

Biota of lichens on the Zadroże Dune and its immediate surroundings

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Abstract. The present paper aims at describing the biota of lichens of the Zadroże Dune and its adjacent area in Toruń. The research on lichens was conducted during the years 2005–2006. The data on lichens come from my own research and literature. Altogether, the occurrence of 82 lichen taxa was recorded in the investigated area, including 74 species recorded during my own research. Due to the availability of habitats and substrata, terricolous species dominate here, mainly from the genus *Cladonia* and *Cetraria*. Particularly noteworthy are rare, endangered and protected species from this area e.g. *Peltigera canina*, *Polyblastia agraria*, *Rinodina conradii* and *Stereocaulon condensatum*.

Key words: lichens, dry sand grasslands, eutrophication, Toruń.

1. Introduction

Within the territory of Toruń, the most characteristic elements of the landscape relief are the ice-marginal valleys and river valleys with the preserved system of river terraces and edges in between. Extensive dune areas spread out over all terraces, except the floodplain. In the valley of Toruń, the biggest dune complex occurs within the early post-glacial relief of the Polish Lowland, and within the city of Toruń its significant fragment called the field of Toruń, Aleksandrów and Gniewkowo. Dunes within the city can be described as parabolic, straight linear, irregularly undulated with more or less smooth surface (Niewiarowski & Weckwerth 2006).

Together with spatial development of Toruń, some permanent anthropogenic relief transformations have taken place. Some of the dune areas have been completely destroyed due to the expansion of residential and industrial areas, sport facilities and communication routes. At

present, most of the sandy dune fields are covered with pine and mixed forests.

Among the dune areas, the Zadroże Dune is particularly noteworthy together with the adjacent areas, especially near the street Poznańska due to the biota of lichens inhabiting those areas (Anikiejówna & Gorska 1949).

Scattered dune grasslands of the following communities occur there: *Spergulo-Corynephorum*, *Festuco-Koelerietum glaucae* and *Caricetum arenariae*, and farther towards the Zadroże Dune the contribution of *Calluna vulgaris* is more pronounced, particularly in places where forest was cut down. Over a relatively large area of this territory, despite the neighbourhood of roads, residential and industrial development, well preserved communities of inland dunes occur with numerous lichen species (Ceynowa-Giełdon et al. 2004).

2. Materials and methods

Lichenological studies covered the Zadroże Dune situated in the commune of Wielka Nieszawka and the adjacent eastern area situated within the administrative boundaries of the city of Toruń. In accordance with the ATPOL system of squares, modified for lichenological objectives (Cieśliński & Fałtynowicz 1993), the adjacent south-western end of Toruń, presented in Figure 1, is included within the squares of 10x10 km, Cc-49 and Cd-40, additionally divided into fields of 1x1km.

According to cartographic, floristic and phytosociological data, in the mid-20th century the Zadroże Dune was covered with heaths and psammophilous grasslands. According to the information acquired from the Forest Division of Cierpiszewo, the dune has been gradually afforested since 1950. Nowadays, it is covered with 30–60-year old pine forest, where the undergrowth and the herb layer occur only here and there. The lists of terrestrial lichens occurring at two research sites before the afforestation of the dune, published by Anikiejówna and Gorska (1949), were used for comparisons with the species composition recorded during my field studies in the research area situated within the boundaries of Toruń, marked in Figure 1. This fragment of the city has been deforested to this day. Today, most of the research area is covered with the same plant communities as the Zadroże Dune before it was afforested. During the 2nd World War, part of this area was converted to the prisoner-of-war camp (Stalag XX), first with French and British prisoners and from 1941 – with Russian ones. This area was described as Soviet Heide (Tyszkiewicz 1976). At the turn of the 1960s and the 1970s in the eastern part of this area, production floors and an administrative building of a poultry plant were built. At the beginning of the 1980s at the back of this plant, allotment gardens were established. At the beginning of the 21st century, the Toruń ring road was constructed through the south-western part of this area, next to which warehouses with building materials and car showrooms were created.

Nowadays, places that are not covered by forest, cultivated vegetation or buildings, are covered by heath vegetation, psammophilous grasslands, patches of mosses, particularly *Polytrichum piliferum*, and terrestrial lichens. The species composition of terrestrial lichens occurring there at the turn of the 20th and 21st centuries was determined by Ceynowa-Giełdon (1993) and Ceynowa-Giełdon et al. (2004). The detailed description of physiographic conditions, vegetation and the history of the Zadroże Dune, as well as the research area located in the territory of Toruń are presented by other articles included in the 12th Issue of Ecological Questions.

In the Table 1 with species lists of lichens, two research sites on the Zadroże Dune, the lichen species of which

were studied by Anikiejówna and Górska (1949), were denoted with symbols A. The list of lichens occurring in the 1990s and at the beginning of the 21st century in the area located near Toruń, published by Ceynowa-Giełdon (1993) and Ceynowa-Giełdon et al. (2004), was denoted by the symbol B and C, respectively. Biota of lichens, which I determined in the area situated within the city of Toruń (Fig. 1) concern the state of 2005 and 2006.

Collection of lichens within the said area was done from all possible substrata of their occurrence, with particular consideration to terricolous lichens (epigeic). Moreover, substrata like bark of trees (*Acer platanoides*, *Betula pendula*, *Pinus sylvestris*, *Populus* ssp.) were analysed; inventory and collection of lichens were also conducted from wood, acid and artificial calcareous rock substrata, as well as other substrata of anthropogenic origin (leather, slag, thalli of other lichens).

The identification keys by Purvis et al. (1992), Wirth (1995) and other monographs were used to determine the collected lichens. Also the method of thin-layer chromatography (TLC) was applied according to Orange et al. (2001) for the following genera: *Cladonia* and *Lepraria*, as well as for the species – *Scoliciosporum sarothamni* and *Lecanora expallens*. Specimens of *Cladonia* from the group *chlorophaea* not confirmed chromatographically were defined as *Cladonia chlorophaea* s. l.

The names of lichens are given after Diederich et al. (2009) and Santesson et al. (2004). The collected herbarium material has been deposited at the Herbarium of the Institute of Ecology and Environment Protection Nicolaus Copernicus University in Toruń (TRN).

3. Results

In total, 82 lichen taxa were recorded in the territory of the Zadroże Dune and its immediate surroundings. Data on biota of lichenized fungi come from both literature and my own research (Tab. 1).

At present, the presence of previously recorded taxa, such as: *Cetraria ericetorum*, *Cladonia cariosa*, *C. chlorophaea*, *C. furcata* subsp. *subrangiformis*, *Placynthiella oligotropha* has not been confirmed. Neither the occurrence of *Cladonia rangiferina* nor *Steinia geophana* or *Verrucaria xyloxena* has been confirmed. The former species was quoted only by Anikiejówna and Górska (1949) and the latter ones were defined by Ceynowa-Giełdon (2001) and Ceynowa-Giełdon et al. (2004) as ephemeral taxa. Historical data are related mainly to species of terricolous lichens. Previously, no detailed lichenological research has been conducted in this area and the aforementioned taxa only supplement the lists of plant species.

Furthermore, historical herbarium collections have not been preserved and therefore taxonomic verification of li-

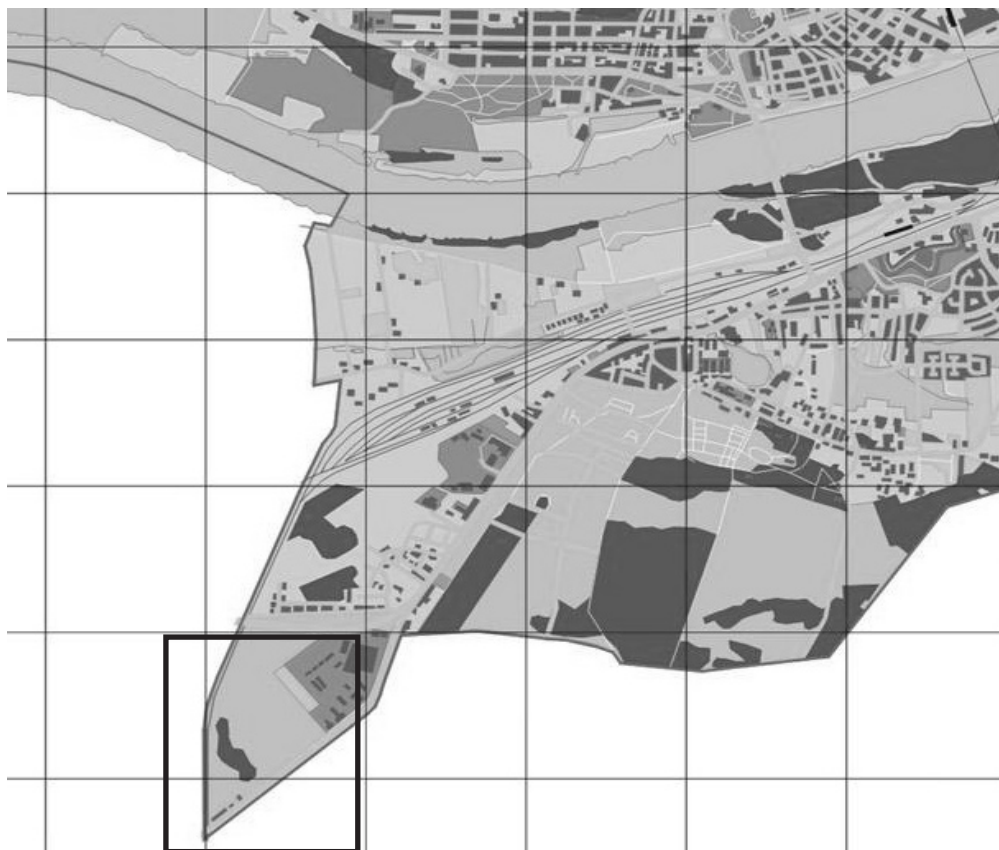


Figure 1. Fragment of the city of Toruń on the left bank of the Vistula river with the indicated boundary of the study area and the grid of ATPOL squares 1x1 km in the background

chens was impossible, particularly in the case of critical taxa.

Among 74 species recorded during my own research, taxa of terricolous lichens predominate – 29 taxa, including 20 species from the genus *Cladonia*. Apart from species of terricolous lichens, characteristic of acid and poor substrata, also calciphilous lichens were found in the study area. Among them e.g.: *Polyblastia agraria*, *Peltigera canina* and *Cladonia furcata* subsp. *subrangiformis* are particularly noteworthy. Those species prefer substrata enriched with calcium compounds, for instance due to dumping of concrete rubble.

Lichens populated also in large numbers the bark of *Acer platanoides*. 21 species of lichens were recorded on the bark of this phorophyte. Among others, the following species occurred exclusively on this substratum: *Evernia prunastri*, *Lecanora expallens*, *Phlyctis argena*, *Pseudevernia furfuracea*, *Scoliciosporum sarothamni*, *Strangospora pinicola* and *Tuckermanopsis chlorophylla*.

Leather of a shoe dumped on the Dune turned out to be an interesting substratum, on which 10 lichen species were recorded, including rare taxa such as: *Rinodina conradii* and *Thelidium minutulum*.

Lichens growing on thalli of other lichenized fungi from this area constitute another interesting example. And those are: *Diploschistes muscorum* and *Scutula dedicata* – a rare lichenized lichenicolous fungus recorded on the thallus of *Peltigera didactyla* (Kukwa & Adamska 2006).

Diploschistes muscorum is a toxitolerant and at present expansive species, also within the study area. It grows here on thalli of lichens from the genus *Cladonia* and on the surface of *Trapeliopsis granulosa* in xerothermic patches of *Festuco-Koelerietum glaucae*. The species is known from its capacity to accumulate substantial amounts of heavy metals, mainly Zn and Pb, as well as its efficiency in their detoxification (Cuny et. al. 2004).

10 species from all lichen species recorded in the study area are listed on the Red List of lichens occurring in Poland

<i>Stereocaulon condensatum</i> Hoffm.										+			VU	sp
<i>Strangospora pinicola</i> (A.Massal.) Körb.				+									LC	
<i>Thelidium minutulum</i> Körb.												+	NT	
<i>Trapeliopsis flexuosa</i> (Fr.) Coppins & P.James										+				
<i>Trapeliopsis granulosa</i> (Hoffm.) Lumbsch										+		+		
<i>Tuckermannopsis chlorophylla</i> (Willd.) Hale				+									VU	sp
<i>Verrucaria xyloxena</i> Norman				+										
<i>Xanthoria candelaria</i> (L.) Th.Fr.				+										
<i>Xanthoria elegans</i> (Link) Th.Fr.												+		
<i>Xanthoria parietina</i> (L.) Th.Fr.				+										
<i>Xanthoria polycarpa</i> (Hoffm.) Rieber				+										

Historical date: A – according to Anikiejówna & Gorska (1949), B – according to Ceynowa-Giełdon (1993), C- according to Ceynowa-Giełdon et al. (2004); substrata: Ac – Acer, Be – Betula, Ps – Pinus, Po – Populus, lig – wood, ter – soil, rup – acid bedrock, rua – calcareous substratum of anthropogenic origin, var – leather, slag, thalli of lichens; threat categories (Cieśliński et al. 2006): EN – Endangered, VU – Vulnerable, NT – Near Threatened, LC – Least Concern, DD – Data Deficient; protected by law (Rozporządzenie 2004): sp – strict protection, pp – partial protection

(Cieśliński et al. 2006) in 4 categories of threat, including 1 species – *Rinodina conradii* at the risk of extinction (EN – Endangered), 4 species exposed (VU – Vulnerable), e.g. *Stereocaulon condensatum*, 3 taxa NT – Near Threatened, as well as 1 species of LC – Least Concern and 1 species of unknown risk (DD – Data Deficient). Furthermore, 13 legally protected taxa were recorded here, including 6 strictly protected species (Rozporządzenie 2004).

4. Discussion and conclusions

In comparison with data concerning other towns of Poland, Toruń turned out to be an exceptional town due to the contribution of terricolous lichens, also rare, endangered and protected ones. For instance in Poznań (Kepel 1999) and in Olsztyn (Kubiak 2005) the occurrence of 29 species of terricolous lichens from the genus *Cladonia* was confirmed, in Białystok Matwiejuk (2007) quoted 17 taxa, and Kiszka (1999) – only 9 species in Przemyśl.

Whereas in Toruń 34 taxa from this genus were recorded in the whole town (Adamska 2008).

At present, as many as 29 species of terricolous lichens were recorded on the Zdroże Dune and its immediate surroundings, including 20 *Cladonia* ssp. Terricolous lichens on dry arenaceous grasslands are particularly sensitive indicators of transformations in habitat conditions, which proceed for instance as a consequence of eutrophication (Buelmann 2005).

Long-term observations of these processes could prove that habitat conditions change within the entire ecosystem, and this should result in some actions protecting the analysed areas. On the one hand, eutrophication of the analysed habitats, particularly of dry arenaceous grasslands, constitutes a threat to species inhabiting acid, xeric and poor substrata, whereas on the other hand, it leads to spreading of nitrophilous and coniphilous species, especially epiphytic ones, such as e.g.: *Phaeophyscia orbicularis* or *Xanthoria parietina* (cf. Nash III 2008).

Similar tendencies have been observed by e.g. Kubiak (2005) in Olsztyn and Matwiejuk (2007) in Białystok, and outside Poland by e.g.: Gombert et al. (2005) in Grenoble or Munzi et. al. (2007) in Roma.

Contribution of terricolous lichens in communities of vascular plants constituted the subject of several scientific studies carried out on arenaceous grasslands (Cieśliński 1979; Czyżewska 1992).

Lichens are diagnostic of analysed associations. For example, according to Cieśliński (1979) in the association *Spergulo-Corynephorum* on the Kielce-Sandomierz Upland there occur lichen species such as: *Cetraria aculeata*, *Cladonia uncialis*, *Placynthiella uliginosa* and *Trapeliopsis granulosa*, as well as species characteristic of coniferous forests – *Cladonia furcata*, *Cetraria islandica* or *Cladonia glauca*, what indicates certain succession connections with forest communities. The situation is similar within the Zdroże Dune in Toruń. Furthermore, within the research area, also *Cladonia cervicornis* and *C. floerkeana* occur

between patches of heather, the same way as described by Cieśliński (1979).

High nature value of the Zadroże Dune is manifested by a significant contribution of lichen species particularly sensitive to anthropopressure, included on the Red List of lichens endangered in Poland (Cieśliński et al. 2006) and provided with species protection. They make up 21% of the total number of lichen taxa recorded in the study area.

The Zadroże Dune as described by Ceynowa-Giełdon et al. (2004), due to its natural character and location within the city of Toruń, attracted some interest of researchers already long time ago (Anikiejówna & Gorska 1949).

The most significant changes in the species composition of the vegetation and lichens occurring here has been brought about by expansion of *Tragopogon floccosus* spreading over the dunes of the Toruń Valley (Ceynowa-Giełdon 1993).

Another threat to biota of epigeic lichens could also be posed by the typical urban process of expansion and development of yet another areas intended for buildings and roads. Lichens of open areas lose their habitats due to afforestation, development of urbanization and secondary succession of vegetation (Czyżewska 2003).

At present, the study area is also devastated through trampling down, dumping of wastes and levelling of the area.

Due to threats posed to this naturally and historically valuable land (Tyszkiewicz 1976), it is particularly important to include the arenaceous grasslands (Namura-Ochal-ska 2005) and heaths (Kujawa-Pawlaczyk 2005a, b) within the framework of Natura 2000 protection.

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