JEE Journal of Ecological Engineering

Journal of Ecological Engineering, 2025, 26(3), 159–165
https://doi.org/10.12911/22998993/199581
ISSN 2299–8993, License CC-BY 4.0

Received: 2024.11.18
Accepted: 2025.01.13
Published: 2025.01.28

Drosera intermedia Hayne – introduction of rare plants near Radomsko, Central Poland

Ryszard Plackowski[1]

[1] Independent researcher, ul. Wergiliusza 2E/1, 60-461 Poznań, Poland
E-mail: plackowski@interia.pl

ABSTRACT

The study proved the adaptability of *Drosera intermedia* on a habitat identified using the bioindication method through the floristic and syntaxonomic suite. Other factors, such as soil and co-occurring species, should also be taken into account. This is not a specific transitional peatland, but a site which is syntaxonomically difficult to identify. Species from the class *Scheuchzerio-Caricetea nigrae* as well *Oxycocco-Sphagnetea* were recorded. Taxa from other classes, such as *Alnetea glutinosae*, were also found in smaller numbers. This study confirmed that *Drosera intermedia* has a wide ecological range, which is in agreement with the available literature. Soil surveys indicated, among other things, a medium pH value, high ash content and organic matter distribution. In turn, statistical tests found that the highest correlation was between the pH values (in H_2O and in KCL). In contrast, the negative ones were between carbon and ash content as well as between S and pH in H_2O. Higher N and C scores were associated with higher pH values in H_2O in KCl and CaO.

Keywords: conservation, *Drosera intermedia*, vascular plant, soil properties.

INTRODUCTION

Poland is currently experiencing a rapid decline in the populations of many hydrophilic plant species in ca. 15 species and hybrids (Sychowa and Zarzycki, 1968; Thommen, 1990). These include the entire genus *Drosera*. One of them, the most endangered species in Poland is *Drosera intermedia* (Karo, 1881; Mowszowicz, 1978). This paper is a detailed work on the population dynamics of this taxon introduced artificially in the area of its former occurrence, together with the realisation of soil analysis. It allows assessing the potential for adaptation to maintain populations of *Drosera intermedia* (Fig. 1). In the literature, only a few studies mention appearances of *Drosera intermedia* at sites in administratively neighbouring parts of Poland. Casper and Krausch (2008) confirmed that the biology and presence of forms of the species under consideration is quite intricate (as in another species e.g. *Drosera rotundifolia*). In the company of bryophytes *Sphagnum* s. and *Polytrichum sp*., floating rosettes sometimes form in *Drosera intermedia*. They are hardly visible, but form a new generation of plant in the next growing season.

The test point was located near the village of Bobry, in the Łódzkie administrative district, bordering the Silesian district. It is about 15 km a

Figure 1. *Drosera intermedia* in its natural habitat

south of Radomsko, near Czestochowa (Fig. 2). The coordinates of the site are: N 51°01'10'', E 19°24'30''. It is located at 207 m above sea level, while the highest elevation around the site is 300 m above sea level. In geobotanical terms, the site is located in the South Polish Upland District Division, in the Lodz-Wielun Uplands Land (Matuszkiewicz 2013). In turn, Kondracki (1994) classified it from the point of view of geographical division, in the Radomszańskie Hills. The peat bog on which observations were conducted is subject to strong anthropogenic and industrial pressure (Backer et al. 1991). It is a peat bog with a heterogeneous floristic composition. Most of the species are representatives of the high peatland flora. The peatbog is located near a pond and a dozen or so metres from a pine forest and borders other peatbogs and scrubland. The process of plant species extinction, which has been observed for many years, but has recently intensified, is mostly a side effect of human activity (Frahm, 1983; Zając and Zając, 2019).

The meteorological data for the observation point located at Bobry were calculated using the inverse distance method (IDM). It is based on the use of measurements from the nearest available meteorological stations. The method is based on the assumption that the closest measurement point has the greatest influence on the value at a given point. Therefore, the distance that separates the measurement points and the estimated point is the weighting factor for this influence. The strength of the influence of the measuring point on the estimated point decreases as the distance from the estimated point increases (Dubaniewicz,1974). Data sets for the Sulejow (32 km away) and Czestochowa (48 km away) stations were used. The data for calculations were taken from the global database of NOAA (National Oceanic and Atmospheric Administration – USA), and the Polish Meteorological Yearbooks. In order to ensure high quality of meteorological data, a qualitative analysis of the collected data was also performed (Nyćkowiak et al., 2010). Somewhat outdated information can be found in the work of Dubaniewicz (1974) for Sulejów: frost period – 1st January – 27th February, and 28th February – 23rd March, frost-free period – 24th March – 9th November, frost period – 10th November – 10th December, and 11th December – 31st December. According to Nyćkowiak et al. (2014), the climate of the Sulejow meteorological station is as follows: the temperature 8.1 °C, the rainfall 600 mm,.

The aim of this study was to determine possible adaptation for an artificially created site in the selected transitional peatland. This problem was solved with the help of indicator plants growing with *Drosera intermedia* which were observed.

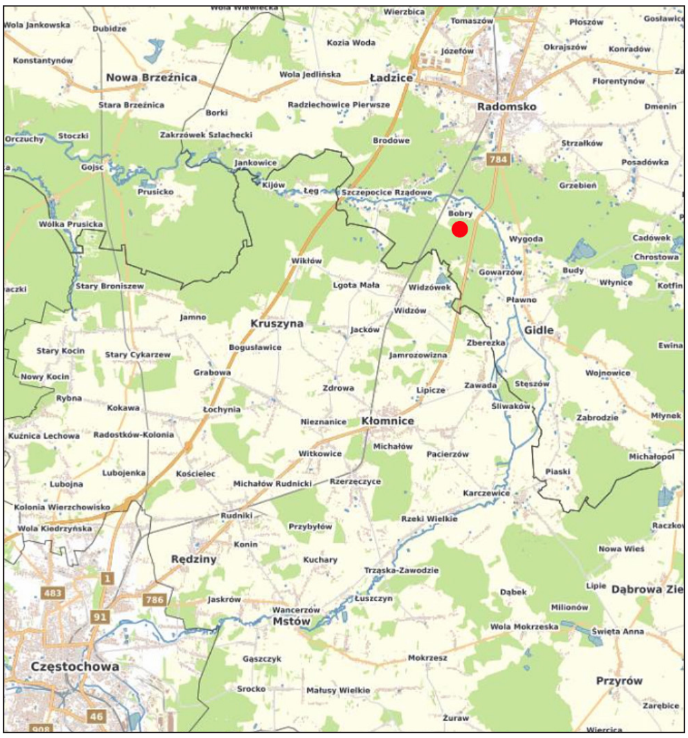

Figure 2. Location of the research site (marked in red)

MATERIAL AND METHODS

The material originated from the seeds received. The observations carried out previously did not include soil analyses, so it was not possible to find the factor responsible for the fluctuations in the number of specimens of *Drosera intermedia*. Each year counted flowering or fruiting specimens of *Drosera intermedia* summed together. In the same period, flowering, fruiting and non-flowering occurred. The nomenclature of herbaceous species is in accordance with Rutkowski (1998), the position of bryophytes is in line with Frahm (1983), while the syntaxonomic one – according to Matuszkiewicz (2013). Using the Braun-Blanquet method (Scamoni, 1955) it was possible to make conjectures about the developmental trend of individual species in the future. For this type of observation, small study plots are recommended (Faliński, 2001; Rutkowski, 1998).

Methodology of soil pH (PN-ISO 10390), total C, N, and S involved analysis with the LECO infrared TruMac device (for carbon and sulphur) and determination of exhaust heat conductivity (for nitrogen), trace elements (content close to the total) – analysis of samples in 60% HCl, using the AAS method. Ash content – heating the sample at 550 °C and determination of the weight loss, CaO – determination of the calcium content in extracts using the AAS method. The random soil samples were taken from the top for the descriptive and statistical study of Person correlation. The method of linear statistics was applied (Aczel, 1989; Sobczyk, 2007; Łomnicki, 2014**)**. The water level within the years 2010–2020 was shown in Table 1.

RESULTS AND DISCUSSION

The basic thesis of the work is the change of biotic and abiotic factors or its absence on the presence of *Drosera intermedia*. A number of analyses were carried out to determine in which habitat parameters this species can adapt. These values and their interpretation are included in Tables 2 and 3, respectively.

The taxons in decline during the study period include the covered species *Drosera rotundifolia*, followed by *Carex canescens*, *C. rostrata* and *Drosera intermedia* – discussed in detail here – in addition to the rare hydrophyte *Utricularia minor* as well as seedlings *Pinus sylvestris,* and *Frangula alnus,* which mostly disappeared. A fairly distinct phenomenon was the disappearance of northern species, such as *Vaccinium vitisidaea,* recorded from 1998 to 2008 and after intermittently until 2019. *Typha latifolia* was observed in the area. which did not appear during such a large period of observation. Fruiting specimens of *Hydrocotyle vulgaris* grew at a distance of 20 m from the observed area, a taxon considered to be Atlantic (Frahm, 1983). It appeared there regularly through

Table 1. The water level in the years 2010–2020

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Water level in cm	-10	-9	-30	-2	-15	+5	-11	-8	-30	-24	-4
Individum	8	14	129	1	3	3	3	4	3	150	3

Table 2. Mean values of Ellenberg's index numbers on the studied areas (Zarzycki et al., 2002)

Specification	Light value (L)	Temperature value (T)	Soil moisture (W)	Trophy value (Tr)	Soil acidity (R)	Organic matter content in soil ot water (H)
Drosera intermedia	4.0	4.0	5.0	2.0	2.5	3.0
Andromeda polifolia	4.0	3.5	5.0	1.0	1.0	3.0
Eriophorum angustifolium	4.0	3.0	5.0	3.0	3.0	3.0
Oxycoccus palustris	4.0	2.5	5.0	1.5	2.0	3.0
Vaccinium uliginosum	4.0	3.0	3.5	2.0	2.0	2.0

Note: L – moderate light. T – from moderately cold areas to moderately warm climate condition. W – from moist to wet. Tr – from soil oligotrophy to mesotrophic. R – highly acidic. H – from soil mineral-humic to soil rich in organic matter.

Table 3. Chemical properties of soil up to 20 cm

No.	N (%)	C (%)	C/N	S (%)	pH (H_2O)	pH (KCl)	CaO (%)	Asches (%)
1.	1.396	42.021	30.20	1.1200	3.84	3.44	0.274	9.94
2.	1.465	42.292	28.86	1.1200	3.69	3.41	0.264	10.79
3.	1.516	37.027	23.93	0.9700	3.75	3.58	0.207	16.24
4.	1.332	41.326	31.o2	1.0800	none	none	0.210	12.56
5.	1.562	37.367	26.92	1.0500	3.94	3.70	0.224	21.51
6.	1.657	40.847	25.98	0.6670	4.70	4.68	0.337	11.54
7.	1.220	41.037	33.63	1.1500	3.75	3.58	0.161	11.22
8.	1.417	41.835	26.92	0.8900	3.73	3.34	0.247	13.29
9.	1.415	41.405	25.98	0.7070	2.40	5.95	none	9.55
10.	1.332	43.138	32.38	0.9050	3.87	3.42	0.181	7.63
11.	1.222	41.965	41.96	1.0300	3.70	3.67	0.252	8.64
12.	1.426	42.075	29.52	0.7650	4.50	4.25	0.426	8.53

Note: none – no sample.

vegetative and sexual reproduction. The bryophyte layer was characterised throughout the period without change. Throughout the research period, *Spagnum fallax* and *S. palustris* were dominant. As far as other bryophytes are concerned, *Polytrichum communae* and *P. strictum* appeared. In the last research period (2020), *Eriophorum vaginatum, Juncus effusus,* and *Oxycocus palustris* still prevailed. To a lesser extent, *Carex canescens* and *Potentilla palustris* were present. There was an expansion of *Agrostis canina.* Species that have completely withdrawn from the succession were not found. The presence of *Peucedanum palustre* and the American species *Bidens frondosa* is also interesting (Hereżniak, 2002). The latter probably arrived with seeds, going on to form adult specimens. Fluctuations due to the prevailing situations occurred in *Juncus bulbosus*. which has a specific developmental biology to complex changes in the flora were mainly due to abiotic factors, such as wind and water. The species that found their way to the surface accidentally by anthropogenic influence were also recorded. An example of spreading by this means is the genus *Bidens* in the initial stage, further it spread through water (Kaźmierczakowa et al., 2016). The possibility of growth of *Phragmites australis* was provided by several factors, such as wind and water. Of the life forms ranked on the Raunkiaer'a scale (Weihe, 1972), the predominant ones were hemicryptophytes, and hydrophytes. They had difficulty transitioning into magenoraphytes. This happened for several reasons, such as human activities or the presence of forest animals. However, the case of *Drosera intermedia* in the discussion of its belonging to hydrophytes is debatable. This is because from the hundreds of seeds produced, developing seedlings were observed in late autumn (Lecoufle, 2006). From the abiotic rapid changes in the level of the water table, *Betula pubescens* was very sensitive to this factor. Human interference is the basic cause of the changes taking place. The above-mentioned features are emphasized by atypicality, such a structure is mentioned by Falinski (2001). The small number of species does not allow a clear syntaxonomic position to be established. From the observations made, the different directions of succession that could be found during the more than 20 years of observations were established. On the one hand, species from the class *Oxycocco-Sphagnetea* were recorded, on the other *Scheuchzerio-Caricetea nigrae* were found. The first class did not have a large number of species in total. These were expansive taxa which did not allow others to enter. From the first class, there were species such as *Andromeda polifolia, Drosera rotundifolia*, and *Oxycoccus palustris,* which withdrew from the course of succession (Provost, 1979). A small number of species were taxa from the class *Phragmitetea*. Typical species from the class *Vaccinio-Piceetea*, e.g. *Vaccinio vitis-idaea.* Also, seedlings of *Pinus sylvestris* did not remain for a longer period of time, occurring rarely. Approximately 50 m from the study area, close to a reservoir, *Phragmites australis* and *Typha latifolia* were already growing frequently. *Lysimachia thyrsiflora* was increasingly showing up there. In the near future, species from the class *Alnetea glutinosae* can be expected to supplant the disappearing *Betula pubescens*. A species from the class *Litortrelietea* that has been recorded is *Juncus bulbosus* (Matuszkiewicz, 2013). This is an annual species, so it is difficult to assess its emergence dynamics during the study period. In conclusion, the modest number of species did not allow a clear determination of the syntaxonomic status of the present site of *Drosera intermedia* as an experiment of the planted seedlings. Such observations are indicative of progressive overgrowth of the plot and its environs. The C:N values were mostly similar over the study period. A few values deviated from the norm. The broader the value the more advanced the degree of soil decomposition (Table 4). Reduced decomposition activity is a negative characteristic occurring in soil evolution. This value depends, among other things, on decomposition and humification processes. The sulphur content was negligible for the area under consideration. On the other hand, the pH value of the soil indicates its acidity, but still acceptable for this type transitory bog (Scamoni, 1955).

Predominantly undecomposed material from the genera *Sphagnum* sp. and *Polytrichum strictum*, described as *Drosera intermedia*, are between high and transitional. The ash content varied greatly. indicating an average degree of decomposition and organic matter. The number of specimens after the tree cutting was significantly reduced. The development biology of this species is unpredictable. It is difficult to see the relationship between the number of specimens and the level. Each capsule produces hundreds of seeds. Occasionally, germination has been observed, with seedlings forming in late autumn. However, their further development cannot be definitely considered. Counting all in clumps of small non-flowering specimens in the field was impossible. This fact was related to the clump-like morphology of this species. Separation of individual ones was impossible due to the necessity of leaving the *Drosera intermedia* plantation intact for the next research season. The number of *Drosera intermedia* specimens in the final stage of the research did not allow the statistical method to be developed extensively. Not every population fulfils the requirements for the application of typical statistics in the established model of the *Drosera intermedia* population (Falińska, 2002). The issue of the resettlement of peatland species is described in (Lecointe and Provost, 1977); during that period, favourable conditions were created in France. In turn, determination of changes in the number of individuals of *Drosera intermedia* over several years was carried out by De Rider and Dhont (1992). The results in the percentage of specimens were similar to those obtained in the present study. Some attempts against all expectations, such as the resettlement of *Saxifraga hirculus* in further observation rounds were unsuccessful (Mirek et al., 1989; Oberdorfer, 1994). *Drosera intermedia* is a characteristic species of the association *Rhynchrosporion.* In addition to transitional bogs, it is found in a variety of habitats. e.g. depending on factors, such as pH value both in water and in KCl. Sometimes, it was found in other habitats without peat substrate (Table 2). A species growing with *Drosera intermedia* includes *Rhynchospora alba* (Bournerias, 1989). This is similar to alkaline values in which *Drosera intermedia* was found in the work (Lecointe and Provost, 1977), where *Drosera intermedia* grew in the company of calciphilous species. *Drosera intermedia* is sometimes found in dune depressions (northern France) and in Poland in humid forests with *Empetrum nigrum* and *Myrica gale*. The Ellenberg index numbers do not specify exact values, but only approximate ranges of values of several ranges of the factors examined. Landolt (2001) mentions this too. According to the division of Raunkiaer, *Drosera intermedia* is treated as a hydrophyte (Weihe, 1972; Casper and Krautsch, 2008). A considerable number of seeds are produced; hence, the population of *Drosera intermedia* is protected from apparent decline (Sychowa and Zarzycki, 1968; Plackowski, 2010).

The location of the site in question is an area where *Drosera intermedia* grew under the influence of acid rain. However, these may be local impacts. Due to drought in the last 3 growing seasons, this species has not been confirmed. The *Drosera intermedia* is considered extinct in vicinity of Central Poland (Karo, 1881; Mowszowicz, 1978); similarly, it does not occur near the Warsaw agglomeration (Sudnik-Wojcikowska, 1987; Herezniak, 2002) or in neighbouring countries, such as the Czech Republic (Kubat, 2002; Dostal, 1988). This issue is also mentioned by Landolt (2001) in the Zurich metropolitan area or an urbanised city region (Auhagen, 1991). Physico-chemical changes occurring for species with low ecological amplitude are quite common (Lasmer et al., 1993). On the other hand, shrubs of the genus *Salix* appear, as well as herbaceous plants, such as *Carex rostrata* or *Phgramitis australis*. among others. *Drosera intermedia* has been found to influence selected habitat parameters hitherto considered to be other adaptations (Rehder, 1948). The seed bank of the species in question favours the apparent disappearance of *Drosera intermedia*; hence, the clear fluctuations resulting from the biology of plant.

Table 4. Results of Pearson correlation with the significance level of 0.05

Correlation	N (%)	C (%)	C/N	S (%)	pH (H_2O)	pH (KCl)	CaO (%)	Asches (%)
N (%)	1.0000	-.4902	-.8295	-.4984	.5559	.5072	.3835	.5355
	–	p=.150	p=.003	p=.143	p=.095	p=.135	p=.274	p=.111
C (%)	-.4902	1.0000	.5041	-.0865	.0381	-.0812	.2309	-.8919
	p=.150	–	p=.137	p=.812	p=.917	p=.824	p=.521	p=.001
C/N	-.8295	-.5041	1.0000	.3239	-.3042	-.1801	-.1572	-.5578
	p=.003	p=.137	–	p=.361	p=.393	p=.619	p=.664	p=.094
S (%)	-.4984	-.0865	.3239	1.0000	-.8253	-.7570	-.6235	.1578
	p=.143	p=.812	p=.361	–	p=.003	p=.011	p=.054	p=.663
pH (H_2O)	.5559	.0381	-.3042	-.8253	1.0000	.9457	.7583	-.1184
	p=.095	p=.917	p=.393	p=.003	–	p=.000	p=.011	p=.745
pH (KCl)	.5072	-.0812	-.1801	-.7570	.9457	1.0000	.6945	-.0631
	p=.135	p=.824	p=.619	p=.011	p=.000	–	p=.026	p=.862
CaO (%)	.3835	.2309	-.1572	-.6235	.7583	.6945	1.0000	-.2667
	p=.274	p=.521	p=.664	p=.054	p=.011	p=.026	–	p=.456
Asches (%)	.5355	-.8919	-.5578	.1578	-.1184	-.0631	-.2667	1.0000
	p=.111	p=.001	p=.094	p=.663	p=.745	p=.862	p=.456	–

Calculated Pearson correlation coefficients which constitute a part of linear analyses indicate rather weak relationships, both positive and negative. In the case of CaO, the R correlation coefficient is positive and diversified for all. The R correlation coefficient calculated from the abovementioned correlation table shows that the measured variable is consistent with CaO. Only ashes have a coefficient of variation > 0.2, which proves a large dispersion around the mean value (Table 4).

The calculated Pearson correlation coefficients, which constitute a part of linear analyses, indicate rather weak relationships (Topolski, 2008).

CONCLUSIONS

As results of the study, twenty species of vascular plants were found. the predominant soil features are those of highmoor peatbogs. Expansion the shrubs of the *Salix* sp. and predominant are those of high and transitional moors. C:N ratio shows that organic matter was flexible and it characterised by biological activity, involving P*ragmites australis* and *Salix* genus invasion. *Drosera intermedia* sometimes appears near urban agglomerations. Transformations of bogs is an unusual event from the viewpoint of nature as well as biotic and abiotic factors. *Drosera intermedia* was recognized. Statistical value was positive and negative. The phenomenon of bog land eco-tonality was most frequently seen in *Phragmites australis* and *Typha latifolia*. The measured value of C:N indicated the bioaccumulation phenomenon. The C:N ratio in organic matter was flexible and it was characterized by a high biological activity.

REFERENCES

1. Aczel A. 1989. Statistics in management. PWN Warszawa (in Polish).
2. Auhagen A. 1991. Vorschlag für eine Präzierung der Definition der in Roten Listen verwendeten Gefährungsgrade. Im: Landschaftentwicklung und Umweltforschung. Schriftenreihe des Fachbereichs Landschaftseentwicklung der TU Berlin. Rote Listen der gefährdeten Pflanzen und Tiere in Berlin. Schwerpunkt Berlin (West). (in German).
3. Backer R., Auhagen A. et al. 1991. Liste der wildwaschsenden Farn-und Blutenpflanzen von Berlin (West) Landschaftwicklungung und Umweltforchung. Schrtiftenreihe des Fachberets Landschasftentwicklung dfr TU Berlin (in German).
4. Bournerias M. 1989. Guide des grouppements vegetaux de la region parisienne. Bassin parisien – Nord de la France (ecologie et phytogeographie) Sedes, 88. Boulevard Saint Germain, Paris (in French).
5. Casper S.J., Krausch H.D. 2008. Süßwasserflora von Mitteleuropa: Pteridophyta und Anthophyta Teil 1 (Süßwasserflora von Mitteleuropa, 23) (German Edition). Spektrum Akademischer Verlag, pp. 408. (in German).

6. De Rider F., Dhond A.A. 1992. The demography of a clonal herbaceous perennial the long leaved sundew *Drosera intermedia* in different heathland habitats. *Ecography*, 15(2), 129-143. https://doi.org/10.1111/j.1600-0587.1992.tb00016.x
7. Dostal J. 1988. Nova kvetena CSSR. Pars 1. Academia Praha (in Czech).
8. Dubaniewicz H. 1974. Climate of the Łódź Voivodeship. *Acta Geographica Lodzensis*, 4, 120. (in Polish).
9. Falińska K. 2002. Guide to the study of population biology of plants. PWN Warszawa (in Polish).
10. Faliński B.J. 2001. Guide to labeling long-term ecological studies. PWN Warszawa (in Polish).
11. Frahm J.P. 1983. Moss flora. Verlag Euglen Ulmer. Stuttgart (in German).
12. Hereżniak J. 2002. Regional list of extinct and threatened vascular plants of the northern part of the Silesia-Cracow Uplands. *Acta Universitatis Lodziensis. Folia Biologica et Oecologica*, 1, 39-64 (in Polish). https://doi.org/10.18778/1730-2366.01.02
13. Karo F. 1881. Flora of the Częstochowa area. *Pamiętnik Fizyograficzny*, VI, 208-237 (in Polish).
14. Kaźmierczakowa R., Bloch-Orłowska J., Celka Z. et al. 2016. Red List of pteridiophytes and flowering plants. Institute Ochrony Przyrody PAN, Kraków (in Polish).
15. Kondracki J. 1994. Geography of Poland. Physical-geographical mesoregions. PWN Warszawa (in Polish).
16. Kubat K. 2002. Klic ke kvetetene Ceske republiky. Academia, Praha (in Czech).
17. Landolt E. 2001. Flora der Stadt Zürich (1984–1998). Birkhäuser Verlag. Basel-Boston-Berlin (in German).
18. Lasmer et al. 1993. Flora of the Baltic Countries. Compendium of Vascular Plants. Tartu (in Russian).
19. Lecointe A., Provost M. 1977. A propos d'une 'transplantation de sauvegarde' d'*Andromeda polifolia* L. (Ericaceae) de Baupte (Manche) à Cessières (Aisne). *Bulletin de la Société Linnéenne de Normandie*, 105, 95–100. (in French).
20. Lecoufle M. 2006. Plantas Carnivoras. Ediciones Omega S.A. (in Spain).
21. Łomnicki A. 2014. Introduction to statistics for naturalists. PWN Warszawa (in Polish).
22. Matuszkiewicz W. 2013. A guide to identifying plant communities in Poland. PWN Warszawa (in Polish).
23. Mirek Z., Piękoś-Mirkowa H., Zając A., Zając M. 1989. Flowering Plants and Pteridiophytes of Poland. A Check List. Instytut Botaniki PAN, Kraków. (in Polish).
24. Mowszowicz J. 1978. Conspectus florae Poloniae Medianae (plantae vasculares). Uniwersytet Łódzki (in Polish).
25. Nyćkowiak J., Leśny J., Olejnik J. 2014. Changes in meteorogical conditions in a Polish cities. 1884–2009. *Polish Journal of Environmental Studies*, 23(1), 149-155.
26. Oberdorfer E. 1994. Pflanzensozionsoziologische, Excursionsflora. Veglag Eugen. Ulmer, Stuttgart (in German).
27. Plackowski R. 2010. Przemiany flory i roślinności wybranych torfowisk środkowej Polski. Wydawnictwo Politechniki Poznańskiej. Poznań, pp. 133. (in Polish).
28. Provost M. 1979. Quelques données récentes sur la répartition de certaines plantes vasculaires rares. méconnues ou nouvelles en Basse-Normandie (1ère partie). *Bulletin de la Société linnéenne de Normandie*, 107, 71-82. (in French).
29. Rehder A. 2001. Manual of cultivated trees and shrubs (2nd edition). Macmillan. New York, pp. 996.
30. Rutkowski L. 1998. Key to the identification of vascular plants of lowland Poland. PWN Warszawa, pp. 814. (in Polish).
31. Scamoni A. 1955. Einfuring in die praktische Vegetationskunde. Deutscher Verlag der Wissenscafter. Berlin. (in German).
32. Sobczyk M. 2012. Statistics. PWN Warszawa, pp. 428. (in Polish).
33. Sudnik-Wójcikowska B. 1987. Flora miasta Warszawy i jej przemiany w ciągu XIX i XX wieku. Wydawnictwa Uniwersytetu Warszawskiego. Warszawa, pp. 242 (in Polish).
34. Sychowa. M., Zarzycki K. 1968. Our sundews. *Chrońmy Przyrodę Ojczystą* 24(2), 16-26 (in Polish).
35. Thommen F.B. 1990. Systematisch-ökologische Untersuchungen an schweizerischen Drosera. Ber. Geob. ETH Stiffung Rubel. Zurich, 56, 150-174 (in German).
36. Topolski M. 2020. Application of the stochlaris gradient method in the construction of the main components of PCA in task diagnosis of multiple sclerosis in children. In: Computational Science – ICCS 2020.
37. Weihe K. 1972. Garcke Illustrierte Flora. Verlag Paul Parey. Berlin und Hamburg (in German).
38. Zając A., Zając M. 2019. Atlas of the distribution of vascular plants in Poland. Instytut Botaniki Uniwersytetu Jagiellońskiego (in Polish).
39. Zarzycki K., Trzcińska-Tacik H., Różański W., Szeląg Z., Wołek J., Korzeniak U. 2002. Ecological indicator values of vascular plant of Poland. Instytut Botaniki PAN, Kraków, pp. 183.