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The Identification of the Abundance of European Larch Trees in Polish Forests

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Abstract: The purpose of the study was to identify the abundance of European larch trees in Polish forests, taking into account the size of areas and their location. A dendrometric analysis (volume, age of trees) was performed as a source of knowledge on the availability of the raw material base as a response to the production needs of wood products in Poland. The detailed data were made available in 2023 by the Directorate General of State Forests on the basis of a license specifying the conditions of use of the vector record of the forest numerical map and appraisal description data. European larch trees are in areas all around Poland. They grow throughout the country, with most stands located in the southern and northern parts of Poland. Stands with a dominant share of larch in the species composition (i.e., those that are part of trees stands with a minimum area of 0.1 ha) occupy 44,813 ha and occur in 17,553 stand divisions. The analysis of productivity showed that the average height of larch stands in Poland ranges from 5 m to 45 m. Tree stands are predominately 26–30 m in height. Most stands with trees over 30 m high are located in the RDFS Krosno (over 15% of the entire forest area with larch as the dominant species). European larch stands in Poland are characterized by significant differences in the average DBH. They are correlated with the age of the stands.

Keywords: European larch; *Larix decidua*; larch stands in Poland; productivity of European larch

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1. Introduction

The strategic value of wood in Poland is confirmed by the fact that the industry based on the processing of this raw material is one of the pillars of the Polish economy. The market share of the forestry-based industry in GDP (gross domestic product) is approximately 1.7% and is higher than in the EU (about 1%) [1]. The forestry industry is based on Scots pine wood; however, European larch is one of the most researched tree species in Europe [2]. Larch (*Larix* Mill.) it is one of the most important elements of the boreal forest, where it occupies 50% of resources [3]. Larch is also one of the most valuable conifers in temperate forests as well as in mountainous regions, where it is either native or introduced in artificial plantations. It is highly appreciated for its wood properties, including high mechanical strength, attractive reddish color, and high natural durability [4]. The distribution range of European larch was shaped after the last glacial period, and currently encompasses the Alps, the Sudetes, and a scattered range in the Carpathians up to the Apuseni Mountains [5]. Larches in Poland have often been grouped together or divided into geographic subspecies by several authors [6,7]. It is a transitional species, colonizing open terrain after natural disturbances. European larch forms pure stands, but it is more often found with other alpine tree species, which tend to replace it if no other disturbances occur, and is planted across Europe with varying results. According to the provenance experience of IUFRO 1944, the best growth and development have provenances from the Sudetes and the Western Carpathians regions [8–10]. Currently, it is cultivated on a larger scale in the lowlands [11]. The results of the last inventory of European larch in Polish forests showed that the area of

pure larch stands was over 126 thousand ha, which was approximately 1.8% of the State Forests area [12]. It should be assumed that the number and area of sites have changed over the decades. Currently, there are no detailed analyses relating to the size of the larch raw material base in Poland, or its localization [13]. The generally accepted data do not allow us to determine the production potential of larch wood products in order to meet internal needs related to the possibility of replacing larch wood from the Far East with local raw material. Based on data from the Central Statistical Office of Poland [14], the area of seed tree stands with larch is approximately 1803 ha and the area of derivative crops in 2021 was 2417 ha. Such information seems to be insufficient.

In times of global trade, several dozen wood species from different parts of the world are permanently available in Poland as well. However, the exploitation of forests, especially tropical forests, is associated with the phenomenon of their disappearance. A compromise in the face of limitations in obtaining tropical wood—resulting from historical and economic conditions—was the import of larch wood from the Far East (mainly Siberia), from where Siberian and Dahurian larch wood was supplied in large quantities to the European market [15]. Due to the current political situations, economic situations, and international trade restrictions including supply chain disruptions, there is a real need to define an alternative to the Asian larches imported so far to Europe, including Poland. European larch wood is not inferior to the properties of Siberian larch wood in the context of its usefulness (Table 1). Any differences occur mainly due to the growth conditions and ecological factors, especially altitude, exposure, soil, and climate effects on wood structures. The ring width of wood can alter wood structure. The mechanical properties of wood change because of narrow or wide rings affect the density of wood [16].

Table 1. Comparison of some properties of European (*Larix decidua* Mill.) and Siberian larch (*Larix sibirica* Ledeb.) wood.

Species	Density [kg/m^3]	CS * [MPa]	MOR * [MPa]	MOE * [MPa]	References
Larix decidua Mill.	401	-	50.7	5.2	[17]
	465	-	69.6	9.0	[17]
	478 (316–569)	57.5 (20.4–87.8)	24.8 (12.3–34.4)	-	[18]
	540	-	-	-	[19]
	652	-	-	-	[20]
Larix sibirica Ledeb.	572 (500–698)	-	-	-	[21]
	590	53.1	-	6.3–9.7	[22]
	620–680	46.3–51.1	79.8–103.9	7.0–9.5	[23]

* CS—compression strength along the fibers, MOR—bending strength, MOE—modulus of elasticity.

Larch wood is included in the standard for the strength sorting of construction and building sawn timber [24]. The durability of the dominant heartwood on the trunk is also defined as medium or low durability (both European and Siberian larch) [25]. Nevertheless, a high variability of heartwood/sapwood extent at different genetic levels (populations, progenies and clones) has been shown together with a high genetic control [4,7]. At the same time, numerous studies have been carried out related to the influence of the position of trees in the stand on the properties of wood [18], related to determining the dynamics of growth [26], and regarding resistance to biotic factors [27,28]. Generally, any sources describing the wood properties of larch may be found in the literature. These analyses are preceded by a detailed description of the stands from which the research material is taken. European larch (*Larix decidua* Mill.), as a species with fragmented distribution range, is expected to exhibit strong genetic differentiation among local and regional subpopulations, and thus has strong geographic variation regarding silvicultural traits [2]. This is why it has been the object of provenance research from the very beginning of large provenance experiments coordinated by the International Union of Forestry Research Organizations (IUFRO) [8–10]. However, there are practically no extensive analyses describing the effect

of factors determining growth and development conditions on the physical and mechanical properties of wood in this species, especially European larch [18]. It is necessary to determine of the size of the larch resource base in Poland, and this will allow us to define the variability of tree populations and stand growth conditions. Forest areas in Poland are 9.2 million hectares. The vast majority are state forests in Poland, of which over 7.3 million hectares are managed by the State Forests [14]. Thus, the source of data in this area is the State Forests Information System (SILP). SILP is a computer management support system at the State Forests National Forest Holding in Poland [29]. These data can also be a starting point for further analyses, the effect of which may be to consider European larch as a species used for afforestation projects [30].

The main purpose of the study was to identify the abundance of European larch trees in Polish forests, taking into account the size of areas and their location. A dendrometric analysis (volume, age of trees) will be performed. The scientific activity will provide new knowledge on the availability of the raw material base as a response to the production needs of wood products. At the same time, new knowledge on the possibility of replacing imported larch with local raw material will be provided, which has both ecological and economic dimensions.

2. Materials and Methods

The output data, which is the basic source of information on the share and distribution of European larch in Poland, were made available in 2023 by the Directorate General of State Forests (DGLP) on the basis of a license specifying the conditions of use of the vector record of the forest numerical map and appraisal description data. The data were prepared based on the State Forests Information System (SILP).

Units of the State Forests include 429 forest districts and 17 Regional Directorates of the State Forests (RDSF). Therefore, the analyses were carried out taking into account the distinguished regional directorates.

The available data presented 196,018 forest divisions (forest addresses) in which European larch occurred. However, due to the fact that in many cases, the share of larch in the stand was single or the stand was in the recovery phase, there was a need to reduce the numbers of areas in which it occurred in Poland. From all the data in the SILP database, areas where larch was in the tree stand layer or the proportion of larch was at least 50% were selected. This was due to 'forest' is defined in the Act as land with a minimum area of 0.1 ha that is covered with forest vegetation (forest crops), trees and shrubs and forest runes [31]. Among them, those in which larch was in first rank were selected. The selected data were defined as areas with a significant share of European larch and used for the analyses. Based on the data obtained, a map was created illustrating the European larch proportions divided into forest districts.

The size of the occupied area and the types of forest habitats where this species occurred were determined. Data on the age of stands, average diameter at breast height (DBH), and height of trees as well as yield classes were also compiled and analyzed. The SILP system data was collected based on the methodology described in the Forest Management Manual [32]:

- The average DBH was determined separately for each story, from 5 cm upwards, rounded to full centimeters based on measurements of 5–10 trees taken in places representative of a given stand;
- The average height was determined separately for each story, from 1 m upwards, rounded up to full meters based on measurements of 5–10 trees made in places representative for a given stand (basically on the same trees on which DBH was measured);
- The volume was determined on the basis of the number of trees, their average DBH, and average height.

Statistical analysis of the test results was carried out using Statistica v. 13.3 software (TIBCO 2013). To determine the significance of observed relations, an analysis of variance (ANOVA) was made at the 0.05 level of significance.

3. Results and Discussion

3.1. Location of European Larch Sites in Poland

European larch trees occurred in areas across Poland, with the most stands of this species located in south-western and western Poland (Figure 1). These were the areas of RDSF in Katowice, Wroclaw, Krosno, and Gdansk. Its trace amounts were found in central and eastern Poland (RDSF in Warsaw, Zielona Góra, Bialystok and Lublin). These data are an important verification of common information that in Poland, European larch occurs mostly in mountainous regions (Sudetes and Carpathians) and is found in lowlands only in South Poland (Świętokrzyskie Mountains) [2,11]. Taking into account the obtained data, European larch in Poland occurs in both the southern and northern areas (Figure 1).

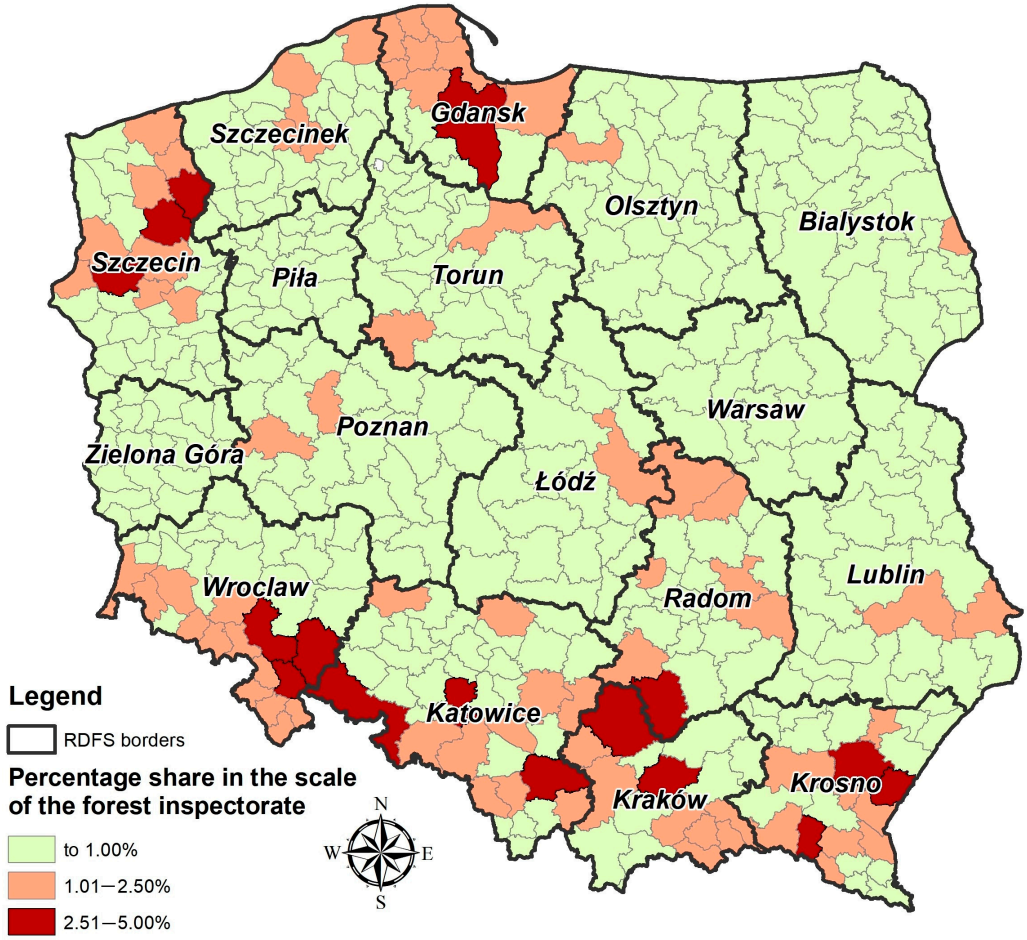

Figure 1. Arrangement of European larch stands in Poland broken down by forest inspectorates with a proportion of larch of at least 50%.

In general, the area of larch stands ranged from 0.01 ha to 46.9 ha, with an average of 2.55 ha. The largest divisions were found in Cisna, Komańcza, Bircza, and Romanów. The total area of stands with European larch is approximately 682,548 ha. The calculations regarding the occurrence of larch show that the forest area in Poland, according to Central Statistical Office of Poland [14] and Forest Europe [33], is 9,483,000 ha; with the share of 682,548 ha, European larch accounts for 7.2% of the forests area share. Based on this, it should be stated that the current marginalization of the raw material base in terms of European larch should be verified. Stands with a dominant share of larch in the species

composition (those where European larch were at least 50%) occupied 44,813.20 ha and occur in 17,553 stand divisions.

European larch occurred in Poland in 32 types of forest sites (Table 2). It was most numerous in deciduous fresh mixed forest (FMDF—31%) and deciduous fresh forest (FDF—22%) habitats. It was quite common to find tree stand divisions in deciduous fresh upland forest habitats (FUDF—12%) and deciduous fresh mountain forest habitats (FMoDF—12%). It was less numerous in other types of forest habitats. Ecologically, these are optimal habitats for this species [34]. This confirmed the habitat requirements of larch in the conditions of Central Europe. In coniferous forests, larch occurred less often, but it occurred most often in fresh mixed coniferous forest (FMCF—17%). Larch is particularly suitable for creating two-story tree stands, in which it forms the upper story, with shade-tolerant species in the lower story. Growing within pine-birch and oak-birch forests confirmed that these ecotypes demand less light and are able to grow in the shade of other tree species such as larch [7].

Most breeders, authorities in the field of larch cultivation, state that this species is most suitable for growing in stands mixed together with species that have different ecological properties, having a beneficial effect on larch and keeping the soil in good condition. It grows and develops very well in an admixture with linden, hornbeam, or possibly beech in the lowlands, and with blackberry, pine, and spruce in the mountains [7]. In multi-species stands, especially those with a complex structure, larch is characterized by better stem structure and health, and increases the productivity and value of the stand. Examples of such stands were provided by forests in the Świętokrzyskie Mountains [35]. Carpathian provenances that generally support warmer winters and drier summers than at their sites of origin may have an advantage compared to Sudetic populations with opposite preferences [35].

European larch growing in the conditions of Poland corresponded to the first three yield classes (from I to III). Those yield classes are an indicator of the production capacity of the forest habitat and the forest stand [36]. Among the forest divisions with larch as the dominant species, as much as 83% of the area was classified to the first yield class. Tree stands covering nearly 15% of the area were classified as class II. The remaining stands were classified as class III. The largest number of larch stands in the first yield class is located in the RDSF in Szczecin, Krosno, and Katowice (Table 3). Equally good conditions for growth were also found in the RDSF in Gdansk and Wroclaw.

3.2. Productivity of European Larch Stands in Poland

The starting point for assessing the yielding of European larch stands in Poland was the analysis of the age of stands. The largest area share was held by stands in the II (21–40) and III age classes (41–60)—28% and 28%, respectively. Less numerous European larch was represented by stands in age class IV (22%) and V (11%). This proved the increased introduction of European larch after World War II. The stands were built during the renewal period in the 1960s and 1970s [34]. Tree stands over 120 years old occupy only 2% of the area. They were created during the large-scale introduction of larch in Poland at the turn of the century before World War I [33]. Tree stands up to 20 years old (class I) held 6%. In most RDSFs, larch was represented in all age classes (Figure 2). Most young stands (up to 40 years of age) were part of forests in the RDSF Katowice, Krosno, and Wroclaw. At the same time, the largest areas with young stands were also in RDSF Katowice, Krosno, and Wroclaw. Stands aged 41–60 years dominate in RDSF Szczecin, Gdansk, and Katowice; those aged 61–80 years are in RDSF Kraków, Gdansk, and Krosno, and the oldest stands are in RDSF Wroclaw, Katowice, Cracow and Radom (Figure 2).

Table 2. Characteristics of European larch stands with a species composition above 50% in individual RDSFs, broken down by forest site types [ha].

Forest Type *	RDSF																
	Bialystok	**Gdansk**	**Katowice**	**Kraków**	**Krosno**	**Lublin**	**Łódź**	**Olsztyn**	**Piła**	**Poznan**	**Radom**	**Szczecin**	**Szczecinek**	**Torun**	**Warsaw**	**Wroclaw**	**Zielona Góra**
MSCF																0.6	
FMoCF			803.1	806.3	1868.6	339.9	8.8			0.4	749.5					838.0	
WMoCF																1.8	
MSCF		3.0											0.7				
MMSCF																21.5	
FMMCF																20.5	
WMMCF																47.1	
FMCF	158.2	101.7	787.8	43.6	101.6	48.7	91.0	111.6	303.9	62.3	68.5	330.6	329.1	92.4	16.9	279.6	294.3
WMCF	2.3	3.7	278.4	31.9	51.7	1.3	3.8	3.2	13.1	31.8	5.5	30.4	14.2	2.4	3.1	54.8	17.8
FMUCF			25.3	2.6	0.5	0.8	0.8			3.7	18.3					11.9	
WMUCF											6.0						
FCF	2.0		86.3		1.5	3.8	2.3	0.9	13.8	0.7		3.5	16.2	2.3	4.0	16.4	15.5
WCF			7.0			0.5				4.0							
WMoCF			519.6	1227.2	2700.1						16.5					954.3	
FMoDF			280.5	136.4	3.7						7.4					1281.7	
WMoDF			24.9	3.8	106.1											11.6	
FlDF		34.1	12.9		29.5	1.5	1.5	9.4	2.3	3.1							4.4
FlMoDF			2.5	6.0	6.1												
FUDF			0.6		29.5											0.2	
MSDF		2.0	3.2					2.2				0.9					
FMMoDF			27.2	19.2												311.7	
WMMoDF			25.6													50.7	
FMDF	463.1	2366.8	1417.3	49.0	244.8	227.7	491.8	776.4	638.2	528.6	979.4	2476.9	1660.4	615.7	200.0	555.5	332.3
MUDF	24.7	7.5	445.2	11.1	93.4	19.7	19.9	15.7	40.2	46.9	33.0	125.2	48.9	13.3	10.7	61.1	59.3
FMUDF																	
WMUDF			7.3		1.8	1.2					53.8					13.3	
FDF	314.4	1383.2	526.7	6.4	123.1	556.7	333.7	1246.3	341.0	623.6	422.4	2155.7	1047.6	560.7	196.2	153.5	111.0
WDF		21.1	77.6	16.0	39.4	17.6	24.2	54.6	14.1	17.6	13.0	46.7	17.2	0.8	24.3	22.5	18.2
FUDF			298.5	71.1	15.7	46.6	8.0			16.7	258.6					853.7	
WUDF			24.1	1.3	63.2	3.8					15.8					28.4	
ADF			1.7	0.4		2.0	0.8	1.4				2.0					0.1
AADF										0.4		1.4					

* Coniferous forests: MSCF—mountain swamp, FMoCF—fresh mountain, WMoCF—wet mountain, MSCF—mixed swamp, MMSCF—mixed mountain swamp, FMMCF—fresh mixed mountain, WMMCF—wet mixed mountain, FMCF—fresh mixed, WMCF—wet mixed, FMUCF—fresh mixed upland, WMUCF—wet mixed upland, FCF—fresh, WCF—wet, WMoCF—wet mountain; deciduous forests: FMoDF—fresh mountain, WMoDF—wet mountain, FlDF—floodplain, FlMoDF—floodplain mountain, FUDF—floodplain upland, MSDF—mixed swamp, FMMoDF—fresh mixed mountain, WMMoDF—wet mixed mountain, FMDF—fresh mixed, MUDF—mixed upland, FMUDF—fresh mixed upland, WMUDF—wet mixed upland, FDF—fresh, WDF—wet, FUDF—fresh upland, WUDF—wet upland, ADF—alder, AADF—alder ash.

Table 3. Characteristics of European larch stands with a species composition above 50% in individual RDSFs, broken down by yield class [ha].

Yield Class	RDSF																
	Bialystok	**Gdansk**	**Katowice**	**Kraków**	**Krosno**	**Lublin**	**Łódź**	**Olsztyn**	**Piła**	**Poznan**	**Radom**	**Szczecin**	**Szczecinek**	**Torun**	**Warsaw**	**Wroclaw**	**Zielona Góra**
I	907.9	3591.9	4602.6	1674.8	4483.8	1169.7	867.4	2126.5	1120.3	1034.8	2389.8	4889.2	2715.8	1198.9	427.0	3370.0	719.7
II	51.6	316.0	946.9	723.1	970.2	92.0	113.0	86.4	186.9	285.8	245.1	267.1	411.6	86.8	25.6	1747.8	118.8
III	5.2	15.1	133.9	34.3	26.3	10.0	6.2	8.8	59.3	19.1	12.8	16.9	7.0	1.7	2.7	475.0	14.1

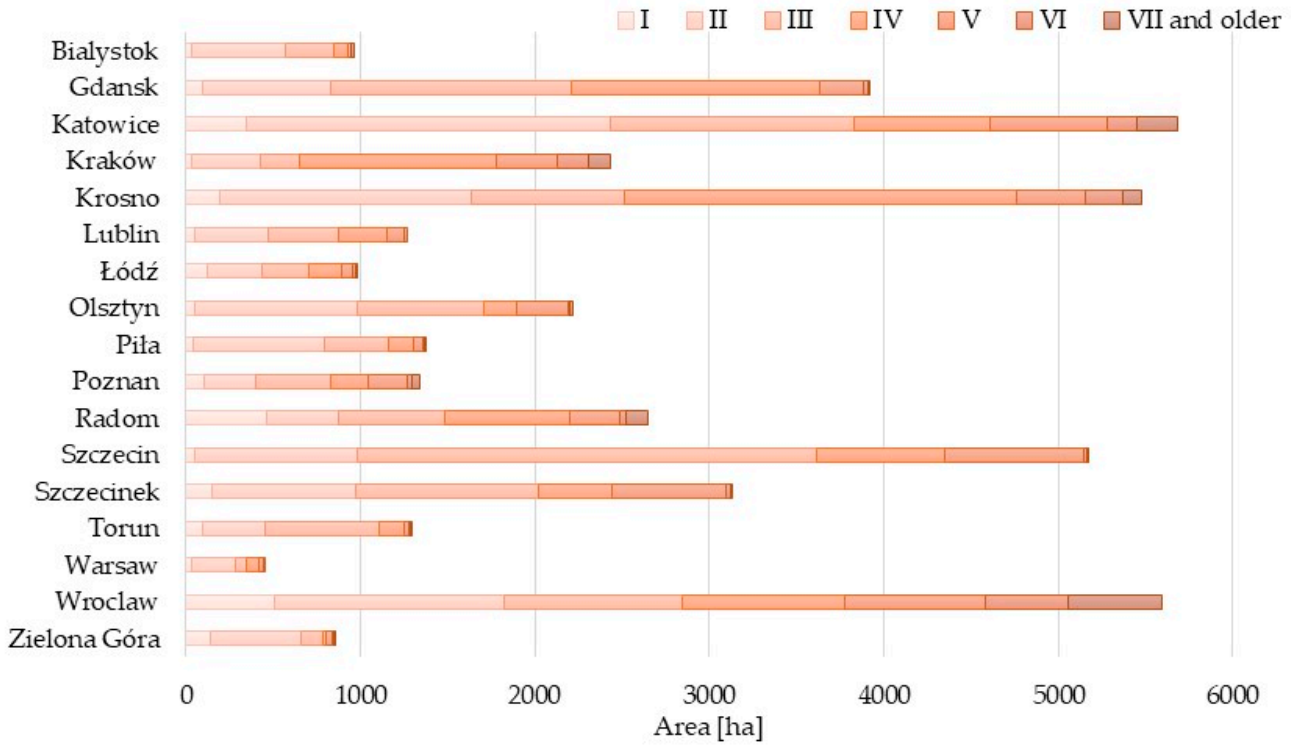

Figure 2. Characteristics of stands with the share of European larch in the species composition above 50% in individual RDSFs, broken down by age classes: I—below 20, II—21–40, III—41–60, IV—61–80, V—81–100, VI—101–120, VII—above 121.

The productivity of European larch stands in Poland was analyzed based on tree growth characteristics, such as tree height and diameter at breast high (DBH). The average height of larch stands in Poland ranged from 5 m to 45 m. Tree stands of 25–30 m height predominated. Most stands with trees over 30 m high were located in the RDFS Krosno (over 15% of the entire forest area with larch as the dominant species), as shown in Figure 3. The largest share of stands with trees at a height of 25–35 m occurred in RDSF Szczecin, Krosno, and Wroclaw. Stands with a height exceeding 40 m were found in Radom and Katowice RDSFs. The height of the stands was a derivative of their age (Table 4). The greatest height differentiation was observed in young age classes, which was most likely related to the growth dynamics of young trees and their habitat conditions [26]. The lowest variability of height among young trees was observed in RDSF Radom, with a relatively large share of habitats in the form of deciduous fresh mixed forests as well as deciduous wet upland forests, with much less in coniferous forests.

Table 4. Statistical evaluation of the factors influencing tree height and DBH.

Feature	Factor	Sum of Squares	Mean Sum of Squares	Fisher's F-Test	Significance Level
		SS	MS	F	*p*
Tree height	Site type	119,374	3316.0	830.13	0.000102 *
	Trees age	12,791,604	63,639.8	15,931.91	0.000000 *
	Site type × age	49,027.4	18.40368	4.847005	0.000000 *
	Error	737,707.0	3.79692		
DBH	Site type	130,687	3630.2	333.70	0.000000 *
	Trees age	21,706,014	107,990.1	9926.67	0.000000 *
	Site type × age	146,759	55.46430	5.408579	0.000000 *
	Error	1,939,063	10.25487		

*—significant at the 0.05 level.

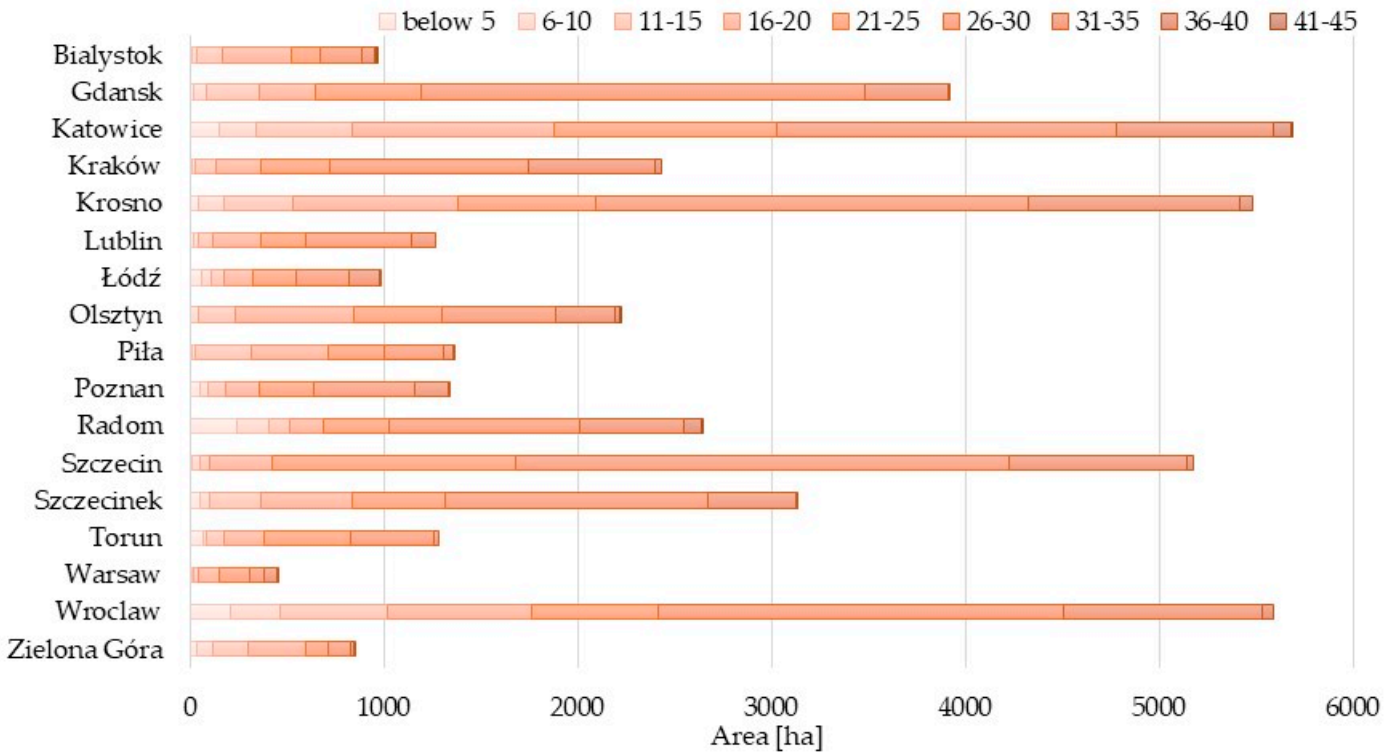

Figure 3. Characteristics of stands with the share of European larch in the species composition above 50% in individual RDSFs, broken down by tree height.

ANOVA revealed that the lowest trees were found in coniferous forests—wet mountain, swamp mountain, fresh mountain and wet mountain. The highest trees were found in deciduous forests: mixed mountain, fresh upland, fresh mountain and fresh mixed upland. The type of habitat has a significant impact on the height of the trees (Table 4). A greater biodiversity of tree species in stand composition increases stand productivity [37] and stability [38]. For this reason, the environmental factor is equally important, especially in the case of young stands. There is a relationship between the dynamics of tree growth and the technical features of the wood obtained from them. The harder the growing conditions, the smaller the growth dynamic, which translates to the density of the wood and its mechanical characteristics. Taking this into account, it can be argued that on the basis of the data obtained, specific divisions for obtaining wood of specific industrial needs could be identified. However, this requires an in-depth analysis, including wood testing. Knowledge in this area can be used in practice, as the integration of wood quality parameters into larch breeding programs should be highly recommended [39]. Nevertheless, based on the data obtained, in terms of average heights, larch stands in Poland do not differ from stands growing in European conditions.

An important factor in the description of stands is their diameter at breast high (DBH). European larch stands in Poland were characterized by significant differences in the average DBH. It is correlated with the age of the stands (Table 4) and ranges from 1 cm in age class I to 122 cm in age class VII. All stands were classified into 8 classes of thickness, graded every 10 cm (Figure 4). The majority of stands were an average DBH of 31 to 40 cm, and their area was approximately 16,000 ha (these were stands of younger age classes). In areas of 10,000 ha, there were stands with a DBH of 21 to 30 cm. A significant part of the stands were also those of a DBH of 11–20 cm (area 7900 ha) and a DBH of 41–45 cm (area of 7200 ha). As in the case of tree height variation, the greatest DBH differentiation was observed in young age classes, which were most likely caused by growth dynamics of young trees and their habitat conditions [26]. A large proportion of stands with large diameters was found in the Krosno RDSF—41–50 cm in 1908 ha in total, and 51–60 cm

in 318 ha. In RDSF Krosno, stands over 81 years of age predominate. Those stands were mainly found in deciduous mountain and upland mixed deciduous forest habitats, but these are also the areas with the lowest yearly temperatures [40]. It can be assumed that the grown trees will provide wood with high quality parameters [16]. The highest values of the average DBH of European larch stands in Poland were found in the areas of RDLP Szczecin and Radom (stands dominate in mixed fresh and wet forests). In the case of RDSF Radom, this share seems to be higher than the results from the age of the stands. This may indicate favorable growth conditions (Central European Lowland), which in the case of coniferous wood, translates into a lower density of the material and worse technical parameters [16]. ANOVA confirmed the influence of habitat type on DBH (Table 4), and showed that the smallest DBH were reached by trees growing in coniferous forests: wet mountain, swamp mountain, fresh, and wet. The largest DBH values were observed in deciduous forests: fresh upland, fresh mountain, mixed mountain, fresh mixed upland, and fresh mixed.

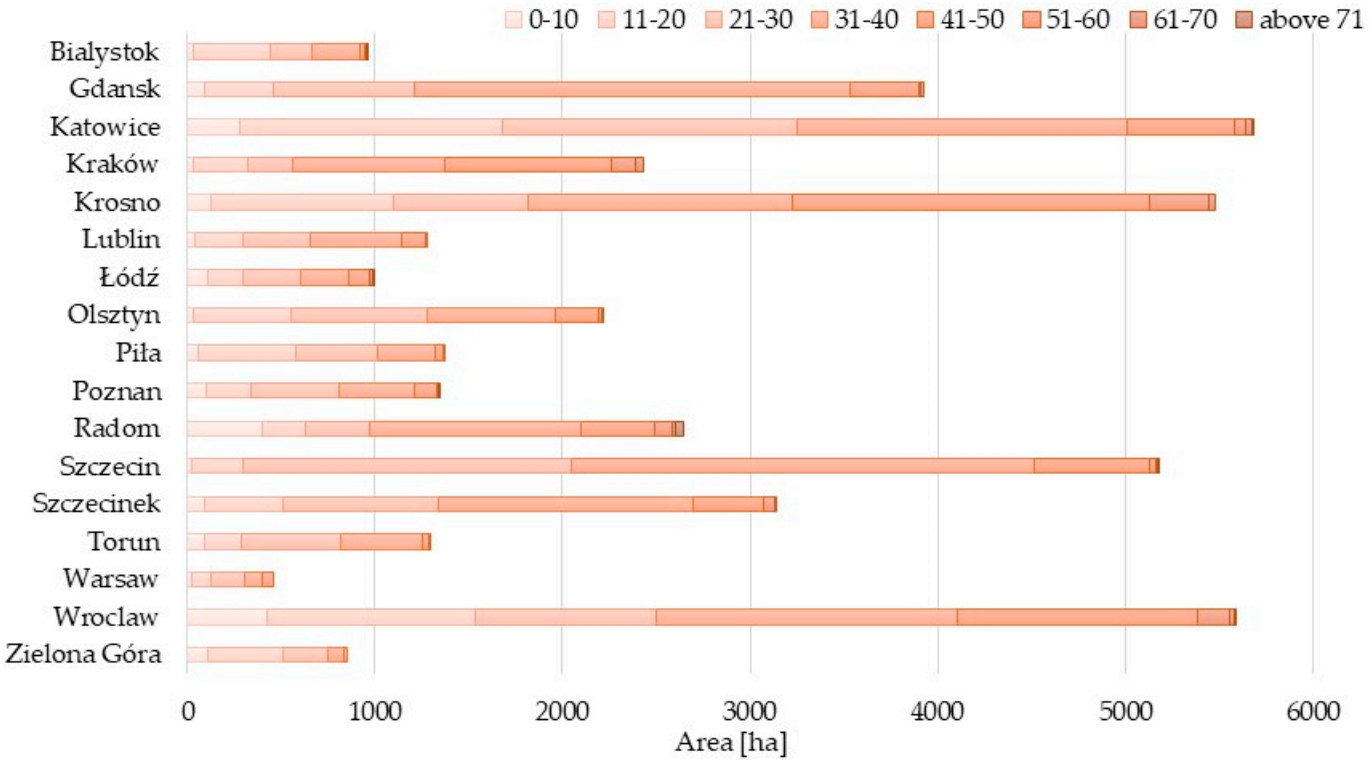

Figure 4. Characteristics of stands with a share of European larch in the species composition of above 50% in individual RDSFs, broken down by DBH.

Previous breeding activities and seed orchard programs did not consider wood quality traits, but focused on growth performance and stem form [39]. Accordingly, for second-generation breeding programs, it is indispensable to consider wood properties to sustain the inherent characteristics of the species in future plantations. The pointed quantity of potential of the raw material would make reducing the wood deficit and wood import in Poland possible by considering to include larch wood in the industry [41]. Taking into account the characteristics of stands with larch and the age of the trees, it should be assumed that the current forest resources are able to meet the current needs of the wood industry in wood of this species. Trees of a higher diameter can be a source of general-purpose sawn timber, and after selection, construction timber [24]. Identification of standing larch wood resources also makes it possible to supplement raw material deficits in the wood processing industry [41].

The total volume of European larch trees in stands with a species composition above 50% on the date of data acquisition was 8,734,794 m^3. The largest stock of standing wood was recorded in RDSF Wrocław, followed by RDSF Szczecin and RDSF Katowice (Table 5).

The presented numbers result directly from the area of stands with a species composition above 50% (r = 0.97).

Table 5. Volume of European larch trees in stands with a species composition above 50% in individual RDSF [$10^3 \cdot m^3$].

RDSF																
Bialystok	**Gdansk**	**Katowice**	**Kraków**	**Krosno**	**Lublin**	**Łódź**	**Olsztyn**	**Piła**	**Poznan**	**Radom**	**Szczecin**	**Szczecinek**	**Torun**	**Warsaw**	**Wroclaw**	**Zielona Góra**
206.1	749.9	1129.0	488.1	855.6	233.5	154.8	536.9	319.1	255.6	397.3	1065.5	653.6	231.1	71.6	1236.3	150.7

4. Conclusions

Data on the abundance of European larch trees in Polish forests was collected, taking into account the size of areas and their location. A dendrometric analysis (high, diameter at breast high, volume) as well as age of trees was performed as a source of knowledge on the availability of the raw material base as a response to the production needs of wood products in Poland. European larch occurs with varying frequency in almost all of Poland. Most stands of this species are located in southern and northern Poland. Stands with European larch account for 7.2% of the forests' area share. This is a significant update to the currently accepted data. It was also found that the total volume of European larch trees in stands with a species composition above 50% on the date of data acquisition was 8,734,794 m^3. The current forest resources are able to meet the current needs of the wood industry in larch wood.

The area occupied by larches was determined by many factors, not only natural, pluvial-terminal, and legislative factors, but also the appropriate interpretation of data describing the occurrence of the species in Poland based on SILP information. Stands with a dominant share of larch in the species composition (i.e., those that were part of tree stands with a minimum area of 0.1 ha) occupied 44,813 ha, and occur in 17,553 stand divisions. Larch seems to be an extremely plastic species with a wide range of requirements. It is most numerous in deciduous fresh mixed forest (31%) and deciduous fresh forest (22%) habitats. It is quite common to find tree stand divisions in deciduous fresh upland forest habitats (12%) and deciduous fresh mountain forests (8%). The average height of larch stands in Poland ranges from 5 m to 45 m. Tree stands are predominately 25–30 m in height. Most stands with trees over 30 m high are located in RDFS Krosno (over 15% of the entire forest area with larch as the dominant species). European larch stands in Poland are characterized by significant differences in the average DBH; it is correlated with the age of the stands. However, the highest values of the average DBH of European larch stands in Poland are found in the areas of RDFSs Radom and Katowice.

It should be pointed out that the spread of European larch stands throughout Poland and their occurrence in various types of habitats within various microclimates has an effect in the form of variable stand productivity. On the basis of the data obtained, specific divisions for obtaining wood for specific industrial needs could be identified with deeper analysis, including wood testing during the next stage of the future research. On the basis of the provenance experiments' results, material for research will be collected. A dendrometric analysis, as well as characteristics of wood taken from the breast height of selected trees (diameter, share of heartwood, grain, and density, which determine the technical characteristics of wood) will more completely show the prospect of increasing the applicability of European larch wood in the wood industry.

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