# A relation between biometric features of crowns and conducting area shares in the Scotch pine stems (*Pinus sylvestris* L.) impact of the form of pine necrotic bark (FCF)

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The study attempts to determine the relationship between the biometrics of the treetops, and the conducting surface. Analyzed pines of varying form of necrotic bark, which have grown in terms of fresh coniferous forest habitat type (FCF). The study was conducted in Wolsztyn Forest District administratively belonging to the Regional Directorate of State Forests in Zielona Góra. They were there faces trial belonging to the selected type of forest habitat that is fresh coniferous forest (FCF) in Przychodzko and Nowy Dwór Forest Distrcits. On the surfaces of these trees were selected test are assumed to characterize the stand, and obtained from them study material in the form of discs. They were selected based on the dendrometric method - Urich I. In summary, studies found that there is a clear correlation conductive surface of biometric features regardless of the form of necrotic bark.

*Scots pine, necrotic bark*

## Introduction

Carbon petroleum, iron and wood create a group of the most important economic and industrial raw materials. They condition the development of the economy and everyday life. The use of wood is so versatile and common and each one of us meets that raw material almost every day. It has a very wide range of applications, handling, processing or refining. Despite the development of technology and the creation of many plastics that imitate the properties of wood, it still does not lose its increasing attractiveness and value as a renewable raw material.

The commercial forest areas are continually reduced due to the constant progress of civilization. The reason for this is: construction of roads, highways or development of urban areas, which until now were not frequently used by humans. For the same reason the demand for lumber is not only high but is still growing, and forested former farmland not give satisfactory qualitative results in the first generations.

Pine is a heartwood species. According to Hejnowicz (2002) heartwood is called the inner of the wood shot or stems of growing trees. It is devoid of living cells and nutrients are replaced by heartwood substances - mainly flavonoids. Heartwood of freshly felled tree is little different from the sapwood, then darkens strongly and differs clearly (Krzysik 1970). Pine has clear annual rings. Sapwood has yellow-white color, while the heartwood is pinkish, reddish or brown - reddish (Krzysik 1970).

The bark of pine is produced by cambium tissue covering tree stems and branches. Thanks to its insulating properties bark acts as a protective layer of the tree, as well as of cambium, localized at the periphery of tree, against fluctuations in temperature, sunlight, water loss and penetration of fungi and insects (Krzysik 1970).

The aim of the study was to determine the relationship between the crown and the biometric features of the conducting surface of pine shot having different forms of necrotic bark and growing in conditions of fresh coniferous forest habitat (FCF).

## Methods

The study was conducted in Wolsztyn Forest District administratively belonging to the Regional Directorate of State Forests in Zielona Góra. Sample plots were established in Przychodzko and Nowy Dwór Forest Districts, belonging to forest fresh coniferous forest (FCF) habitat. Sample trees were selected on the chosen surfaces, which were characterizing the whole stand. Then study material, in the form of discs, was obtained from selected trees.

The field works consisted of the following steps:

- selection and designation of sample plots,
- measurements of diameter at breast height,
- measuring the height of trees,
- determining the form of necrotic bark,
- determining the extent of necrotic bark,
- designation and felling of model trees,
- cutting discs out of wood.

Model trees were determined by Urich I$^{st}$ method. This method consists on measuring trees diameters at breast height, setting them in a rising order, allocating them to the class having the same cross-sectional area and then allocating the same number of trees to each classes (Grochowski 1973).

The following biometric measurements were determined:

- diameter at breast height,
- height,
- stems length to the first living branch,
- stems length to the first dry branch,
- the length of the crown,
- the width of the crown,
- the largest diameter on whorls from the base,
- the amount of whorls on living crown,
- the length of necrotic bark on the stem,
- the zone with knobs bigger than 1 cm,
- overgrown knot zone, up to 1 cm,
- the zone of snag.

The research material, in the form of wood discs, was grinded using an angle grinder and sand paper. This significantly improved the visibility of annual wood rings boundaries and zones of early and late wood. The next stage was to measure the discs in four main geographical directions from the core to the outer part of the disc. Different types of width were measured sequentially:

- of the core,
- heartwood area,
- sapwood area, taking into consideration the width of early and late wood.

Measurements were performed using a special tool that reads width of an each ring. It was connected to PC and compatible with the installed software, which was used to read all the data needed for further calculations.

The collected data were transferred to Microsoft Excel, where width of annual rings, as well as share of early wood in the annual ring and in all disc were calculated. The results obtained allowed further calculations.

## Results

Biometric characteristics of the analyzed sample trees delivered from plots 72b and 27d are shown in Table 1.

**Table 1.** Biometric parameters of sample trees

| The number of trees | Diameter at breast height [cm] | Height [m] | Stem length to first living branches | The length of stems to the first dry branch | The length of the crown [m] | The width of the crown [m] | The largest diameter on whorls from the base | The amount of whorls on living crown [m] | The length of necrotic bark on the stem [m] | The zone with knobs bigger than 1 cm [m] | Overgrown knot zone, up to 1 cm 1 cm [m] | The zone of snag [m] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **72b C/1** | 22 | 21,1 | 13,7 | 13,4 | 7,7 | 3,7 | 1,4 | 28 | 3,2 | 6,2 | 3,7 | 3,5 |
| C/3 | 32 | 21,5 | 13 | 12,5 | 9 | 9,5 | 3,5 | 46 | 4,9 | 6,4 | 4,2 | 1,9 |
| M/1 | 22 | 22,7 | 14,1 | 15,1 | 8,6 | 4,2 | 1,9 | 43 | 4,7 | 7,9 | 5,3 | 0,9 |
| M/3 | 32 | 23,8 | 15,1 | 14 | 9,8 | 5,4 | 2,2 | 35 | 5,4 | 7 | 1,4 | 5,6 |
| G/3 | 37 | 23 | 15,6 | 14,9 | 8,1 | 8,5 | 1,1 | 33 | 8,2 | 6,6 | 3,8 | 4,5 |
| **27d C/1** | 23 | | 18,9 | 19,3 | 7,1 | 3,9 | 1,4 | 21 | 5,2 | 7,2 | 5,7 | 6 |
| **C/2** | 27 | 24,7 | 15,8 | 15,3 | 9,4 | 4,2 | 4,2 | 33 | 4,5 | 3,6 | 2,3 | 9,4 |
| **C/3** | 32 | 24,1 | 17,4 | 16,5 | 7,6 | 3,8 | 3 | 27 | 9,8 | 6,8 | 2,2 | 7,5 |
| **M/1** | 23 | 24,1 | 18,8 | 18,5 | 5,6 | 4 | 1,1 | 21 | 7,6 | 3,6 | 2,4 | 12,5 |
| **M/2** | 27 | 25,4 | 18,7 | 18,4 | 7 | 3,2 | 2,2 | 24 | 4,7 | 5,1 | 0,9 | 12,4 |
| **G/1** | 27 | 26,4 | 18,4 | 18 | 8,4 | 4,4 | 1,9 | 26 | 6 | 3,2 | 1,3 | 13,5 |
| **G/2** | 31 | 27,4 | 19,6 | 19,1 | 8,3 | 4,7 | 2 | 23 | 8,1 | 4,1 | 2,6 | 12,4 |
| **G/3** | 36 | 25,6 | 17,9 | 17,9 | 7,7 | 4,2 | 2,6 | 29 | 11,7 | 3,3 | 2,4 | 12,2 |

These data indicate that there is a clear balance of individual biometric parameters. Tree with thin finely peeling bark and relatively thin shellbark, usually have lower performance of these features, and the trees are characterized by a thick bark longitudinally fissured show higher average performance of biometric features. This is particularly noticeable in relation to the diameter at breast height, length and width of the crown.

The data characterizing the share of early wood in annual ring of pines having different forms of necrotic bark are showed in Table 2. The highest shares of early wood in the annual ring have pine trees with thick bark longitudinally cracked. The lowest share of early wood had pines with relatively thin shellbark, while the average value concerned trees with thin finely peeling bark.

**Table 2.** Share of early wood in annual ring in trees with bark having certain necrotic forms.

| Form bark necrotic | Measures of location and dispersion | The conductive surface |
|---|---|---|
| Bark thin, very flaky C | The arithmetic mean | 1,016153 |
| | The standard deviation | 0,20052 |
| | Coefficient of variation [%] | 19,73 |
| Bark relatively thin, shellbark M | The arithmetic mean | 0,761055 |
| | The standard deviation | 0,237036 |
| | Coefficient of variation [%] | 31,15 |
| Bark thick, longitudinally fissured G | The arithmetic mean | 1,132019 |
| | The standard deviation | 0,037683 |
| | Coefficient of variation [%] | 3,33 |

The largest part of sapwood surface was found in pine trees with thick bark longitudinally cracked (it was 43142.10 $mm^2$). The smallest part of sapwood surface was found in pine trees with thin finely peeling bark (28589.25 $mm^2$). Pines with thin shellbark showed the mean area part of the sapwood (37187.22 $mm^2$).

## Conclusions

1. It was a clear proportional relationship between share of early wood in annual ring and biometric crown features of pine trees having different forms of necrotic bark.
2. Pines characterized by diverse form of necrotic bark have different surface area of early wood in average annual ring of stems sapwood areas.
3. Trees with thick longitudinally cracked bark show the highest average early wood surface in annual ring, while trees with thin shellbark have the smallest surface area of early wood.
4. The highest average sapwood surface area of trees of varied necrotic bark form was found in pine trees with thick longitudinally cracked bark (43142.10 $mm^2$), while the lowest was found in pine trees with thin fine peeling bark (37187.22 $mm^2$). Intermediate values were found in pine trees having relatively thin shellbark (28589.25 $mm^2$).
5. The average surface share of early wood in part of sapwood was the highest pine trees with thick longitudinally cracked bark, the lowest was found in pine trees with thin finely peeling bark, and pine trees with

relatively thin shellbark were characterized by intermediate values of this feature.

**List of Literature**


1. GROCHOWSKI J. 1973. Dendrometria. Państwowe Wydawnictwo Rolnicze i Leśne. Warszawa.
2. HEJNOWICZ Z. 2002. Anatomia i histogeneza roślin naczyniowych. Wydawnictwo Naukowe PWN. Warszawa.
3. KRZYSIK F. 1970. Nauka o drewnie. PWN. Warszawa.


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