualities. Birch plywood and veneer are used in construction, transport and concert hall interiors. Healthy birch wood is also very suitable for joinery products that require high-quality wood. Chemical pulp and extracts from birch have applications in the paper, textile and pharmaceutical industries (Luostarinen, Verkasalo 2000; Savill 2013; Dubois et al. 2020).

Approximately 25 000–28 000 m^3 of birch wood is processed annually in the Czech Republic, which is mainly used to produce plywood, furniture and small wood products (Reh et al. 2024). Nevertheless, it remains to some extent undervalued and neglected by the forestry sector (Mauer, Palátová 2003). This may be because birch rarely forms pure stands that would allow the harvesting of larger quantities of wood raw material at a time. Another reason is stem defects, which significantly increase the amount of waste wood (Luostarinen,

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Verkasalo 2000). The short life span of the tree and the low durability of the wood can also be considered a weakness of birch. Birch does not tolerate storage well and is easily subject to mould, insects and decay. In western and central Europe, birch has a poor reputation due to its invasive nature and the inferior quality of its wood caused by poor forest management. Data on trade statistics for birch logs in these regions are lacking. The timber industry prefers other broadleaved species. In Finland, on the other hand, birch has a significant industrial impact; most of its production goes to the pulp and plywood industry (Dubois et al. 2020).

Birch also provides commercial opportunities in non-timber forest products; birch sap being considered the most important product. Finland, for example, as one of the largest sap producers, has the potential to expand its production due to its abundant birch reserves. The sap is collected for only a few weeks in spring and the average yield per tree is 50–100 L. The tree can be exploited for up to 10 years, and rental income for sap extraction can exceed the income from pulp sales (Verkasalo 2017).

Alder. Despite its limited occurrence in forests, black alder has good potential for timber production. However, it only provides high-quality timber in habitats that meet its optimal conditions. In such environments, it grows similarly fast as ash, maple or cherry, and its wood reaches a high market value and a target diameter at breast high of ~40–50 (55) cm can be achieved with rotations of (30) 40–65 years. However, after about 60 years of age, it becomes susceptible to heart rot, which reduces the quality of the wood and means that alder trunks with a larger diameter are rare (Claessens et al. 2010).

Alder wood is soft, not very flexible, splits easily, resists moisture, is light and very durable in water. It is used for piers, underwater supports, bridge piles or small boats. In this respect, it is comparable to the best species such as oak, larch or robinia (Krauss, Raczkowski 1985; Sloup 2015; Houston Durrant et al. 2016). The aesthetic and mechanical properties of alder wood make it suitable for many different uses, including energy use, paper fibre production and particleboard production, although it has limitations due to its red colour. The wood is widely used in furniture (plywood, frames, bars), art (artistic cabinetmakers), the production of musical instruments (e.g. electric guitars) or as high-quality charcoal. In addition, according to a study by Toksoy (2006), alder plywood can be a suitable alternative to beech plywood, due to the similar inherent properties of these wood species. However, alder wood is not suitable for constructions, where high strength is required. It is highly valued in joinery, where it is used as solid wood or veneer, especially for its pattern and colour. For joinery, logs with a minimum length of 3 m and a diameter of 40 cm are ideal, with logs with a larger diameter having a higher market value. Last, but not least, alder stands are valuable for wildlife; the cones gradually open, releasing seeds and providing a reliable source of food throughout the winter (Claessens et al. 2010; Savill 2013; Sloup 2015; Houston Durrant et al. 2016). In the Czech Republic, annual alder processing is around 35 000–38 000 m^3 and is used primarily to produce plywood, furniture and cladding (Reh et al. 2024).

Aspen. The wood of most poplars is ideal for peeling into thick veneers. It is soft and light-coloured, with a low but variable density and a fine texture. The quality of the wood varies depending on the species, region and growing conditions. Aspen wood has a finer texture than faster-growing species. With a weight of approximately 430 $kg \cdot m^{-3}$, it is not very dense and is comparable to willow wood (Savill 2013). Aspen is the preferred wood species to produce cladding panels, veneers, OSB boards, fibreboards and pulp (Mackes, Lynch 2001).

The growing demand for woody biomass in the energy sector increases the need for alternative wood sources. One promising solution is the use of the concept of 'short rotation forestry' (SRF), which includes fast-growing tree species, including those of the genus *Populus* (Konôpka et al. 2020). For example, in the Nordic and Baltic countries, the hybrid *Populus tremula* × *tremuloides* is planted for experimental and commercial purposes in short-rotation cultivation (usually for 20–30 years). This hybrid has proven to be a highly productive deciduous species that can produce almost twice as much wood as the original aspen in the best locations. Due to its rapid growth, it is one of the most promising tree species in Northern Europe and represents an important source of biomass for the energy, fibre and wood processing industries (Tullus et al. 2009, 2011; Caudullo, de Rigo 2016).

Timber prices and the timber market. The situation in the timber market in the Czech Republic

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has been very difficult in recent years. It has been influenced by the effects and consequences of the calamity in the Czech forests and the high share of salvage fellings, especially in spruce forests, the changing market situation in the Czech Republic, Europe, the USA and Canada, and finally the high demand for energy wood in 2022, which has significantly disrupted and complicated market practices in the trade in raw wood assortments. These included endangered supplies of fibre wood, which can in principle be used for energy purposes, or the extremely rising price of firewood [in 2022, the price of long hard firewood often exceeded EUR 61 to EUR 73.3 (excluding VAT) per 1 m^3 at the roadside and this price has persisted until 2024], etc.

The Czech Statistical Office does not survey the prices of birch, alder and aspen in the context of the quarterly survey of prices of raw timber assortments. Among broadleaved species, it only surveys prices for beech and oak. Therefore, as part of the NAZV QK22020008 project, a price survey was carried out among selected respondents in the Western Highlands region of the Czech Republic. Furthermore, the prices of beech timber assortments found by the price survey were compared with the average annual beech prices published by the Czech Statistical Office (CSO 2019–2023). These prices represent regular prices excluding VAT per 1 m^3 of timber. The results are presented in Figures 1–10. In some cases, no price was obtained from respondents within the quarters of the 2019–2023 reference period.

In Czech conditions, the timber price development and price factors from neighbouring countries that influence it were analysed by Hušbauer et al. (2017). The authors also point out the unavailability of data, or its incompleteness and missing or complicating factors that would allow subsequent data processing [e.g. the publication of data that only covers selected tree species, not that detailed division of price information (coniferous/deciduous), lack of detailed information on the number of respondents, etc.]. In Slovakia, analyses of price changes were conducted e.g. by Suchomel et al. (2012) and by Gejdoš and Potkány (2017). Analyses include different tree species (e.g. spruce

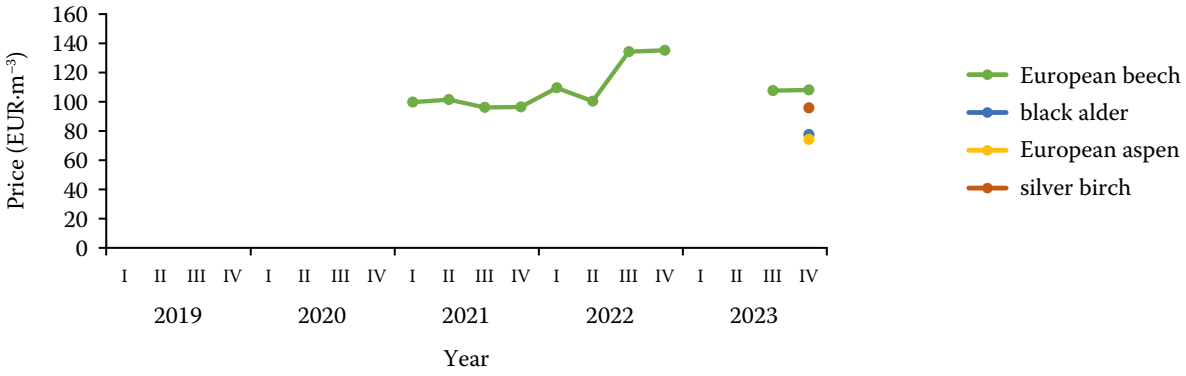

Figure 1. Timber quality grade II – Price trends for the tree species European beech, black alder, European aspen and silver birch based on a price survey in EUR·m^{-3} for the period 2019–2023 by quarters

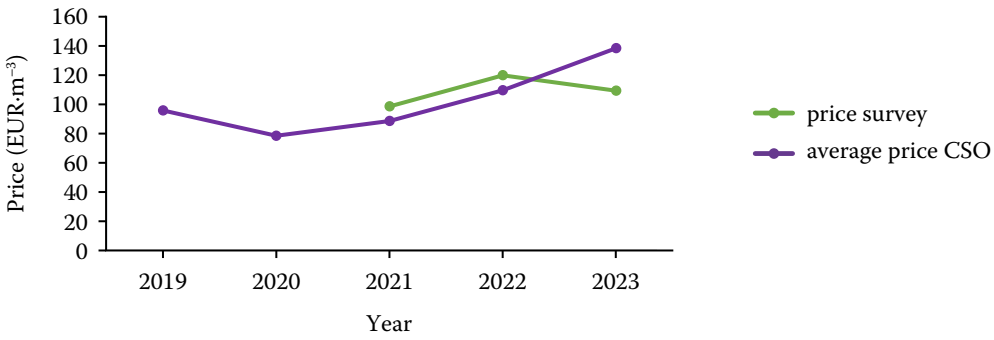

Figure 2. Timber quality grade II – Price trends of European beech wood based on price survey and average prices by the Czech Statistical Office (CSO) in EUR·m^{-3} for the period 2019–2023

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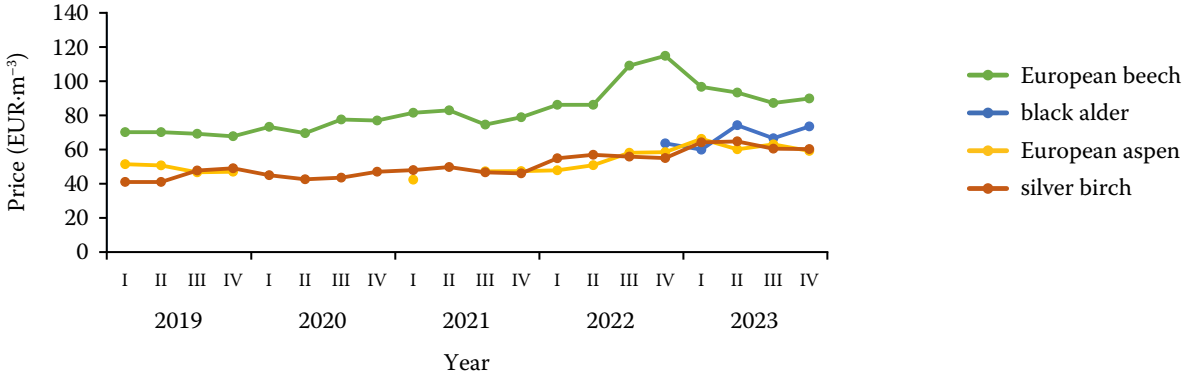

Figure 3. Timber quality grade IIIAB – Price trends for the tree species European beech, black alder, European aspen and silver birch based on a price survey in EUR·m^{-3} for the period 2019–2023 by quarters

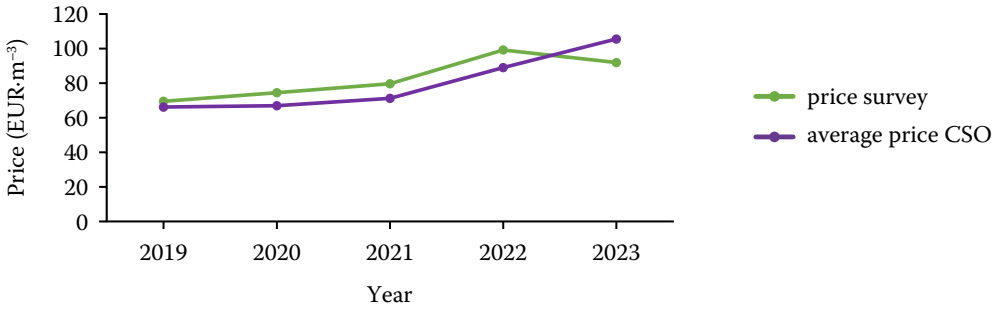

Figure 4. Timber quality grade IIIAB – Price trends of European beech wood based on price survey and average prices by the Czech Statistical Office (CSO) in EUR·m^{-3} for the period 2019–2023

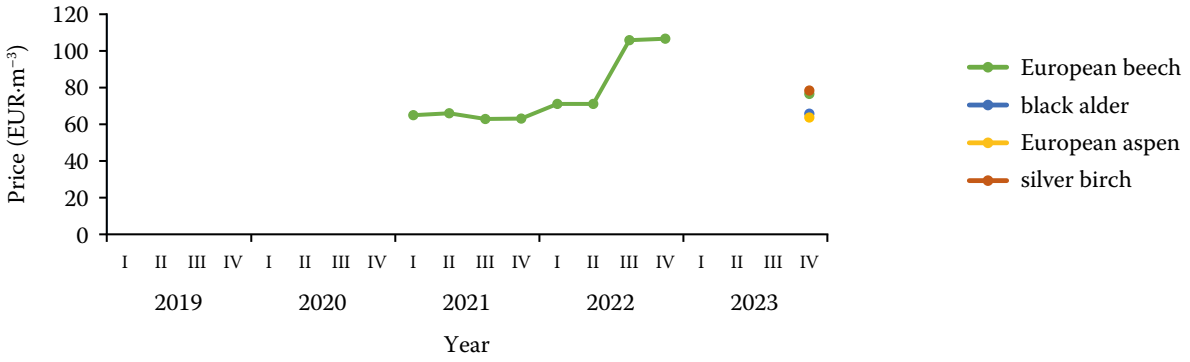

Figure 5. Timber quality grade IIIC – Price trends for the tree species European beech, black alder, European aspen and silver birch based on a price survey in CZK·m^{-3} for the period 2019–2023 by quarters

and fir in roundwood, and spruce, fir and oak roundwood and firewood). In Poland, a study by Banaś and Kożuch (2019) analysed changes in supply and timber prices, including birch and alder, and informed that in sawn-timber, the price for birch sawn-timber between 2005 and 2018 varied from EUR 46 (± 4.9) per m^3, while the price for alder sawn-timber varied slightly more from EUR 49.3 (± 5.1) per m^3. Less variability was observed among pulpwood (birch: EUR 33.5 ± 3.4, alder: EUR 29.7 ± 3.5).

The results of the price development of timber assortments (Figures 1–10) refer to the group of respondents interviewed in the price survey in the Western Highlands region. To formulate conclusions valid for the whole Czech Republic, it would be necessary to address respondents in other regions of the Czech Republic and to carry

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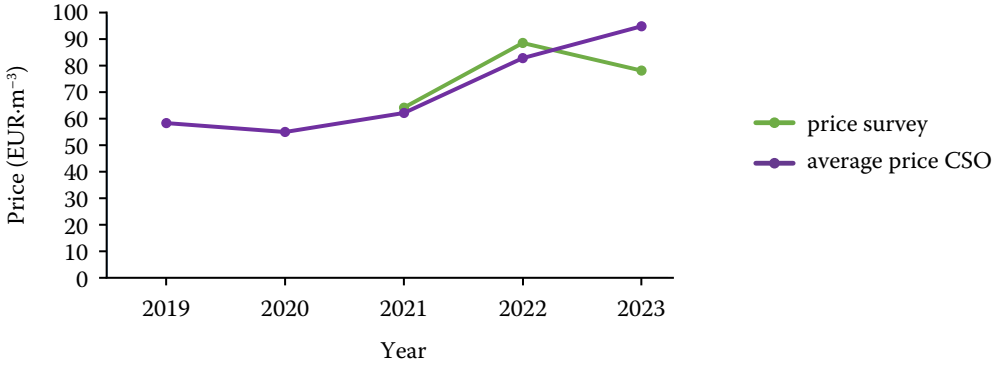

Figure 6. Timber quality grade IIIC – Price trends of European beech wood based on price survey and average prices by the Czech Statistical Office (CSO) in EUR·m^{-3} for the period 2019–2023

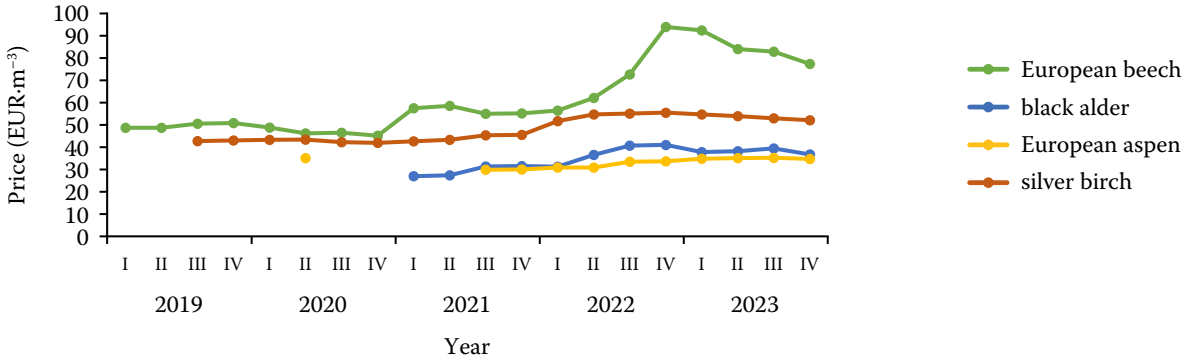

Figure 7. Timber quality grade V – Price trends for tree species European beech, black alder, European aspen and silver birch based on a price survey in EUR·m^{-3} for the period 2019–2023 by quarters

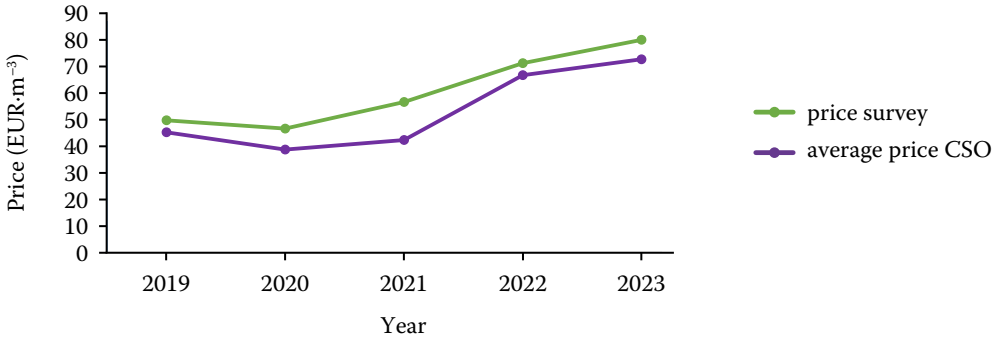

Figure 8. Timber quality grade V – Price trends of European beech wood based on price survey and average prices by the Czech Statistical Office (CSO) in EUR·m^{-3} for the period 2019–2023

out related statistical evaluations. Based on the graphical representation of the price development of timber assortments (Figures 1–10), the following conclusions can be drawn:

(*i*) In the price survey, the highest prices of timber species were for beech.

(*ii*) In the case of roundwood assortments (quality II, IIIAB), it cannot be clearly stated that any of the pioneer tree species (birch, alder, aspen) always achieved higher prices during the observed period. Only in 2023 higher prices could be seen for alder (IAB quality grade).

(*iii*) Very few of the observed prices for the pioneer tree species were for the II and IIIC quality, which are not actually produced and, therefore, not traded by the respondents.

(*iv*) The birch assortments of timber quality V had the highest price of the observed prices of this

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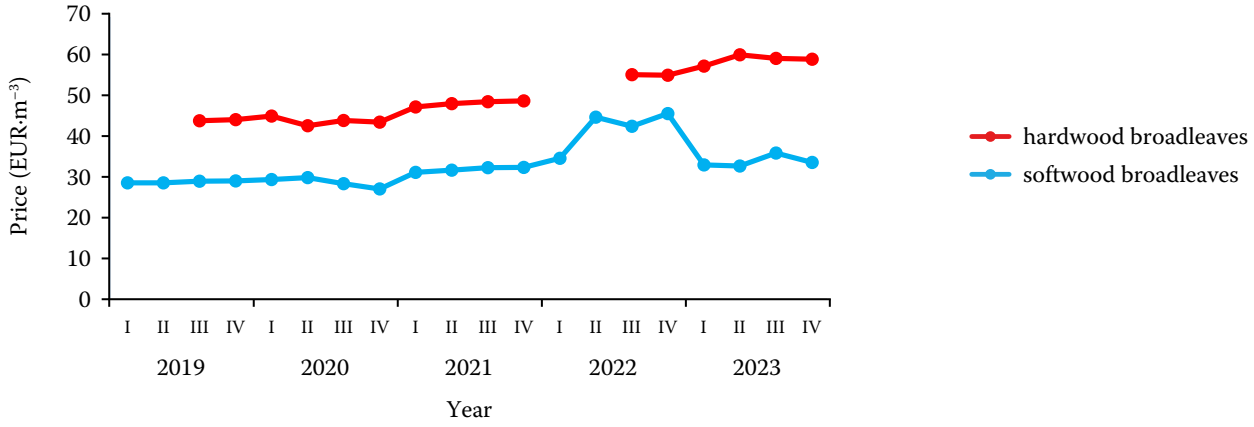

Figure 9. Timber quality grade VI – Price trends for hardwood and softwood broadleaves based on a price survey in EUR·m^{-3} for the period 2019–2023 by quarters

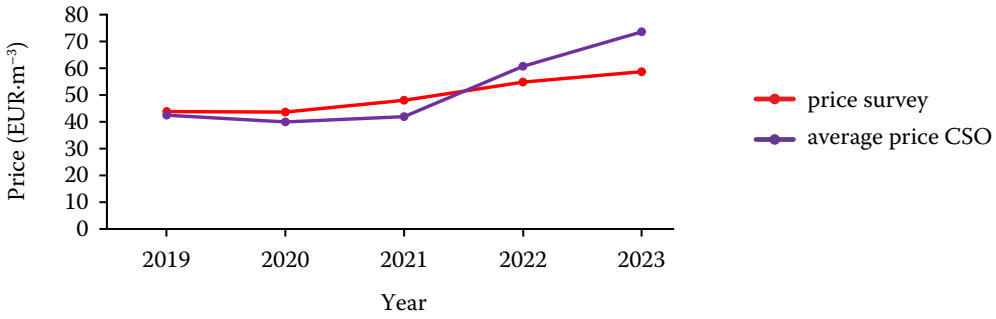

Figure 10. Timber quality grade VI – Price trends of hardwood and softwood broadleaves based on price survey and average prices by the Czech Statistical Office (CSO) in EUR·m^{-3} for the period 2019–2023

quality of timber for the pioneer tree species during the period under review.

(*v*) Except for 2023, the prices of beech timber identified by the price survey show a similar trend to the prices of beech timber identified by the CSO. In 2023, the price of beech timber assortments decreased noticeably for the respondents surveyed.

CONCLUSION

If we want to change the view of pioneer tree species (birch, alder, aspen) from weed tree species to an alternative to Czech commercial tree species, it is desirable to provide clear information on the possibilities of processing the wood of pioneer tree species into products with higher added value. The demand from wood-processing companies for quality wood from pioneer tree species can help to shift this view among forest owners and managers.

The use of pioneer tree species might lead to an acceleration of the restoration process because of the provision of rich and abundant tree-related microhabitats (Spînu et al. 2023). In times of climate change, pioneer species like birch and aspen can help in silviculture. The main advantages are low demands for stands and good soil utilization (Tretter et al. 2022). In Czech forestry, it might be useful to devote more space to providing information on the possible use and benefits of pioneer tree species as it can lead to perception change among important stakeholder groups – not only among industrial partners but also among forest owners.

On the other hand, the comprehensive use of pioneer tree species wood in the Czech Republic is possible if there are sufficient supplies of wood from forest stands with pioneer tree species in the Czech Republic, which will create a prerequisite for a balanced and long-term supply of wood raw material to the Czech market. Without this, wood-process-

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ing and other industries will not be willing to invest, in most cases, large amounts of money into new technologies for processing wood from pioneer tree species. Of course, this is not the case for the energy use. But even here the question is how society will view the use of wood for energy purposes in the future in terms of carbon storage requirements.

Using a system approach, information on the prices of the timber assortments of considered species is also important for deciding on the optimal species composition of the restored forest stands. In the case of commercial tree species, this information is available at a national level. However, the situation is quite the opposite for the timber assortments of pioneer species, where information on their prices is completely lacking. This confirms the fact that the market for assortments of timber from pioneer tree species in the Czech Republic basically does not exist. Objectively, however, it should be noted that the reason for the absence of a market for pioneer tree species wood in the Czech Republic lies in the low volume of these assortments traded. It is therefore advisable to support efforts to create a functional Economic Forestry Information System, the introduction of which has been discussed in the Czech Republic for almost 20 years.

The transferability of the study would be improved if more respondents were included in the study (also from different regions), however one should keep in mind that the group of respondents that could report relevant data on pioneer tree species prices is limited. The region of Western Highlands is specific, but relevant as a case study due to being heavily affected by the bark beetle calamity. More profound conclusions could have been made if more data was available and accessible for in-depth statistical analysis. Nevertheless, the study provides important insights that can be used in forest management practices and potentially replicated in countries with similar forestry conditions.

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