http://dx.doi.org/10.18778/8088-193-8.08

8. Discussion

8.1. Abandoned lands in the buffer zones around landscape parks in the Łódź Voivodeship

Stanisław Krysiak, Anna Majchrowska, Elżbieta Papińska

The spatial distribution of abandoned land, presented in chapters 4.1–4.3, shows the regional intensity variations of the phenomenon of land abandonment and different reasons for discontinuing cultivation in individual areas. Abandoning the agricultural use is a social phenomenon, which results from economic reasons, sometimes demographic ones (ageing of the farmers, no interest among the youth in farming the land, marginalisation and social exclusion, etc.), advancing urbanisation of the suburban zones, exclusion of lands for commercial and industrial investments, road construction, mineral extraction, etc. Thus, land abandonment results from farmers' decisions to discontinue the former agricultural usage. Examples include areas around the Sieradz landscape parks, with the lowest rate of land abandonment, caused by advanced agriculture, characteristic of the eastern part of Greater Poland (Fig. 8.1). Arable land in classes 0 and 1 of abandonment intensity constitute as much as 97.2%. Even areas with poor habitat potential (e.g. geocomplex types 15, 6, 4 or 7) are cultivated and have a low percentage of abandoned lands.

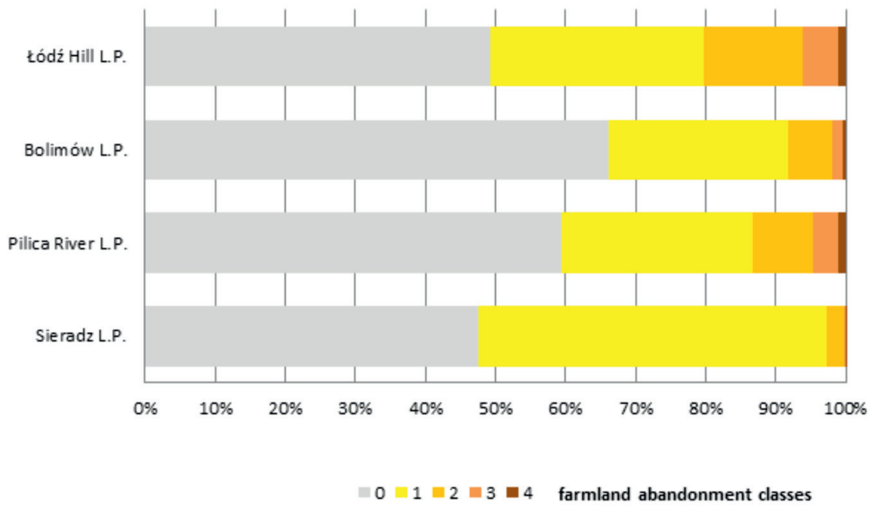


Fig. 8.1. Percentage of areas in land abandonment intensity classes in the buffer zones around landscape parks of the Łódź Voivodeship

Source: own elaboration.

Among driving forces of farmland abandonment in the Łódź Voivodeship, natural conditions play a major role. In a significant part of cases, land abandonment results from decreased profitability of agricultural production. Here, environmental conditions make it ineffective to cultivate habitats with a medium or poor biological productivity potential (sometimes, the poorest habitats have never been cultivated or have been afforested before). Such a situation occurs around the Pilica landscape parks and near the Bolimów Landscape Park. In these zones, a higher share of lands in abandonment classes 2, 3 and 4 is observed (Fig. 8.1).

This applies particularly to areas on the Pilica River and on the Warta River within the Szczerców Basin. The above observation complies with the results of J. Bański's research (1999) into problem areas in the Polish agriculture. On the map which shows "areas backward in their development" (Fig. 18, p. 61), J. Bański indicated many communes located in the southern and eastern part of the Łódź Voivodeship. Some of these communes were categorized as "critical areas", in which agriculture is doomed to failure without external help, and the condition for their development can be the introduction of other economic functions such as tourism and recreation or forestry (p. 62). Low agricultural value of soils of areas on the Pilica River resulted in high forest cover, unseen in other parts of the Łódź Voivodeship. The phenomenon is reflected in statistical data on forest cover in communes, according to which the Inowłódz commune is characterised by 58.3% of forest cover, the Przedbórz commune – 54.2%, and the Sulejów commune – 42.5% (http://lodz.stat.gov.pl/vademecum/vademecum_lodzkie/portrety_gmin). Within the buffer zone around the Pilica landscape parks, nearly 647 km² of forest were excluded from further analyses. A similar situation, but on a smaller scale, concerns areas around the Sieradz landscape parks. In some communes, the forest cover reaches up to 40%, for example in the Wierzchlas commune it is 37.8%, in the Osjaków commune – 36.3% (http://lodz.stat.gov.pl/vademecum/vademecum_lodzkie/portrety_gmin). In this case, almost 367 km² within the buffer was covered by forest and excluded from further analyses.

The buffer zones around landscape parks established in the southern part of the Łódź Voivodeship are characterised by the occurrence of large forest complexes, diverse land relief of the border between lowlands and uplands, and mosaic landscape. Crucial are large river valleys of the Pilica (along with the Sulejów Reservoir) and Warta, which make the described area also an important European ecological corridor of animal migrations (Paturalska-Nowak, Szymańska 2009). The vicinity of Przedbórz, the Wieluń Upland and the Bolimów Forest are regarded as nodes of national importance within the national ecological network ECONET-Poland, whereas the river valleys of Warta, Pilica, Rawka and Bzura have the status of national ecological corridors (Bernatek 2011).

Around forest areas, on larger rivers and in areas of favourable microclimate the replacement of agricultural functions with touristic ones is another frequent reason for land abandonment. The scale of this phenomenon is so large that, in relation to the areas on the Pilica River, it was called "touristic colonisation" (Wojciechowska 1998). It is particularly well visible around the Sulejów Reservoir in places like Smardzewice, Zarzęcin, Karolinów, Tresta, Twarda, Borki, Nagórzyce, Swolszewice, Bronisławów, Barkowice Mokre, Włodzimierzów. In the Spała Landscape Park, the above situation concerns Glinnik, Królowa Wola, Ciebłowice, Inowłódz, Żądłowice. In the Przedbórz Landscape Park, the abandoned lands are a part of the physiognomy of Miejskie Pola, Wygwizdów, Jabłonna, Wojciechów, Piskorzeniec, Wymysłów, Borowa, Stanisławów, Łączkowice, Wola Życińska, Chałupy, Dobromierz, Stara Wieś, Mojżeszów (Krysiak 2012).

The concentration of abandoned lands between Maluszyn and Skotniki (Fig. 4.4) indicates that the problem of low profitability of agricultural use concerns the Pilica river valley, where the decreased importance of cattle breeding resulted in discontinued grazing and mowing in large areas of grasslands.

The unique location of the Łódź Hills Landscape Park within the zone of the Łódź agglomeration induces strong urbanisation pressure on its surroundings (Jakóbczyk-Gryszkiewicz 2011). Suburbanisation shows in massive exclusion of lands from agricultural use, which results in a considerable percentage of abandoned lands of class 2 and 3 – about 20% (Fig. 8.1). Similar situations are observed near Piotrków Trybunalski, Tomaszów Mazowiecki and Sulejów (around the Pilica Landscape Parks), and Skierniewice (the buffer zone around the Bolimów Landscape Park).

The large concentrations of abandoned lands are related to suburban areas or peripheral areas, often lying within the administrative borders of towns. They are areas with the usually chaotic development of permanent housing by individual investors and, to a lesser degree, by real estate developers. A typical component of the landscape are abandoned lands on derelict farmlands, which await sale or commencement of building works, and areas at different stages of secondary succession alternating with plots with houses which have been or are being built and single cultivated fields. At many locations, recreational development is sometimes introduced as the initial stage of building development in post--agricultural lands. The marginal zone of the Łódź Hills, e.g. near Rosanów, Smardzew, Szczawin or Swędów, has been one of the most important areas of seasonal summertime housing in the Łódź Voivodeship for several decades (Włodarczyk 1999). The increase of recreational development around large agglomerations in Poland is a typical phenomenon, presented in many scientific publications (Matczak 1986; Kowalczyk 1994; Matuszyńska 2001; Szkup 2003; Łowicki 2008; Myga--Piątek 2012).

Around cities, abandoned lands sometimes occur in more fertile habitats, and their presence can be explained with the cessation of agricultural functions in suburban zones. In places, the distribution of abandoned lands is to some extent related to the suitability of the lands for agricultural production and usually a minimal protection level is preserved for arable lands of high quality, e.g. near Lućmierz, where the soil and agricultural map (Województwo miejskie łódzkie. Mapa glebowo-rolnicza 1986) shows a patch of leeched brown soils, developed on silts lying upon loose sand, classified as the very good rye (4) complex of agricultural suitability.

In recent years, the factor that promoted land abandonment in the analysed areas were the road investments. An example is the S8 expressway, which runs across the northern part of the buffer zone around the Sieradz landscape parks. A concentration of abandoned lands included in class 2 and 3 is visible for instance near the Sieradz, Zduńska Wola or Złoczew junctions. The area to the north of the Warta–Widawka Interfluve Landscape Park, located within its buffer zone, was qualified as colliding with protected areas (http://www.wios.lodz.pl/files/docs/r11xviiix-przyroda.pdf).

Also the A1 and A2 motorways, which run near the Łódź Hills Landscape Park and the Bolimów Landscape Park, are accompanied by areas of intensified land abandonment. Such a situation occurs near Stryków, within a triangle marked by Sosnowiec, Wola Błędowa and the junction of A1 and A2 motorways (Fig. 4.17). Here, concentrations of class 4 of abandonment intensity are found, accompanied mainly by class 2 and 3 squares, which clearly reflect the location of investment areas around the town, and the course of motorways, whose construction might have made it difficult to access some agricultural plots. The issue of farmland abandonment does not appear in scientific literature dealing with spatial influence of roads and motorways construction, but the studies usually stress its negative impact on organising production in farms, breaking connections in the local road network used by agricultural transport and hampering the access to fields, disadvantageous changes in field layout and the resulting decrease in production potential (Dzikowska 2006).

Within the buffer zones around all landscape parks in the Łódź Voivodeship, considerable similarities occur in the structure of the natural environment, expressed in the share of individual geocomplex types (Fig. 8.2). The highest percentage in the analysed zones is taken by areas of plateau glacial tills (from 24.6 to 40.2%), which belong to geocomplex type 5, and a slightly lower share is taken by the sandy and gravelly areas of glacial and fluvioglacial accumulation (from 17.7 to 36.6%), which belong to geocomplex type 6. Among the other geocomplex types, areas of glacial and fluvioglacial accumulation lying upon glacial tills (type 16) and fluvial sediments of hydrogenic sections of valley bottoms (type 11) are also notable. Some geocomplex types occur sporadically and not in all analysed areas. Examples include areas built of siliceous rocks (type 1), carbonate and marl rocks (type 2), cover silts upon glacial tills (type 17) found in the Pilica and Warta landscape parks.

Abandoned lands are present in all geocomplex types, but their share usually corresponds to the habitat potential. In arable lands, which are located outside cities and suburban zones, the lack of abandoned lands results from favourable agricultural conditions. Such conditions are provided first of all by places where the parent rocks are silts upon till (geocomplex of type 17), glacial tills (type 5), clays, muds and mudstones (type 3) and other geocomplex types, where trophic and moisture conditions are shaped by the presence of glacial till in the lower parts of the soil profile. Shallow glacial tills make them the horizon which shapes the water balance of the geocomplex. By hampering the infiltration of precipitation water, tills improve the water balance of the habitat, contributing to periodical increases of moisture in the plant root zone.

In places there are no abandoned farmlands in areas classified as lithogenic geocomplexes related to permeable Quaternary deposits, in particular as geocomplex of type 6. It might seem that the less favourable abiotic conditions could

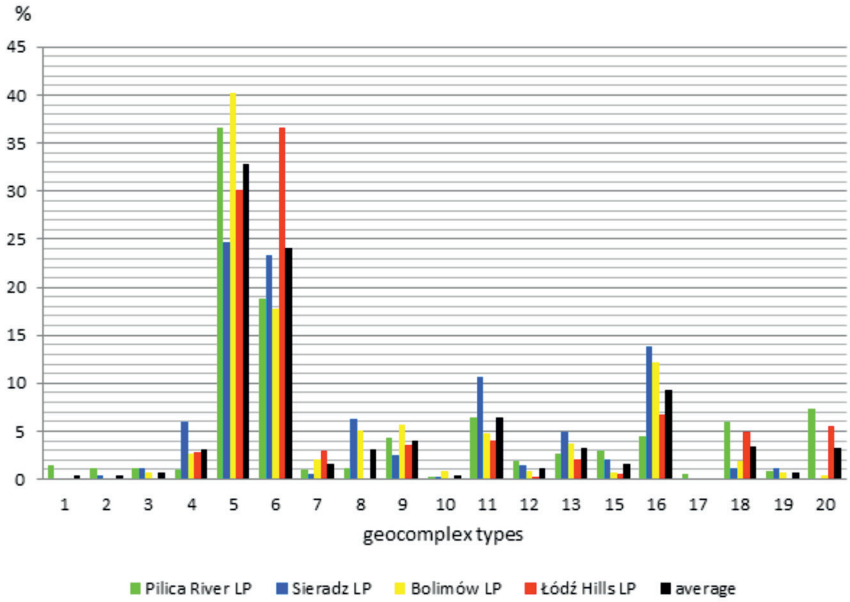


Fig. 8.2. Percentage areas of geocomplex types in the buffer zones around landscape parks of the Łódź Voivodeship

Source: own elaboration

predispose them for discontinuing their use as arable lands and for introducing abandoned lands among them. The soil and agricultural map can help explain this situation (http://geoportal.lodzkie.pl/imap/), as it shows some soils classified as complex 4 and 5 of agricultural suitability, which results from a considerable content of silts. Their thickness is not high enough to be marked on geological maps, yet their contribution to the improvement of the practical value of the soils is significant (Krysiak 1999ab, 2005ab, 2006ab, 2008ab; Papińska 2014). Silts change the infiltration conditions, by retaining water and making it available for plants. At locations where thickness of silts is the highest, there even appear soils classified as complex 2 of agricultural suitability of arable lands and 2z of permanent grasslands.

In all the analysed areas, an intensification of the phenomenon of land abandonment around forest complexes can be noticed (Fig. 4.4, 4.10, 4.23). This applies to both forests which lie outside the landscape parks and those which constitute their borders.

The borderlines of landscape parks in the Łódź Voivodeship are complex. Except for the Sieradz landscape parks, which have a compact shape, the others have very well-developed boundary lengths in relation to their area. Landscape parks on the Pilica River are characterised by particularly well-developed boundary lengths, especially the Sulejów Landscape Park, which consists of two parts, connected by a narrow section of the Pilica valley near Sulejów. In addition, the boundary development degree is influenced by enclaves of farmlands which have not been included in the parks when they were established. Examples of such locations are the vicinities of Zarzęcin and Karolinów in the Sulejów Landscape Park, areas around Królowa Wola and Inowłódz, Żądłowice and Liciążna in the Spała Landscape Park, the vicinities of Policzek, Gaj and Góry Mokre in the Przedbórz Landscape Park. At present, these enclaves have mostly lost their agricultural character, which is confirmed by the considerable share of abandoned lands there (Fig. 4.4). The increased naturalness of landscape there, provides a basis for the possible correction of the course of the boundaries, which might consist in integrating these areas into the parks. The presented suggestion relates to the practice of protecting entire environmental structures and not only their fragments (Żarska 2006).

In the authors' opinion, the recommendation for correcting the park boundaries may be applied to such sections, along which the phenomenon of land abandonment is intensified. It is compatible with the principle of "friendly" utilisation of neighbourhoods of environmentally valuable areas, proposed by B. Żarska (2006). Even if the boundaries are not corrected, the abandoned areas actually do provide a kind of buffer zone, which decreases the degree of isolation of protected areas and minimizes the negative impact of the surroundings.

8.2. Abiotic properties of the abandoned land study plots in the Łódź Voivodeship

Stanisław Krysiak, Anna Majchrowska, Elżbieta Papińska

Research conducted in 39 farmland abandonment study plots showed that the majority of the plots were located within the geocomplex type 6 (Fig. 8.3). Geocomplex types 4 and 15 were in the second place, with the percentage of study plots exceeding 10%. A slightly smaller share (nearly 8%) of the study plots were identified in geocomplex types: 8, 16 and 18. Little more than 5% were found in the geocomplex type 5.

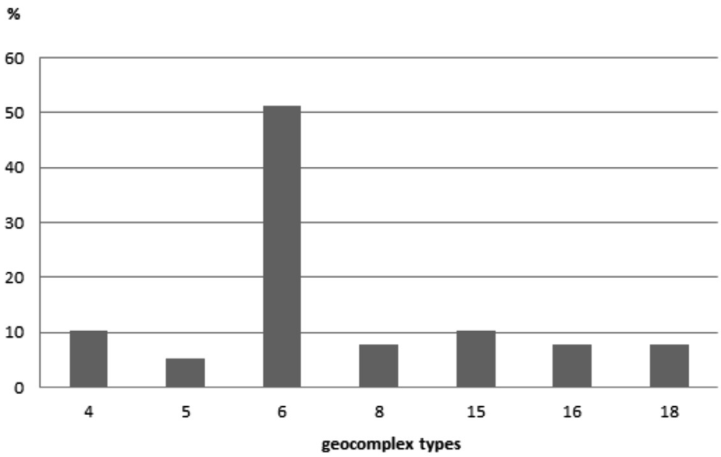


Fig. 8.3. Percentage of the abandonment study plots in individual geocomplex types

Source: own elaboration

One of the basic characteristics of the analysed soils is the grain size distribution, which is primarily dependant on the type of parent rocks. This parameter determines many soil properties, of which the most important include the capacity to retain water available and necessary for vegetation growth, or absorption or depletion of nutrients.

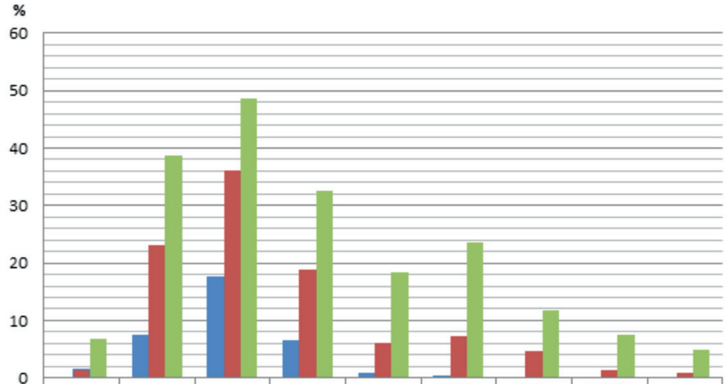
Most of the above mentioned geocomplex types, within which the study plots were delimited, are characterised by the occurrence of sands of various origin (see Tab. 3.1) and were included in the group of lithogenic geocomplexes with permeable Quaternary deposits. Only geocomplex types 5 and 18 were included in the group of lithogenic geocomplexes with hydrologic conditions shaped partially by shallow low-permeable deposits (Tab. 3.1).

The results of grain size distribution from all study plot groups in the soil horizon 0–20 cm indicate the dominance of the sand fraction (85.5%), and in it, the subfraction of medium sand (Fig. 8.4). It ranges from 17.6% (Szymaniszki C) to 48.6% (Wola Pszczółecka B). Due to such a large share of the sand fraction, the soils are characterised by excessive aeration and high permeability and a precipitation-retention type of water balance with the possibility of frequent shortages of soil moisture (e.g. Wola Pszczółecka A and B, Piskorzeniec A, B, C).

An important role in shaping the aeration and moisture properties is played by the silt fraction, whose presence influences the volume of mesopores, which retain capillary water available for plants (Krysiak 1996, 2006b). The average content of the silt fraction in this horizon exceeds 13%. An increased admixture of silt fraction is characteristic of the study plots in which periglacial cover formation occurs (e.g. Glinnik A, Sulejów A, B, C; Łagiewniki B, C; Szymaniszki A, B, C; Polesie A).

A similar situation occurs in the 20–40 cm horizon, which is the optimal one for the development of the root system of herbaceous plants and most trees. The sand fraction shows the highest content – 83.6% (Fig. 8.5). The content of medium sands in this fraction reaches 45%, coarse – 27%, and fine – 24%. The dominance of the sand fraction has a significant influence on the value of specific surface area, which averages in the 0–20 cm horizon at

0.14 $m^2 \cdot g^{-1}$ (median: 0.103 $m^2 \cdot g^{-1}$), and in the 20–40 cm horizon – 0.136 $m^2 \cdot g^{-1}$ (median: 0.119 $m^2 \cdot g^{-1}$). The results of grain size distribution analyses allow to conclude that soils of the abandonment study plots are characterised by excessive aeration and high permeability. Also the water and absorbing capacity of such soils is relatively low, as is the availability of nutrients for plants.

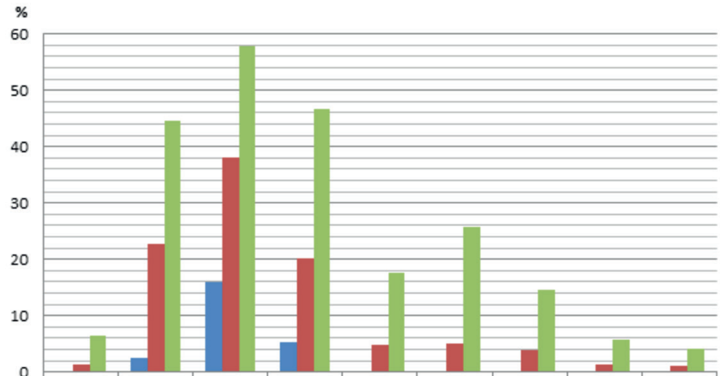


	2,0-1,0	1,0-0,5	0,5-0,25	0,25-0,1	0,1-0,05	0,05-0,02	0,02-0,005	0,005-0,002	< 0,002
min	0	7,4	17,6	6,6	0,9	0,5	0	0	0
average	1,37	23,07	36,21	18,80	6,08	7,33	4,77	1,47	0,91
max	6,7	38,7	48,6	32,6	18,3	23,5	11,7	7,5	4,8

grain size ranges

Fig. 8.4. The minimum, arithmetic mean and maximum percentage of granulometric fractions and subfractions of soils sampled from the study plots, in the 0–20 cm horizon

Source: own elaboration



	2,0-1,0	1,0-0,5	0,5-0,25	0,25-0,1	0,1-0,05	0,05-0,02	0,02-0,005	0,005-0,002	< 0,002
min	0	2,5	16	5,3	0	0	0	0	0
average	1,199	22,692	37,991	20,125	4,699	5,144	3,795	1,411	0,968
max	6,5	44,6	57,8	46,7	17,6	25,7	14,5	5,8	4

grain size ranges

Fig. 8.5. The minimum, arithmetic mean and maximum percentage of granulometric fractions and subfractions of soils sampled from the study plots, in the 20–40 cm horizon

Source: own elaboration

A significant role in shaping the water conditions of some plots is played by glacial tills, which are characterised by a higher content of the clay fraction in the lower parts of the soil profile. These deposits hamper the infiltration of precipitation water, contributing to periodical occurrence of perched water tables available for plant roots. Examples of such study plots include: Glinnik B, Sulejów A and C, Wola Życińska B, Weronika B and C, Wola Pszczółecka C.

Laboratory analyses showed that in all analysed soil profiles, the pH_{KCl} value in the 0–20 cm horizon was very acidic and acidic (Fig. 8.6) and ranged from 3.8 to 5.5. Nearly 80% of the samples were characterised by very acidic reaction, which reached its lowest value of 3.8 in 5% of the samples. The median for this distribution equals 4.2, which indicates a clear share of samples with very acidic reaction (Fig. 8.6).

The distribution of pH_{H2O} in the same horizon is slightly different (Fig. 8.7). The results of reaction analyses are contained in three classes of acidity: very acidic (56.4% of samples), acidic (33.3%) and slightly acidic (10.3%) (Bednarek et. al 2004). The pH values range from 4.3 to 6.4. Despite a greater spread of pH values, the samples classified as very acidic constitute the highest percentage.

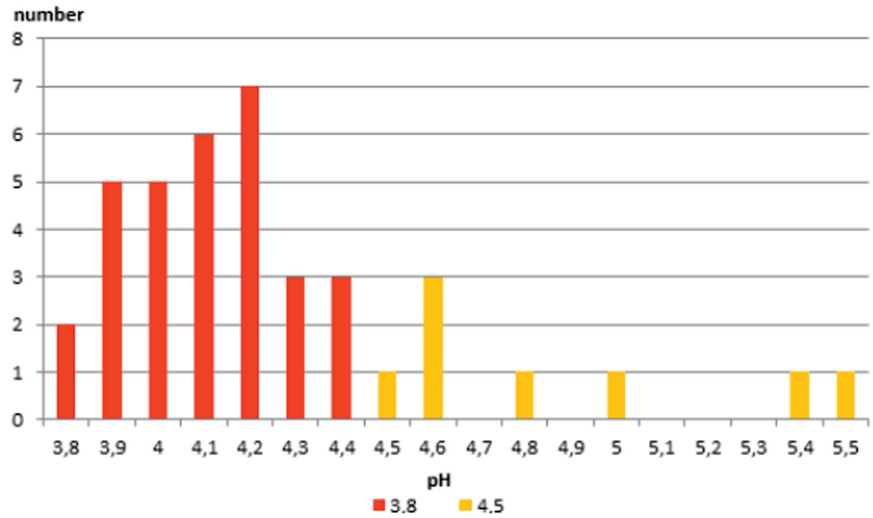


Fig. 8.6. Number of soil samples in pH_{KCl} acidity classes, in the 0–20cm horizon

Source: own elaboration

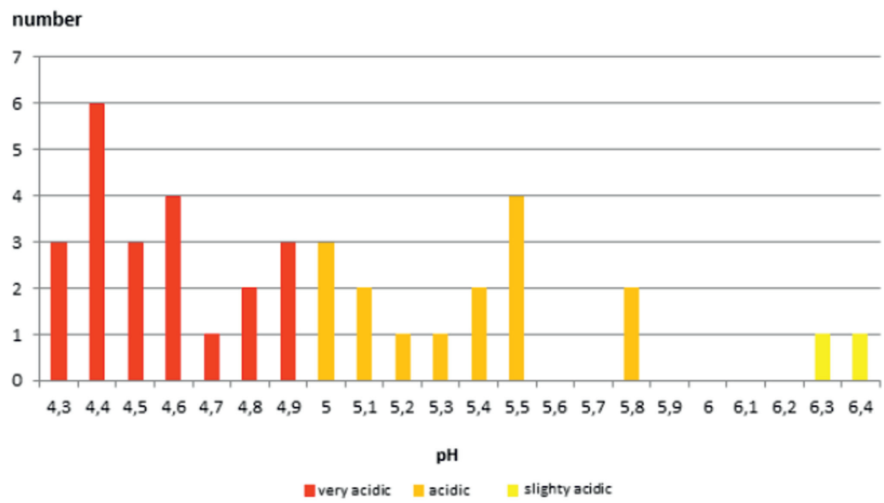


Fig. 8.7. Number of soil samples in pH_{H2O} acidity classes, in the 0–20 cm horizon

Source: own elaboration

Analogous juxtapositions of the pH value were performed for samples taken from the depth of 20–40 cm (Fig. 8.8 and 8.9), that is of great importance for the development of the root system of herbaceous plants and most trees. Also in this case, all samples were characterised by very acidic and acidic pH_{KCl}, although the extreme values exhibited a smaller spread – from 4.1 to 5.3. The percentage of samples classified as very acidic is also lower – they constitute 38% in this horizon.

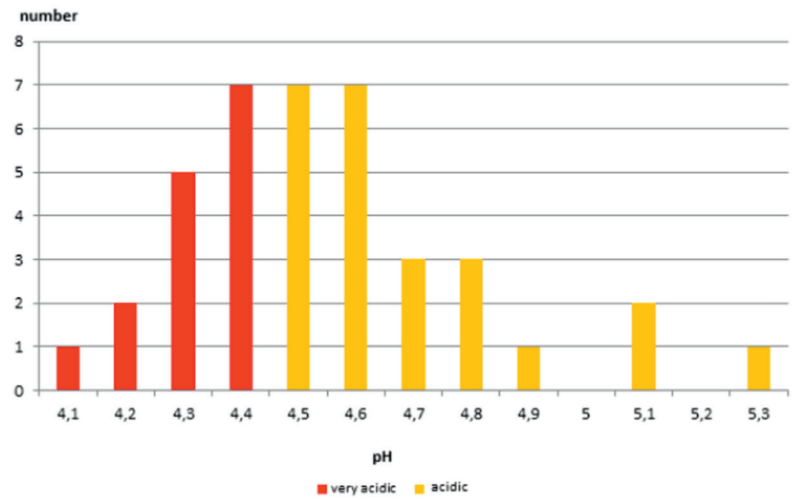


Fig. 8.8. Number of soil samples in pH_{KCl} acidity classes, in the 20–40 cm horizon

Source: own elaboration

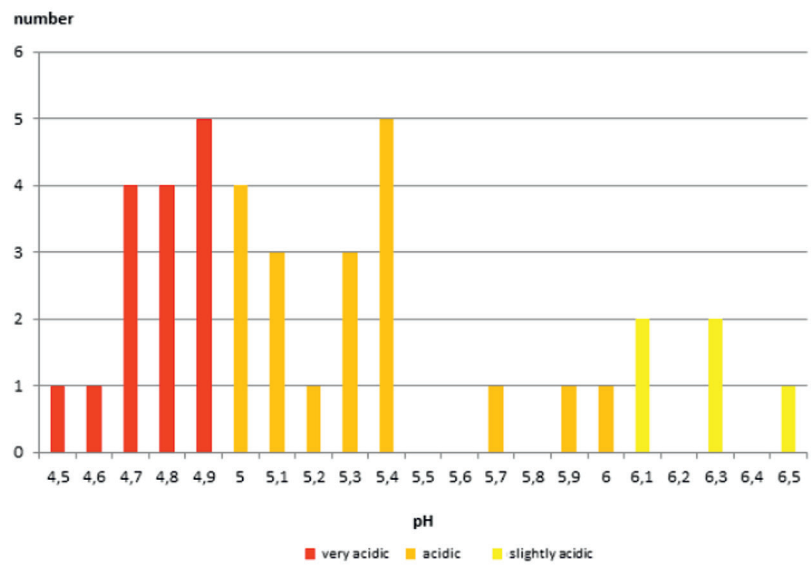


Fig. 8.9. Number of soil samples in pH_{H2O} acidity classes, in the 20–40 cm horizon

Source: own elaboration

The pH value of samples taken from the 20–40 cm horizon, marked in H_2O, is contained in three classes. Very acidic samples make up about 38%, acidic – about 49% and slightly acidic – nearly 13%. Extreme pH values in this case range from 4.5 to 6.5. The presented data indicate that there is a clear shift towards lower acidity.

The analysis of pH is important because "a lot of soil properties are the function of their pH value" (Bednarek et al. 2004, p. 198). It influences, among other things, the composition of exchangeable cations, availability of nutrients for plants, or release of elements which are potentially toxic to plants. In Table 8.1, the selected chemical properties of soils for two horizons: 0–20 cm and 20–40 cm are juxtaposed in order to show their extreme values (min and max) and average values (median and arithmetic mean).

Many abandonment study plots, presented in chapters 5.1–5.3, have a very low saturation degree of the sorptive complex with alkaline cations, not exceeding 20% (Glinnik A, B, C; Celestynów A, B; Piskorzeniec A, B, C; Weronika A, Wola Pszczółecka A, B; Polesie A, B; Wola Makowska B, C). The above parameter was regarded by A. Harasimiuk (2013) as one of the quantitative indicators for delimiting oligotrophic landscapes, which represent the class of landscapes poor in nutrients for

Tab. 8.1. Selected measurements which characterise the chemical properties of soils of the abandonment study plots.

Selected measu-rements	Available nutrients %			Exchangeable cations me/100g				Hydrolytic acidity mmol/100g	Humus %
	P_2O_5	K_2O	Mg	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}		
Level 0–20 cm									
Min.	1.1	0.3	0.2	0.1	0.017	0.004	0.013	1.48	0.63
Average	8.0	2.2	0.8	0.7	0.100	0.000	0.100	3.70	1.40
Median	7.1	1.7	0.5	0.2	0.030	0.030	0.060	3.56	1.38
Max.	18.9	5.8	4.8	2.8	0.410	0.070	0.164	7.25	3.15
Level 20–40 cm									
Min.	0.7	0.20	0.20	0.05	0.010	0.000	0.01	0.84	–
Average	3.0	1.21	0.70	0.50	0.060	0.030	0.04	1.86	–
Median	2.5	0.80	0.30	0.17	0.020	0.020	0.04	1.54	–
Max.	17.2	4.20	3.00	2.10	0.283	0.345	0.12	4.88	–

Source: own elaboration.

living organisms (p. 24). According to A. Harasimiuk, oligotrophic agricultural landscapes, in the conditions of social and economic changes in agriculture, are subject to various scenarios of transformations. For soils of the lowest productivity, the scenario is usually abandonment.

The phenomenon of abandonment causes changes in the soil environment, influencing e.g. the course of physicochemical processes. The changes are difficult to unequivocally define as positive or negative, as the rich literature of this issue often reveals opposing opinions. Some authors point out the decreased fertility of abandoned soils, and even their permanent degradation (Krężel, Miklaszewski 1987; Kutyna, Niedźwiecki 1996; after Zawieja 2013). However, many authors also emphasize the increased content of organic carbon (Tomaszewicz, Chudecka 2010; Włodek et al. 2014) or the higher pH value and saturation degree of the sorptive complex with bases (Chudecka, Tomaszewicz 2004). Some contrasting opinions on the rising trends concerning the organic carbon content were presented in the publications by such authors as T. Wojnowska et al. (2003) and G. Żukowska et al. (2007), and on the impoverishment of the sorptive complex – S. Sienkiewicz et al. (2003) or S. Strączyńska and S. Strączyński (2003).

The results of laboratory studies presented in chapters 5.1–5.3 may constitute the starting point for future research projects, which may be aimed at demonstrating changes taking place in the soil environment after a given period of abandonment. Then, the authors can join the discussion of the directions of transformations which occur in the pedosphere as a result of farmland abandonment.

8.3. Plant cover and fungi of the abandoned lands in the Łódź Voivodeship in comparison with abandoned land habitats in different regions of Poland

Jolanta Adamczyk

There is a high degree of interest in vegetation which encroaches upon the post-cultivation lands. Most studies which were published in this area focus on observing subsequent stages of plant succession, during a shorter or longer period of time. In Poland, the most well-documented in this respect is the Jelonka reserve, on which continuous observations have been conducted for over 40 years (Faliński 1986). Similar research projects were also conducted in other regions of the country (e.g. Wójcik 1996; Balcerkiewicz, Pawlak 1997; Sławski 2002). Shorter time studies of abandoned lands in Poland concerned the area in the Wierzbówka Valley, to the south of Skawina, just behind the edge of the Carpathian Foothills (Dubiel 1984) and the Przemyśl Foothills (Barabasz-Krasny 2002).

In this work, which deals with abandoned lands of the Łódź Voivodeship, it was not one of the aims to study plant succession in these habitats. The short period of research (2 years) and lack of information on the age and previous usage of the abandoned farmland allowed the authors only to evaluate the vegetation which grew there during a given time, with an emphasis on its biocoenotic role in the analysed area. For this reason, a comparison of the abandoned land vegetation in the Łódź Voivodeship was made only with studies of the Wierzbówka Valley and the Przemyśl Foothills. In the Wierzbówka Valley, three development stages were distinguished in the abandoned land vegetation, which differed with respect to the dominating species, physiognomy and age: the *Cirsium arvense* – *Agropyron repens* stage, the *Agrostis vulgaris* – *Holcus mollis* stage and the *Solidago virgaurea* – *Hieracium umbellatum* stage (Dubiel 1984). As regards abandoned lands in the Przemyśl Foothills, the occurrence of three communities was identified: the community with *Hypericum perforatum* and *Torilis japonica*, the community with *Calamagrostis epigejos* and the community with *Vicia tetrasperma* (Barabasz-Krasny 2002). No clear similarity was found between plant communities distinguished in the abandoned lands of the Łódź Voivodeship and those identified in the two above mentioned works. Only the *Calamagrostis epigejos* community, identified in the Przemyśl Foothills (Barabasz-Krasny 2002) also occurred in the area of the Łódź Voivodeship. This confirms the observation that communities which develop in post-agricultural lands are very diverse floristically, devoid of balance and open to alien species from various habitats (Dubiel 1984). Their floristic composition is certainly shaped by numerous biotic and abiotic factors. Most dominating species in the communities of the Carpathian and Przemyśl Foothills also occur in the phytocoenoses of the Łódź Voivodeship abandoned lands, but in different quantities and species compositions. When comparing the studies, one must take into account significant differences in the geologic structure, soil types and climate between the areas of the Carpathian and Przemyśl Foothills and the analysed area of the Łódź Voivodeship. Obviously, they have an impact on the shaping of phytocoenoses in the abandoned lands.

Mycological research in abandoned farmland habitats is not rich. So far, it has been conducted in Białowieża (Kałucka 1999, 2009) and the Chłapowski Landscape Park in central Greater Poland (Kujawa 2007, 2008ab, Kujawa and Kujawa 2008). Recently, preliminary results of studies of abandoned lands in the Łódź Voivodeship have been published (Adamczyk 2014). A reliable comparison of mycological analyses results from Białowieża and Greater Poland with abandoned land research results from the Łódź Voivodeship is impossible. This results from the specificity of the former research, which concerned more diverse habitats than abandoned lands of the Łódź region, as well as from the length of the research period, which was much shorter for the latter research. Two-year mycological studies, conducted in permanent study plots, allow to capture only a few development trends of the macromycete communities. In addition, precipitation during the years when research in the Łódź Voivodeship was conducted (2012–2013) was exceptionally low, which might have had a significant impact on the results of mycological observations.

8.4. Evaluation of the phenomena and processes which influence the plant cover and fungi of the analysed abandoned lands

Jolanta Adamczyk

The shaping of plant cover and fungi of abandoned lands may be influenced by many different abiotic and biotic factors. They may include: the geological substratum, soils, the most recently cultivated crops and the neighbouring communities (Dubiel 1984). On the basis of research conducted in the Łódź Voivodeship, it is possible to attempt at evaluating most of these factors. It is difficult to determine the most recently cultivated crops, as it was impossible to reliably verify the age and previous usage of the abandoned lands.

Soil studies indicate considerable acidification of most analysed abandoned lands. In the communities: *Anthoxanthum aristatum* and *Corynephorus canescens*, as well as *Agrostis capillaris*, *Hieracium pilosella* and *Achillea millefolium*, the pH value in H_2O is 4.2–5.5. The soils in patches of phytocoenoses with *Cladonia* and patches with *Calamgrostis epigejos* have similar pH values. Habitats of communities with *Cirsium arvense*, *Galium mollugo* and *Gnaphalium sylcaticum*, as well as *Elymus repens* or *Poa pratensis* have neutral pH of 5.4–6.3 (Tab. 8.2). The pH value is related to the content of calcium in the soil. It increases with the increasing pH value. The highest calcium content occurs at study plots Sulejów A, Sulejów C and Wola Życińska B. The content of potassium ions is very low compared with the average content for medium agricultural soils. It is the lowest in habitats of the floristically poor communities, and increases in habitats with richer flora.

The content of nitrogen in soils of the analysed abandoned lands is very low. On average, it is about 10 times lower than the nitrogen content in the soils of abandoned lands analysed in the Carpathian Foothills (Dubiel 1984). The highest amount of nitrogen was recorded in soils of the study plots Wola Życińska B and Szymaniszki B (Tab. 8.2). The humus horizon is of considerable thickness in most analysed patches in all observed plant communities. However, it does not prove their fertility, as – according to some authors – during the initial stages of phytocoenoses which are formed in abandoned farmland habitats, the production of biomass is higher than its decomposition (Chudecka, Tomaszewicz 2004; Tomaszewicz, Chudecka 2010).

The results of soil analyses confirm the view of some authors (Dubiel 1984) that during the first development stages of abandoned land vegetation, the soil of these habitats is highly depleted. Insufficient amount of nutrients restricts the possibilities for plants to inhabit the abandoned lands. Poor abandoned lands are first colonised by lichens and grasses with lower nutritional requirements, e.g. the community with *Cladonia*, the community with *Anthoxanthum aristatum* and *Corynephorus canescens*. Richer soils are inhabited by grasses and perennial plants with higher soil fertility requirements, e.g. the community with *Cirsium arvense*, *Galium mollugo* and *Gnaphalium sylcaticum*.

It remains difficult to explain whether abandoned lands with rich flora constitute the stage which occurs after the poorer stages, or they are rather the initial stages in the more fertile abandoned lands. Some studies of abandoned lands found that agricultural soils, characterised by a high nitrogen content, remain rich in this element from the moment of abandoning cultivation until the pole wood forest phase (Sławski 2002). All the abandoned lands in the Łódź Voivodeship showed a very low nitrogen content. Due to missing data concerning their age and previous usage, it is difficult to draw conclusions about their initial nitrogen content.

Macromycetes also reveal a dependency on the fertility of abandoned land habitats. The least fertile patches, overgrown with *Cladonia* or grasses, are characterised by a very small number of macromycete species. Mainly small sporocarps of gasteroid fungi and fungi of the *Conocybe* and *Panaeolus genera* occur there. It is only in several study plots, where trees grow, that mycorrhizal fungi occur. Diversity of macromycete communities increases with soil fertility. In more fertile patches, there are a lot more species, both saprotrophic and mycorrhizal ones. Tree species of fungi occur hardly anywhere, which is probably related to the fact that trees in the abandoned lands are young and produce little substrate in the form of fallen branches, logs and stumps.

Table 8.2. Chemical properties of soils of abandoned land plant communities (at the 20–40 cm horizon)

Plan community	Study plots	pH in H_2O	Ca^{2+} me/100g	K^+ me/100g	P_2O_5 mg/100g	N %	Humus %
Anthoxanthum, Corynephorus	Celestynów A	4.2	N.D.	0.026	1.5	0.047	1.37
	Krzętle A	4.6	0.15	0.013	4.8	0.038	0.86
	Wola Makowska A	5.1	0.20	0.031	17.2	0.033	0.63
	Wola Makowska B	4.8	0.15	0.026	7.1	0.041	0.85
	Polesie C	4.7	0.15	0.018	2.5	0.053	1.42
Agrostis – Hieracium – Achillea	Glinnik A	4.9	0.10	0.044	3.0	0.069	1.75
	Glinnik B	5.5	0.10	0.038	4.0	0.036	0.86
	Wola Życińska A	4.9	0.15	0.013	1.9	0.082	1.85
	Wola Życińska C	5.9	0.80	0.038	1.6	0.075	1.58
	Raciszyn A	5.2	0.20	0.067	0.5	0.050	0.94
	Celestynów B	4.8	0.10	0.013	2.7	0.051	1.42
	Krzętle C	4.9	0.10	0.013	5.3	0.060	1.22
	Weronika B	4.9	0.10	0.026	3.4	0.051	1.33
	Wola Pszczółecka C	4.9	0.45	0.056	1.2	0.072	1.42
Calamagrostis	Wola Życińska B	5.5	2.10	0.102	0.2	0.162	3.15
	Wola Makowska C	4.8	0.15	0.026	1.7	0.078	1.70
	Szymaniszki A	5.2	0.70	0.072	2.9	0.069	1.24
Cladonia	Piskorzeniec A	4.8	0.05	0.013	2.6	0.020	0.64
	Polesie A	4.7	0.15	0.018	2.5	0.053	1.42
	Wola Pszczółecka B	5.1	0.05	0.013	1.6	0.060	1.55
Cirsium Galium Gnaphalium	Raciszyn C	5.4	0.15	0.026	1.6	0.078	1.73
	Weronika C	6.0	0.65	0.044	1.9	0.058	1.02
Elumus Poa	Sulejów A	6.3	1.70	0.062	2.4	0.092	1.98
	Sulejów C	6.1	1.30	0.049	2.4	0.094	1.94
Cirsium Solidago	Szymaniszki B	5.4	1.20	0.072	4.5	0.100	1.86
Betula	Łagiewniki B	4.5	0.15	0.026	1.8	0.072	1.35
	Łagiewniki C	5.0	0.35	0.072	3.1	0.068	1.38

Abbreviations: ***Anthoxanthum-Corynephorus*** – community with *Anthoxanthum aristatum* and *Corynephorus canescens*; ***Agrostis – Hieracium – Achillea*** – community with *Agrostis capillaris*, *Hieracium pilosella* and *Achillea millefolium*; ***Calamagrostis*** – community with *Calamagrostis epigejos*; ***Cladonia*** – community with *Cladonia*; ***Cirsium – Gallium-Gnaphalium*** – community with *Cirsium arvense*, *Galium mollugo* and *Gnaphalium sylvaticum*; ***Elymus-Poa*** – community with *Elymus repens* or *Poa pratensis*; ***Cirsium-Solidago*** – community with *Cirsium arvense* and *Solidago Canadensis*; ***Betula*** – community with *Betula pendula*.

Source: own elaboration.

Another factor of importance in the shaping of vegetation and fungi communities in the abandoned lands is their neighbourhood. In the analysed area, the vast majority of abandoned lands is found near smaller or larger areas overgrown with trees. Only the plots Glinnik A, Polesie A and C, Wola Makowska A are not located near woodlands. The neighbourhood of forests of various origin and species composition favours the rapid occurrence of trees in abandoned lands, especially pine *Pinus sylvestris*, birch *Betula pendula*, less frequently oak *Quercus robur* and rowan *Sorbus aucuparia*. In each isolated type of community, there are patches inhabited by trees. They are young trees of different ages, and sometimes only seedlings. Frequent presence of trees in various types and ages of abandoned lands indicates a clear influence of the nearby woodlands on their flora and vegetation. It may be assumed that many of the analysed patches of abandoned lands overgrown with trees, will – under favourable conditions – develop towards forest communities. In our climate, it is the natural direction of succession in abandoned land habitats (Dubiel 1984; Faliński 1986). Owing to the short period of research, it is impossible to determine what factors influence the fact that in some abandoned lands trees do not appear, despite close neighbourhood of woodlands.

Another factor which influences the phytocoenoses of abandoned lands is the occurrence of expansive species, including invasive species of non-native origin. In the analysed area, the occurrence of 7 such species was recorded (Tab. 6.2). Invasive species of foreign origin quickly colonise new areas and habitats, causing negative effects in ecosystems (Bomanowska et al. 2014). Currently, it is the invasion of species of foreign origin, resulting from human activity, that is considered, apart from habitat fragmentation, to be one of the most serious threats for biodiversity (CBD 1992). In the analysed abandoned lands of the Łódź Voivodeship, the occurrence of two invasive species can be considered as the most dangerous: *Solidago canadensis* and *Padus serotina*. In Poland, *Solidago canadensis* reproduce both sexually and asexually, but it is characterised by rapid clonal proliferation (Sudnik-Wójcikowska 2011). The quick spreading of this species is favoured by longevity of the clones and considerable allocation of biomass (Adamowski et al. 2014). *Solidago canadensis* exhibits high plasticity and easy adaptation to different habitat conditions (Weber and Jacobs 2005). Due to these features, the appearance of this species in abandoned lands may hamper the growth of other plant species and modify the succession direction of abandoned land phytocoenoses. The other dangerous invasive species is *Padus serotina*. This species grows on soils with a wide spectrum of moisture and trophicity, although it is mainly associated with sandy and poor soils, with acidic pH reaction (Closset-Kopp et al. 2010; Halarewicz 2012). *Padus serotina* quickly takes over open habitats: abandoned fields, meadows and pastures (Deckers et al. 2005; Adamczak 2007). *Padus serotina* produces compounds that act allelopathically (prunasin, amygdalin), which can inhibit growth of other plants (Csiszár 2009; Robakowski et al. 2012). Dense undergrowth of *Prunus serotina* restricts the regeneration and growth of indigenous tree species, particularly those that require high amount of daylight, as oak or pine (Starfinger et al. 2003).

The occurrence of *Solidago canadensis* was recorded in 7 study plots of analysed abandoned lands, but it only obtains high cover at plot Szymaniszki B. In other areas, *Solidago canadensis* occurred only as an addition. The presence of *Padus serotina* was recorded in 8 abandoned land areas. It reached the highest cover at plot Szymaniszki C. In other patches it was sparse. Despite the low share of *Solidago canadensis* and *Padus serotina* in most of the analysed abandoned land patches, their presence should be admitted as undesirable and potentially threatening to proper succession in the abandoned lands, owing to the biological properties of these species, as discussed above.

8.5. The importance of abandoned lands for sustaining the ecological processes in areas surrounding the landscape parks of the Łódź Voivodeship

Jolanta Adamczyk

In evaluating the ecological importance of abandoned land habitats, their role in sustaining the biodiversity of the region, the capability to restore forest phytocoenoses or to impede the invasion of non-native plant and animal species must be taken into consideration. The ecological importance of the analysed abandoned lands may result from the type of vegetation, the presence of plant or fungi species that are legally protected, endangered or rare at the scale of the country or region, and their location in relation to other phytocoenoses.

Despite the proximity of landscape parks, in which rare and protected species of flora occur, no legally protected or endangered species were found in the abandoned lands. Only *Helichrysum arenaria* and *Cladonia rangiferina* are partially protected species. However, the significance of abandoned lands as potential refugia for flora and fungi species that are valuable from the point of view of nature conservation cannot be ruled out. It happens that rare species of plants which occur in protected areas leave them for various environmental reasons and look for convenient habitats at other locations. The neighbouring phytocoenoses of abandoned lands may easily become their new sites. Besides, some species identified in the analysed abandoned lands are not frequent in the Łódź region. Such species include *Dianthus cartusianorum* and *Thymus pulegioides*. Their occurrence in abandoned lands is a favourable phenomenon for sustaining the biodiversity of the region. Moreover, the forest phytocoenoses which originated as a result of secondary succession in post-agricultural areas are richer in plant species than abandoned lands that are afforested, and they foster sustained biotic diversity. Artificial afforestation in such habitats are usually shrubs and trees, which are even-aged and lack the zonality of groundcover. Diversity of species is based almost exclusively on the planted target species of forest plant communities (Matysiak 2007). On the other hand, natural succession leads to the formation of forest phytocoenoses with a diverse structure and a greater variety of species. It is very important for the development and life of numerous species of different organisms.

High plant diversity of the analysed abandoned lands may be regarded as a favourable phenomenon. It creates different habitat conditions, which foster the appearance of numerous organisms. For example, even very poor habitats are colonized by several species of *Cladonia*, which enriches the species diversity of the region. Each identified type of abandoned land vegetation is of biocoenotic significance, by creating unique conditions of life for various organisms. The few patches of abandoned lands which were dominated by invasive species of non-native origin – *Solidago canadensis* and *Padus serotina*, must be treated as an exception. They are also the place for various organisms to live but they pose a threat for other plant communities of abandoned lands and natural phytocoenoses, which are protected in the nearby landscape parks. The phenomenon of invasive species of foreign origin occurring in protected areas is currently a worldwide problem (e.g. de Poorter 2007; Foxcroft et al. 2013).

The location of the analysed abandoned lands near afforested areas is very advantageous for the formation of natural ecological corridors (Fig. 4.4, 4.23). Agricultural usage of the land always results in fragmentation of habitats. Secondary succession which occurs in the abandoned lands helps reverse the process (Faliński 1986). Abandoned land phytocoenoses are places where species of various organisms may live or through which they can reach forest phytocoenoses that exist nearby more easily. In a spatially diverse agricultural landscape, in which small areas favourable for the life of individual species are separated with unfavourable areas (fields), corridor connections play an important role. They influence the dynamics of populations of organisms, by limiting their extinction and enabling proper shaping of their communities by decreasing the degree of isolation (Kijowska, Zajadacz 2004). All landscapes are related thanks to corridors, which play an important role in the ecological, visual and economic dimensions. A corridor is a relatively narrow belt of land, different than the surrounding background. It tends to be either isolated or connected with a given area, which is characterised by unique ecological conditions. Abandoned lands may function as belt corridors, as they are wide enough to shape specific habitat conditions inside them. Such corridors can also act as habitats, filters (barrier), guide, source and receiver, but usually they are the main migration paths for substances, energy and organisms in the landscape (Forman 1995).

While analysing the ecological role of the analysed abandoned lands, it is worth pointing to another factor. Abandoned lands are habitats, where the composition of the occurring species, both cultivated and wild, changes many times. Thus, they form a sort of "container" of different diaspores, from crop weeds to species found in meadows, forests and other habitats. They probably also contain spores of various fungi or dormant forms of plant and animal microorganisms. From the environmental point of view, such habitats are very valuable, as a unique, natural gene bank of various organisms.