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Climatological characterisation of the area of the Carpathian Regional Gene Bank in the Wisła Forest District

Abstract: The paper summarises the results of climatological studies concerning the area of the Carpathian Regional Gene Bank station located in the Wisła Forest District. The work provides raw meteorological data, daily, monthly, seasonal and annual records, and various indices such as the pluvial-thermal index, biometeorological index, Sielianinow's index and de Martonne's index. In addition, the detailed profiles of thermal, humidity and rainfall conditions are presented against a background of the general synoptic situation.

Key words: climate, meteorology, Silesian Beskid Mts

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Introduction

The Silesian Beskid Mts are dominated by spruce forests which belong to the most beautiful and abundant forests of this type in Europe. They constitute the commonly known seed base of precious ecotypes of mountain spruce among which the Istebna spruce occupies the dominant position. It was not a coincidence that the field station of the Carpathian Regional Gene Bank was located in this area, in the Wisła Forest District. The station is run by the Department of Forest Trees Breeding of the Agricultural University of Kraków. Within the forest nursery "Wyrchczadeczka" three research areas for gene preservation were established. These included: archives of the progeny of 45 seed stands of Istebna spruce, archives of the progeny of 48 selected spruce trees, and research areas containing beech. The growth and development of the young generation of trees are systematically checked and estimated.

Researchers have built a meteorological station in the area of the forest nursery taking into consideration the fact that meteorological conditions and their seasonal and long-term variability belong to the main factors determining the life of plants. The purpose of the station is to systematically record weather conditions. The information obtained from the records is used to assess the impact of climatic conditions on the development of the tree collection.

Since 1995, the researchers have been taking regular measurements of rainfall, soil and air temperatures and humidity. The measurements and observations follow the climatological schedule and are conducted according to the instructions of the Meteorological and Hydrological Institute. At the end of each calendar year, the weather records are compiled in the form of annual reports.

After six years of research (1995–2000), a preliminary characterisation of the climatic conditions of the forest nursery "Wyrchczadeczka" was prepared for the needs of the Carpathian Regional Gene Bank.

Synoptic situations

In the period of 1995–2000, southern Poland was under high-pressure systems 11% more frequently than under low-pressure systems. In winter months, this difference was even bigger, reaching 48% in January. Balanced situations occurred in the warm months of May, July, September and November. Low-pressure systems dominated usually in April, while high-pressure systems prevailed during the rest of the time.

Particular types of barometric systems were connected with the direction of advection over southern Poland (Fig. 1). In the 6-year period described here, we most often encountered air influxes from the western directions: W – 17.4%, NW and SW – 11%. Winds from this part of the world dominated every month; they were most active, however, in autumn and winter. In the summer months, the dominant barometric systems brought influxes of air from the east and northeast. During spring, particularly in March and April, air influxes often came from the north.

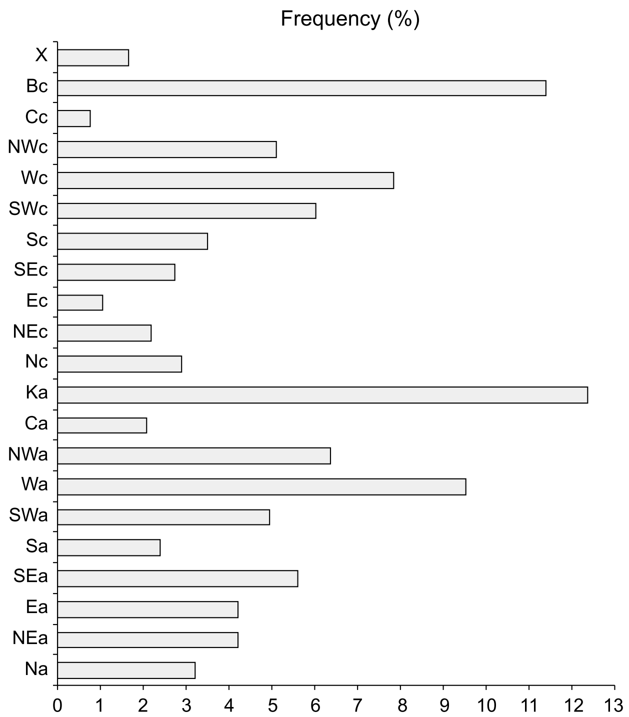

Fig. 1. Fig. 1. Frequency of atmospheric circulation types over southern Poland in 1995–2000 (according to the Niedźwiedź [1988] calendar of synoptic situations)

Na, Nc – situation with advection from north-point, NEa, Nec – situation with advection from north-east-point, Ea, Ec – situation with advection from east-point, SEa, SEc – situation with advection from south-east-point, Sa, Sc – situation with advection from south-point, Swa, SWc – situation with advection from south-west-point, Wa, Wc – situation with advection from west-point, Nwa, NWc – situation with advection from north-west-point, Ca – central anticyclonal situation, without advection, anticyclone centre in southern part of Poland or Slovakia, Ka – high-pressure wedge, ridge of high-pressure axis, Cc – central cyclonal situation, cyclone centre in southern part of Poland or Slovakia, Bc – pressure trough, area of barometric depression, low-pressure trough axiswith different direction of advection, fronts system in different air-mass, X – indefinite situation and barometric saddle, a – anticyclone, c – cyclone

Thermal conditions

The forest nursery is situated at an altitude of 675 m. Thermal indicators locate the area within the moderately warm climatic belt of the Western Carpathians (Hess 1965). The mean annual temperature of the 1995–2000 period was 6.6°C. In recent years, it exceeded 7°C (Table 1). The mean temperatures of June, July and August were usually above 15°C, which corresponds with meteorological summer (Table 1, Fig. 2). The maximum values of air temperature were sometimes very high (Table 2, 3). However, there were also some typical features of a severe mountain climate, such as low values of the

Table 1. Mean monthly air temperatures (1995–2000)

Month	1995	1996	1997	1998	1999	2000	Mean
Jan	–3.6	–5.1	–4.1	–1.0	–1.5	–4.7	–3.3
Feb	0.6	–5.4	–0.9	1.5	–3.4	–0.8	–1.4
Mar	0.3	–2.8	1.0	–0.3	2.8	0.5	0.3
Apr	5.5	5.9	1.9	6.8	8.6	9.1	6.3
May	10.3	12.1	12.0	11.5	12.7	13.8	12.1
Jun	14.4	15.2	15.1	14.2	15.2	15.8	15.0
Jul	19.2	14.2	14.6	16.2	18.6	14.4	16.2
Aug	15.9	15.8	16.9	16.3	16.2	17.0	16.3
Sep	11.0	8.0	11.6	12.1	15.9	10.5	11.5
Oct	9.2	7.8	4.7	6.8	7.1	11.3	7.8
Nov	–1.0	4.3	2.1	–2.8	0.8	6.1	1.5
Dec	–3.5	–6.0	–0.7	–3.3	–2.3	0.1	–2.6
Year	6.5	5.3	6.2	6.5	7.5	7.8	6.6

Table 2. Mean monthly maximum air temperatures (1995–2000)

Month	1995	1996	1997	1998	1999	2000	Mean
Jan	–1.4	–2.7	–1.2	0.8	0.6	–2.0	–1.0
Feb	2.8	–2.5	2.3	4.1	–1.4	2.4	1.3
Mar	3.5	0.5	5.3	2.3	6.3	4.2	3.7
Apr	9.0	10.1	6.1	9.7	13.0	14.9	10.5
May	14.9	16.2	16.1	13.5	17.2	20.1	16.3
Jun	18.5	19.7	19.8	17.4	19.5	21.5	19.4
Jul	23.9	18.7	18.5	19.4	22.5	18.8	20.3
Aug	20.1	20.1	21.8	20.8	20.5	22.6	21.0
Sep	14.3	14.9	16.2	15.2	20.7	15.9	16.2
Oct	13.3	14.7	7.8	8.8	10.4	15.8	11.8
Nov	1.1	12.2	5.0	0.0	3.4	9.7	5.2
Dec	–1.4	1.3	1.1	–2.0	0.1	3.0	0.3
Year	9.8	10.2	9.9	9.2	11.1	12.2	10.4

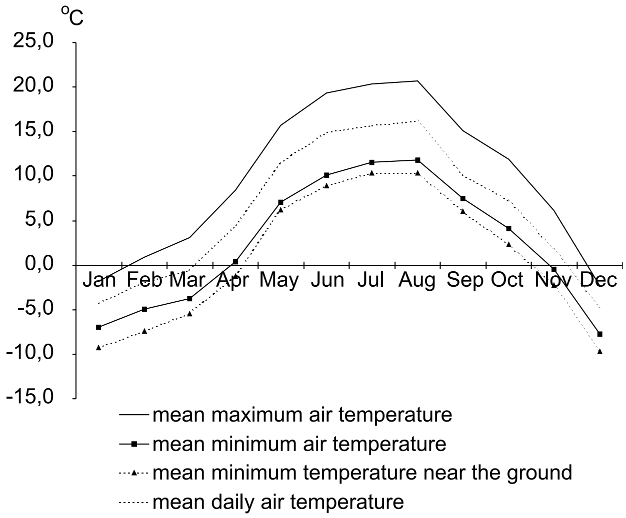

Fig. 2. Mean air temperatures in 1995–2000

mean temperatures of winter months (Table 1), especially of the minimum and absolute minimum temperatures (Table 1, 4, 5, 6, 7), many days in April and October with mean daily and minimum temperatures below zero, (Table 8, 9), occurrences of early and late frosts (Fig. 10), as well as a relatively short vegetation season (Table 10, Fig. 10). The latter climatic indicator showed an extreme annual variability, for example, in 1997 the vegetation season lasted 172 days, while in 2000 it lasted 225 days (Table 10).

During the study period, there was a high daily variability of temperature in winter months. The mean daily temperature changed frequently from negative to positive values. Temperatures below zero often lasted for a few subsequent days, especially in the winter of 1997/1998 (Table 11).

The pattern of annual soil temperatures measured at four different depths is shown in Figure 3 (due to the damage to the measuring instruments, the com-

Table 3. Absolute maximum air temperatures (1995–2000)

Month	1995		1996		1997		1998		1999		2000	
	temp.	date	temp.	date	temp.	date	temp.	date	temp.	date	temp.	date
Jan	5.5	26	8.0	12	5.2	7	7.6	12	6.5	20	6.0	31
Feb	7.0	13, 14	4.5	28	10.8	24	12.4	27	10.0	28	7.5	29
Mar	10.0	11	8.5	15	13.7	12	13.4	4	15.0	27	11.5	29
Apr	24.0	22	21.0	22	16.6	28	17.0	1	16.5	29	24.5	29
May	25.5	27	26.0	19	26.8	15, 16	–	–	25.0	30, 31	27.0	27
Jun	24.5	1, 21	29.5	9	31.2	29	24.5	26	26.0	28	31.5	22
Jul	29.0	22	27.5	8	23.8	4	30.6	22	29.5	6	27.5	4.5
Aug	27.0	23	25.5	2	26.0	22	32.4	3	27.5	9	33.0	20
Sep	22.5	13	19.6	3	24.0	6	22.3	12	23.5	9	23.0	13
Oct	20.5	11	18.2	16	19.0	6	18.2	7	19.0	1	24.5	15
Nov	8.0	17, 28	14.0	18	14.9	7	5.4	4	15.0	2	16.5	1
Dec	4.5	8, 23, 24	5.0	5	7.0	20	2.6	29	5.0	10	9.0	13, 14, 29

Table 4. Mean monthly minimum air temperatures (1995–2000)

Month	1995	1996	1997	1998	1999	2000	Mean
Jan	−6.2	−7.7	−7.0	−1.7	−3.9	−7.2	−5.6
Feb	−1.9	−8.9	−4.1	−0.5	−5.8	−3.4	−4.1
Mar	−2.5	−5.8	−2.9	−2.7	−0.6	−2.5	−2.8
Apr	2.0	1.5	−2.2	4.2	4.3	3.8	2.3
May	5.7	8.3	7.1	7.1	7.2	8.0	7.2
Jun	10.1	10.2	10.0	10.9	10.9	10.1	10.4
Jul	13.8	10.0	10.9	13.0	14.5	10.4	12.1
Aug	11.7	11.7	11.9	12.3	11.4	12.4	11.9
Sep	8.0	7.6	6.8	9.9	10.1	6.8	8.2
Oct	5.7	5.3	1.3	5.8	3.6	8.1	5.0
Nov	−3.2	2.1	−0.3	−5.7	−1.6	3.1	−0.9
Dec	−6.1	−6.1	−2.5	−4.2	−4.6	−2.1	−4.3
Year	3.1	2.3	2.4	4.0	3.8	4.0	3.3

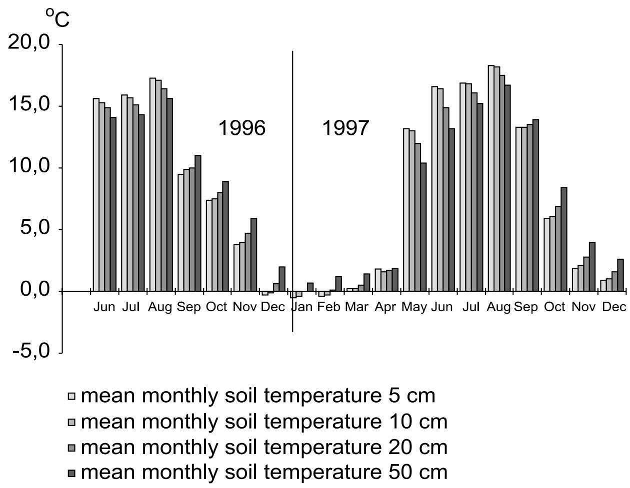

Fig. 3. Mean monthly soil temperatures in 1996 and 1997

Table 5. Absolute minimum air temperatures (1995–2000)

Month	1995		1996		1997		1998		1999		2000	
	temp.	date	temp.	date	temp.	date	temp.	date	temp.	date	temp.	date
Jan	–14.5	15	–15.5	25	–15.4	1	–12.8	30	–14.5	31	–15.0	24
Feb	–7.5	10	–16.0	7, 9, 10	–12.5	3	–16.3	1	–16.5	1	–10.0	23
Mar	–9.0	31	–12.5	4	–8.2	18	–12.8	12	–7.0	14	–8.0	13
Apr	–7.5	11	–10.0	13	–8.9	14	–1.8	14	–1.5	21	–6.0	9, 10
May	–1.5	16	3.0	27	0.0	1	3.6	5	1.5	3.6	1.5	3
Jun	6.0	4, 23	4.0	17	3.6	1	6.2	19	4.5	25	3.5	18
Jul	9.5	7	5.5	22	7.9	13	6.8	8	10.0	23, 30	4.5	14
Aug	6.0	30, 31	8.0	5	9.6	1	5.8	28	6.0	23, 24	8.0	26, 27
Sep	1.0	29	5.0	17	0.7	29	4.8	14	4.5	19	0.5	19
Oct	2.0	22, 23	–3.5	27	–6.7	29	–0.7	29	–3.5	19	1.0	21
Nov	–10.5	22, 23	–6.5	23	–6.9	20	–13.0	29	–7.5	16	–1.0	12, 28, 30
Dec	–15.5	29	–22.0	27	15.8	16	–17.0	11	–14.0	23	–12.0	22

Table 6. Mean monthly minimum soil temperatures (1995–2000)

Month	1995	1996	1997	1998	1999	2000	Mean
Jan	–8.7	–9.3	–9.4	–4.5	–5.4	–8.3	–7.6
Feb	–4.6	–11.7	–5.9	–3.8	–6.8	–3.8	–6.1
Mar	–3.6	–7.0	–5.8	–5.8	–3.1	–2.8	–4.7
Apr	0.9	–1.2	–3.4	2.3	2.3	2.6	0.6
May	4.5	7.6	6.5	5.1	5.1	6.4	5.9
Jun	8.6	9.2	9.1	10.8	9.3	8.9	9.3
Jul	11.4	9.2	10.6	11.5	12.4	9.4	10.7
Aug	10.0	10.5	10.5	10.3	9.3	10.9	10.2
Sep	6.7	5.4	6.1	7.4	8.3	5.1	6.5
Oct	3.6	2.8	0.5	3.5	2.7	5.3	3.1
Nov	–5.1	0.0	–1.6	–5.1	–2.6	1.5	–2.1
Dec	–7.6	–11.8	–3.1	–8.1	–6.8	–	–7.4
Year	1.3	0.3	1.2	2.0	2.1	2.9	1.5

Table 8. Number of days with mean daily temperature below zero and dates of occurrence of such temperature (in parentheses) during months of early spring and autumn (1995–2000)

Month	Number of days					
	1995	1996	1997	1998	1999	2000
Mar	13 (4) (12–16) (21–23) (28–31)	24 (1–14) (16–20) (25) (27–31)	10 (17–26)	17 (1) (9–17) (19–25)	10 (9) (12–19) (21)	16 (3–6) (10–21)
Apr	7 (1) (9–14)	7 (1–3) (13–16)	14 (4–9) (12–16) (20–22)	–	–	–
Sep	–	–	–	–	–	–
Oct	–	–	6 (24–29)	–	–	–

Table 7. Absolute minimum soil temperatures (1995–2000)

Month	1995		1996		1997		1998		1999		2000	
	temp.	date	temp.	date	temp.	date	temp.	date	temp.	date	temp.	date
Jan	–22.0	15	–19.5	23	–20.0	1	–16.0	3.27	–17.0	31	–16.0	1
Feb	–11.0	1	–22.0	1	–15.0	18	–19.0	2	–18.0	1	–10.0	19, 23
Mar	–12.0	31	–12.5	4	–14.5	21	–17.0	12	–10.5	19	–8.0	13
Apr	–11.0	11	–10.5	13	–12.0	14	–4.5	14	–2.5	2	–10.5	9
May	–6.0	16	2.0	27	2.5	10, 26	0.5	23, 24	–1.5	7	–0.5	3
Jun	4.5	24	3.5	15	3.5	1	4.0	19	2.0	25	2.5	2, 18
Jul	7.5	7	4.0	22	6.5	14	5.5	9, 11	8.0	18, 30	4.0	14
Aug	5.5	10	7.5	9	8.0	17	3.5	29	4.5	23	4.5	27
Sep	–1.0	29	1.0	19	–1.5	21	2.0	23	3.0	26	–0.5	19
Oct	–4.5	27	–4.0	27	–11.0	28, 29	–2.0	21	–5.0	19	–3.0	22, 23
Nov	–20.5	23	–11.0	29	–10.5	20	–14.0	21	–10.0	19	–4.0	12
Dec	–20.0	30	–25.5	28	–18.5	17	–19.0	11	–20.0	23	–14.5	22

Table 9. Number of days with minimum temperature of 0°C (1995–2000)

Year	1995/1996		1996/1997		1997/1998		1998/1999		1999/2000		2000/2001	
A.g.l.	200 cm	5 cm	200 cm	5 cm	200 cm	5 cm	200 cm	5 cm	200 cm	5 cm	200 cm	5 cm
Month												
Sep	–	2	–	–		3	–	–	–	–	–	–
Oct	4	9	3	6	10	14	1	3	–	6	–	4
Nov	13	22	11	11	12	15	21	25	13	21	4	9
Dec	30	30	31	31	15	21	26	29	22	29	21	25
Jan	25	25	31	31	19	24	26	30	31	31		
Feb	29	29	22	26	13	16	28	28	25	25		
Mar	31	31	27	29	23	25	18	23	19	21		
Apr	15	17	20	23	–	6	–	8	7	9		
May	–	–	–	–	–	–	–	2	–	–		
Sum	147	165	145	157	92	124	120	148	117	142		

A.g.l. – height above ground level

Table 10. Dates of beginning and end of economic periods and vegetation seasons (1995–2000)

Year	Start of farming seasn (date)	End of farming season (date)	Number of days	Start of vegetation season (date)	End of vegetation season (date)	Number of days
1995	2 Apr	2 Nov	215	19 Apr	20 Oct	185
1996	6 Apr	20 Nov	229	18 Apr	20 Oct	186
1997	24 Apr	15 Oct	175	25 Apr	13 Oct	172
1998	29 Mar	7 Nov	224	30 Mar	25 Oct	210
1999	23 Mar	10 Nov	233	25 Mar	13 Oct	203
2000	11 Apr	15 Dec	249	16 Apr	26 Oct	225
Mean	5 Apr	11 Nov	220	12 Apr	24 Oct	197

Table 11. Number of days with mean daily temperature above zero and dates of occurrence of such temperature (in parentheses) (1995–2000)

Month	Number of days					
	1995/1996	1996/1997	1997/1998	1998/1999	1999/2000	2000/2001
Nov	13	21	21	8	17	30
	(1–3)	(1–21)	(1–03)	(1–07)	(1–14)	(1–30)
	(10–11)		(5–15)	(11)	(27–29)	
	(14–17)		(17)			
	(26–29)		(23)			
			(25–26)			
			(28–30)			
Dec	6	3	16	9	10	18
	(8–10)	(5)	(01–02)	(10–13)	(2–05)	(1–2)
	(17)	(13)	(10–13)	(24–25)	(9–14)	(4–15)
	(23–24)	(19)	(19–28)	(29–31)		(26–29)
Jan	7	3	18	12	2	
	(7–13)	(9)	(1–12)	(2–08)	(30–31)	
		(13–14)	(14–17)	(16–18)		

piled data include only 2 years – 1996 and 1997). The highest soil temperature was recorded in August. During that time, the mean daily values were at all depths higher than the mean air temperature (recorded in the shelter of the instrument). From May until August, there was a negative gradient in the soil profile (temperature decreased with depth). The gradient vector changed direction in September. The positive gradient lasted throughout the autumn and winter months, until April; the surface layer of the soil (10–20 cm) was frozen. The soil under the snow was defrosted already in March. Thus, during the cold part of the year, the roots remained in the soil having above-zero temperatures, while the above-ground parts of trees experienced negative temperatures. Only in January and February was the root's neck in the frozen layer of the soil. This situation had undoubtedly specific physiological implications.

Pluvial and nival conditions

The mean annual sum of precipitation in the 1995–2000 period was 1200 mm. This indicator varied only slightly. In most cases, the annual rainfall was higher than the mean value. The indicator was lower only in 1995 and 1999 (Table 12, 13).

It was the precipitation of the warm part of the year that contributed the most to the precipitation totals (Table 14). The biggest amount of rainfall was usually recorded in June or July. August and October received little rain. The lowest values of monthly totals were those of December and January. The amount of rainy days varied greatly between both months and years (Fig. 4, Table 14). On average, it rained on half of the days of a month. August was usually an exception: during this month, rainfall occurred on one third of the days (Table 15). The contribution of rain precipitation to the annual total was on average 2.5 times bigger than that of solid precipitation (Table 14) despite the fact that snowfall occurred during 50% of the days (Table 15). The snow precipitation normally began in the first 10 days of November. This was usually connected with the appearance of a stable snow cover, which lasted on average until the second half of April (Table 12). However, in some cases, for example in the winter of 1997/1998, the snow cover disappeared and reappeared several times (Fig. 5). The amount of days with snow cover ranged from 101 in 1998 to 167 in 1995 (Table 12). On average, the cover was 31 cm thick. The maximum value (140 cm) was recorded in March 2000.

Table 12. Maximum precipitation and number of days with precipitation and snow cover (1995–2000)

Month	1995			1996			1997			1998			1999			2000			Mean		
	max	number of days		max	number of days		max	number of days		max	number of days		max	number of days		max	number of days		Σ	number of days	
		p	s.c.		p	s.c.		p	s.c.		p	s.c.		p	s.c.		p	s.c.		p	s.c.
Jan	16	19	31	8	9	31	22	9	31	24	15	15	10	15	31	13	20	31	65	14	28
Feb	16	22	28	15	15	29	17	14	28	23	10	14	19	22	28	22	17	29	95	17	26
Mar	17	21	30	16	15	31	18	18	29	11	20	24	17	14	31	36	21	31	110	18	29
Apr	23	19	19	28	15	22	23	19	21	17	12	2	19	14	1	23	10	15	93	15	13
May	27	19	–	38	19	–	8	18	–	30	15	–	16	12	–	14	6	–	112	15	–
Jun	35	18	–	25	16	–	10	13	–	31	21	–	36	17	–	32	7	–	146	15	–
July	43	10	–	22	12	–	17	21	–	19	22	–	44	11	–	43	15	–	165	15	–
Aug	37	15	–	60	14	–	5	8	–	19	8	–	28	10	–	12	2	–	75	10	–
Sep	28	15	–	71	25	–	10	10	–	51	13	–	23	8	–	24	8	–	118	13	–
Oct	7	14	1	10	11	–	7	15	16	16	20	–	27	16	–	11	10	–	70	14	3
Nov	25	15	27	22	15	7	43	16	21	15,0	15	15	16	13	15	18	12	–	90	14	14
Dec	9	15	31	10	10	31	20	18	15	17	15	31	11	16	31	15	15	16	61	15	26
Sum		202	167		176	151		179	161		186	101		168	137		143	122	1200	175	139

Table 13. Rain and snow precipitation totals (1995–2000)

Month	1995			1996			1997			1998			1999			2000		
	snow	rain	Σ	snow	rain	Σ	snow	rain	Σ	snow	rain	Σ	snow	rain	Σ	snow	rain	Σ
Jan	105	15	120	21	2	23	34	–	34	45	53	98	54	–	54	64	–	64
Feb	68	23	91	54	2	56	54	43	97	5	78	83	127	–	127	94	21	115
Mar	78	23	101	91	1	92	39	29	68	59	26	85	39	25	64	187	65	252
Apr	49	48	97	59	31	90	125	28	153	11	65	76	22	38	60	21	59	80
May	–	108	108	–	180	180	–	130	130	–	79	79	–	76	76	–	95	95
Jun	–	150	150	–	110	110	–	122	122	–	192	192	–	209	209	–	95	95
Jul	–	84	84	–	96	96	–	291	291	–	126	126	–	149	149	–	245	245
Aug	–	102	102	–	167	167	–	52	52	–	51	51	–	50	50	–	30	30
Sep	–	97	97	–	245	245	–	37	37	–	178	178	–	76	76	–	78	78
Oct		13	13	–	47	47	11	43	54	15	103	118	–	120	120	–	61	61
Nov	109	23	132	9	78	87	27	86	113	34	23	57	57	12	69	–	81	81
Dec	40	5	45	31	–	31	30	39	69	75	7	82	52	–	52	50	38	88
Year	449	691	1140	265	959	1224	320	900	1220	244	981	1225	351	755	1106	416	868	1284

Table 14. Percentage of rain and snow precipitation in monthly and annual totals (1995–2000)

Month	1995		1996		1997		1998		1999		2000	
	snow	rain	snow	rain	snow	rain	snow	rain	snow	rain	snow	rain
Jan	87.5	12.5	91.3	8.7	100	–	45.9	54.9	100	–	100	–
Feb	74.7	25.3	96.4	3.6	55.6	44.4	6.0	94.0	100	–	81.7	18.3
Mar	77.2	22.8	98.9	1.1	57.3	42.7	69.4	30.6	60.9	39.1	74.2	25.8
Apr	50.5	49.5	65.5	34.5	1.7	18.3	14.5	85.5	36.7	63.3	26.2	73.8
May	–	100.0	–	100.0	–	100.0	–	100.0	–	100.0	–	100.0
Jun	–	100.0	–	100.0	–	100.0	–	100.0	–	100.0	–	100.0
Jul	–	100.0	–	100.0	–	100.0	–	100.0	–	100.0	–	100.0
Aug	–	100.0	–	100.0	–	100.0	–	100.0	–	100.0	–	100.0
Sep	–	100.0	–	100.0	–	100.0	–	100.0	–	100.0	–	100.0
Oct	–	100.0	–	100.0	20.4	79.6	12.7	87.3	–	100.0	–	100.0
Nov	82.5	17.5	10.3	89.7	23.9	76.1	59.6	40.4	82.6	17.4	–	100.0
Dec	88.9	11.1	100.0	–	43.5	56.5	91.5	8.5	100.0	–	56.8	43.2
Year	39.4	60.6	21.6	78.4	26.2	73.8	19.9	80.1	31.7	68.3	32.4	67.6

Table 15. Percentage of days with precipitation and snow cover in monthly and annual totals (1995–2000)

Month	1995		1996		1997		1998		1999		2000	
	p	s.c.	p	s.c.	p	s.c.	p	s.c.	p	s.c.	p	s.c.
Jan	61	100	29	100	29	100	48	48	48	100	64	100
Feb	79	100	51	100	59	97	36	50	78	100	58	100
Mar	67	96	48	100	58	93	64	77	45	100	68	100
Apr	63	63	50	73	63	70	40	7	46	3	33	50
May	61	–	61	–	58	–	48	–	38	–	19	–
Jun	60	–	53	–	43	–	70	–	60	–	23	–
Jul	32	–	38	–	68	–	71	–	35	–	48	–
Aug	48	–	43	–	25	–	26	–	32	–	6	–
Sep	50	–	83	–	33	–	43	–	26	–	27	–
Oct	45	3	35	–	48	52	64	–	51	–	32	–
Nov	50	90	50	23	53	70	50	50	43	50	40	–
Dec	48	100	32	100	58	48	48	100	51	100	48	52
Year	55	45	48	41	49	44	51	28	46	38	39	33

p – precipitation, s.c. – snow cover

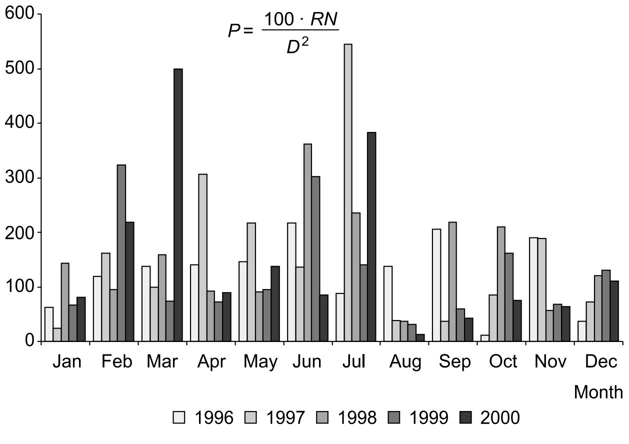

Fig. 4. Sprinkling irrigation index
R – sum of precipitation (mm), N – number of days with precipitation 1.0 mm, D – observation period (days), P – sprinkling irrigation index

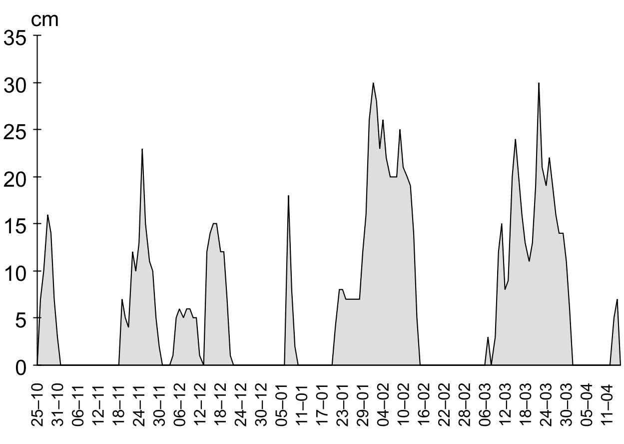

Fig. 5. Course of changes in depth of snow cover in winter 1997/1998

Air humidity and pluvial-thermal indicators

During the period under research, the forest nursery "Wyrchczadeczka" had a relatively high air humidity. The relative humidity below 50% was recorded sporadically and only at midday hours, mainly in spring months (April, May). In the morning and night, the values were almost always above 80–90%. The daily mean usually did not drop below 70% (Table 16). During the cold part of the year, the relative humidity often approached 100%.

The hygroclimate of the forest nursery was to some extent characterised by pluvial-thermal indicators which are presented in the form of diagrams for the months of the vegetation season (Fig. 6–9). The diagrams show that the pluvial-thermal relations at the beginning (April) and end (November) of the vegetation season displayed a very high annual variability. Low values of these indicators occurred most regularly in August, which was the driest month (particularly that of the year 2000; Fig. 6–9), usually with small amounts of rainfall and many sunny days.

The ratio between the energy input (expressed by the values of air temperature) and water input (expressed by precipitation) in the area of the forest nursery is presented in the climatic diagram (according to Walter 1976) worked out on the basis of the data from six years of research (Fig. 10). The diagram indicates a clearly humid character of the climate of the area, which fulfills the requirements of the trees growing there and which is conducive to their development. As follows from the observations conducted, during the whole study period, weather conditions did not pose any serious threat to the trees' growth and development.

Table 16. Mean relative air humidity, % (1995–2000)

Month	1995				1996				1997				1998				1999				2000				Number of days with RH<50% at 13
	7	13	19	mean	7	13	19	mean	7	13	19	mean	7	13	19	mean	7	13	19	mean	7	13	19	mean	
Jan	94	92	94	93	92	92	91	92	98	97	98	98	94	92	94	93	93	85	93	91	94	94	94	94	1
Feb	96	88	93	92	89	88	91	89	91	84	91	89	91	86	92	91	95	89	94	92	97	88	94	93	2
Mar	94	80	90	88	93	84	92	90	96	83	92	90	88	83	90	89	92	76	92	87	97	86	94	92	10
Apr	88	73	86	82	82	66	78	75	94	89	95	93	88	83	92	90	88	69	86	81	86	69	83	79	31
May	84	66	81	77	90	81	87	86	94	89	96	93	82	67	85	78	79	64	82	75	78	66	82	75	27
Jun	87	72	87	82	86	66	74	75	83	71	87	80	88	79	88	85	90	78	92	86	77	64	70	70	17
Jul	78	63	75	72	86	67	84	79	91	86	94	90	89	78	89	88	85	72	84	81	88	77	87	84	18
Aug	83	70	83	79	87	79	89	85	83	71	86	80	85	71	87	85	89	71	89	83	89	72	83	81	11
Sep	93	79	90	87	96	93	97	93	89	75	91	85	96	91	97	96	88	67	84	80	92	75	90	85	7
Oct	92	72	90	85	94	91	95	93	92	83	93	89	94	87	95	93	92	83	94	90	89	73	84	82	9
Nov	96	93	96	95	96	94	97	96	96	90	95	93	95	92	95	94	97	91	97	95	90	84	91	88	1
Dec	96	93	96	95	95	96	96	96	94	94	98	95	94	92	95	94	95	92	96	94	93	90	94	92	1

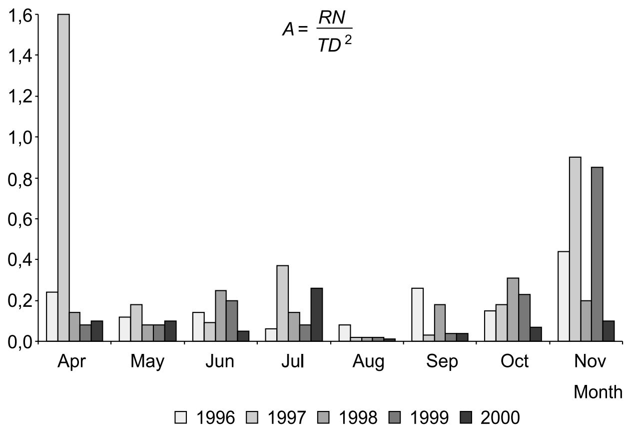

Fig. 6. Pluvial-thermal index
R – sum of precipitation (mm), N – number of days with precipitation 1.0 mm, D – observation period (days), T – mean air temperature in observation period, A – pluvial-thermal index

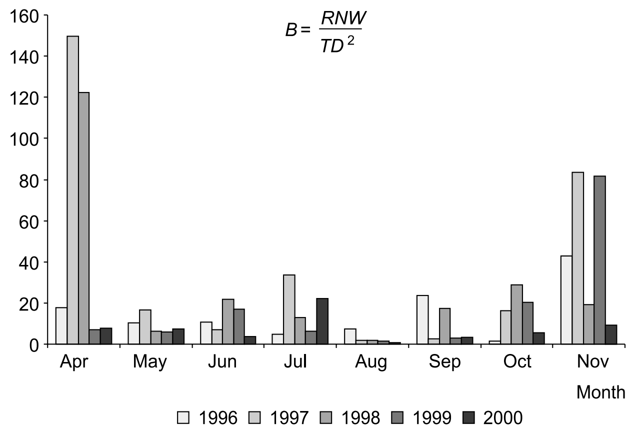

Fig. 7. Biometeorological index
R – sum of precipitation (mm), N – number of days with precipitation 1.0 mm, W – actual water-vapour pressure to saturation vapour pressure ratio at a given temperature, B – biometeorological index

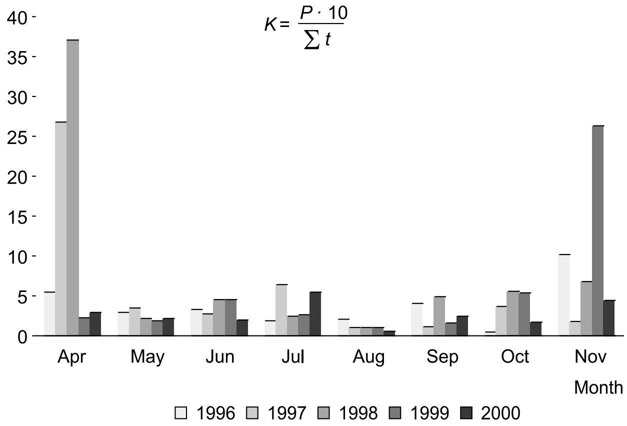

Fig. 8. Sielianinow's index
P – sum of precipitation (mm), t – sum of mean daily air temperature of month, K – Sielianinow's index

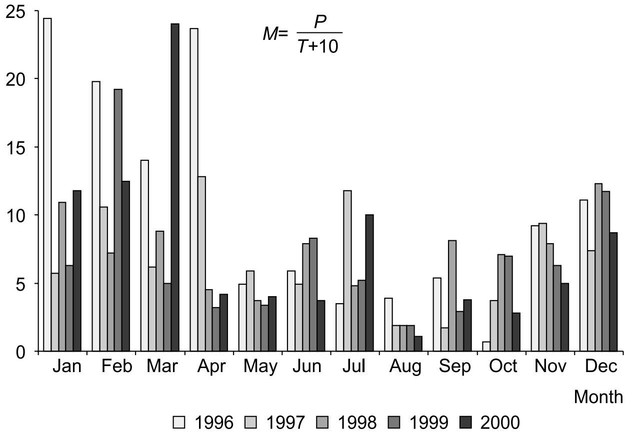

Fig. 9. De Mortonne's index

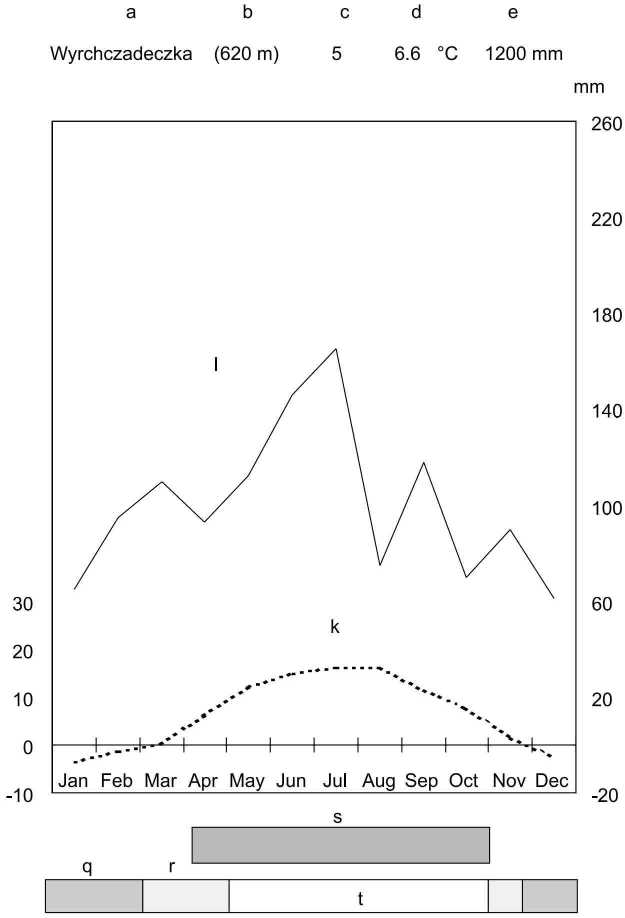

Fig. 10. Climatic diagram
a – station name, b – altitude, c – number of observation years, d – mean annual air temperature, e – mean year sum of precipitation, k – temperature curve, l – precipitation curve, s – duration of vegetation season, t – duration of freeze-free period, q – duration of frosty

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