

Materials for biota of lichens and lichenicolous fungi in the military area near Toruń, Poland

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Abstract. The paper presents the first species list of lichens and lichenicolous fungi found and identified in the artillery training area located near the city of Toruń. Lichenological studies were conducted in that area in 1998–2001 and 2009. A total of 100 taxa were identified, including 4 species of lichenicolous fungi, with particular emphasis on epigeic lichens – mainly from the genus *Cladonia* and *Cetraria* associated with heaths and arenaceous grasslands. The identified lichens include some threatened and protected taxa, i.a. *Bryoria subcana*, *Cetraria islandica*, *Physconia distorta*, *Peltigera canina*, *P. polydactylon*, *P. praetextata*, *Ramalina fraxinea*, *Stereocaulon condensatum*.

Key words: military area, psammophilous grasslands, heathland, lichen biota, threat, protection.

1. Introduction

There are 7 large military training grounds in Poland, with a total area of 90,000 ha. The training ground in Toruń is one of the oldest and the largest facilities of this type, not only in Poland but also in Europe (Wasilewski, 2004). Since the mid-17th century, area IV of the dune field located in the Toruń Basin was used as an artillery range. The military activity in this area, involving cutting of trees and shrubs, military trainings and frequent fires, has contributed to the preservation of non-forest habitats. The artillery range near Toruń is covered in 99.4% with forests of varying age and heaths (Gugnacka-Fiedor & Adamska, 2010).

Floristic studies were carried out in this area already in the 19th century and in the early 20th century (Scholz, 1896; Abromeit et al., 1898; Preuss, 1912). After a long break, floristic studies were resumed (Wilkoń-Michalska, 1971; Chojnacka et al., 2010a; 2010b; Gugnacka-Fiedor & Adamska, 2010).

Although areas used by the army are interesting in terms of nature, the literature on their lichen biota is still scanty because of the difficult access (e.g.: Ciaciura et al., 2013; Dingová & Pišút, 2010; Motiejūnaitė, 1996, 2007; Gilbert, 2000).

Due to the presence of habitats such as grasslands and heaths, the artillery range near Toruń represents a valuable lichenological area. The area is particularly rich in epigeic, epiphytic and epilithic lichens, including threatened and protected species. Some data on the lichens of the military training ground were published by Gugnacka-Fiedor and Adamska (2010), Chojnacka et al. (2010a, 2010b) and Ceynowa-Giełdon et al. (2004).

The objective of this study is to present the list and the distribution of lichen species as well as lichenicolous fungi identified on the military training ground near Toruń.

2. Location

In the Toruń Basin, dunes are the dominant component of the land relief (Kondracki, 2001). The study area is located on one of the six dune fields, referred to as Toruń-Aleksandrów-Gniewkowo dune fields (Mrózek, 1958). The field is one of the largest dune fields in the Toruń Basin. It covers an area of ca. 223 km². The dominant land form are parabolic dunes formed at the end of the last glaciation and characteristic of extensive sandy terraces occurring along large rivers. In the Holocene (Klimaszewski, 1978; Noryskiewicz, 2013), these areas were covered with pine forests and only the human activity in the last millennium, especially deforestation, induced aeolian processes. Infertile podzolic soils with acid reaction and a small content of humus dominate in the area (Burak & Jankowski, 1991).

From the 17th century, part of the dune has been continuously used as an artillery range. The area is owned by the State Treasury and used by the Artillery and Armaments Training Centre in Toruń. It is located in the commune of Wielka Nieszawka (Fig. 1). The military training ground is largely overgrown with pine wood which

remains under the administration of Gniewkowo Forest Division. The training ground covers an area of ca. 12,000 ha (Wasielwski, 2004) and its northern boundary coincides with the southern city limit of Toruń; the western boundary runs along the line: Toruń – Podgórz, the Forest District of Glinki, the railway line Toruń – Inowrocław to Suchatówka; the southern limit runs along the villages: Suchatówka, Kijewo, Grabie, the Tążyna River and the Pieczenia Forest Division and villages: Otłoczyn and Odolin; the eastern limit runs along a bridge above the Tążyna River, road no. 1 and the line of villages: Brzoza, Czerniewice and Toruń – Stawki. Dorożyński (2001) described these limits as: E 018°29' – 018°44' and N 052°51' – 052°59'

The area is covered by a network of roads, both hardened (concrete, paved and asphalted) and not hardened. Firebreaks, ditches and anti-tank barriers are located in the area, as well as engineering and technical buildings in the form of trenches and shelters. Remains of a prisoner-of-war camp from World War II are located in the northern part of the training ground (Wasilewski, 2004).

According to the current nature and forest regionalization (Trampler, 1990), the studied area is located in the

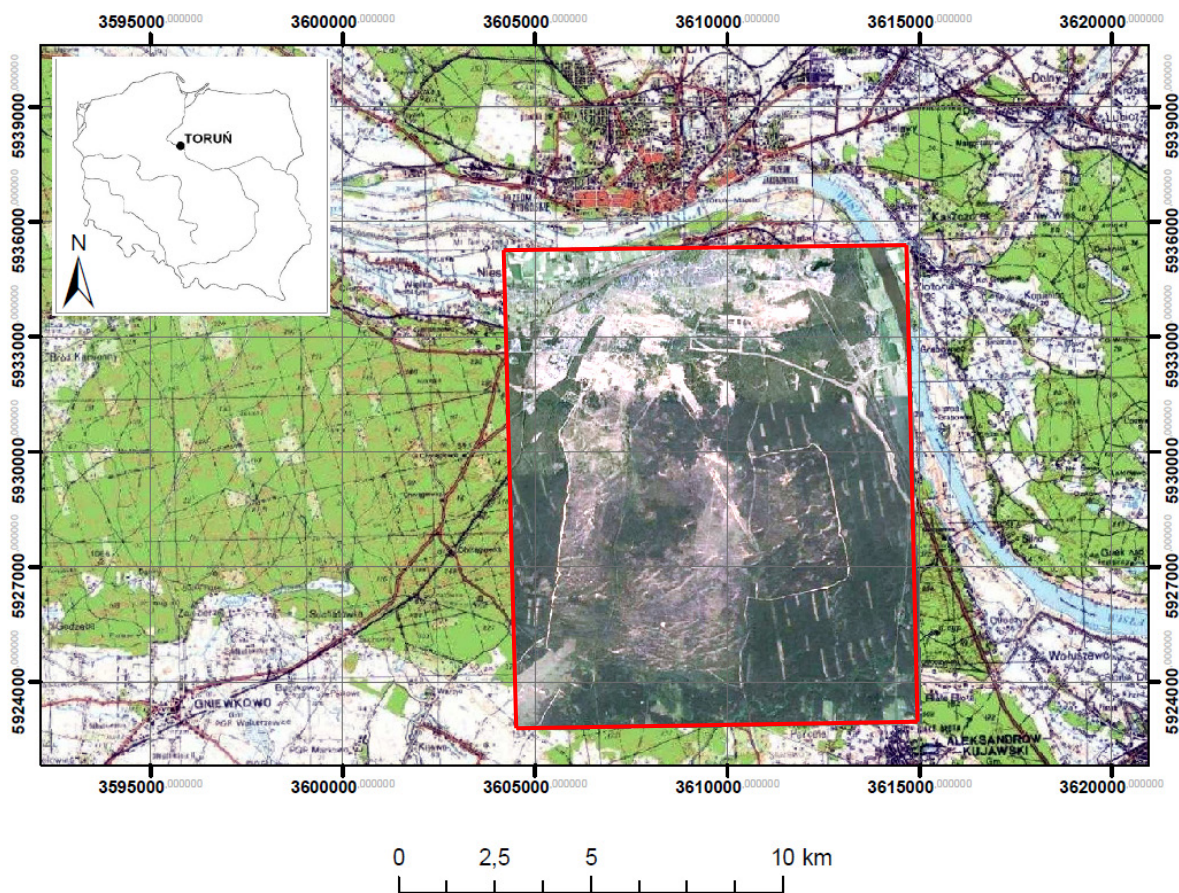


Figure 1. Location of the study area (red line)

Wielkopolska-Pomerania Region (III); the region of the Toruń-Płock Basin (5), the mesoregion of the Toruń-Płock Basin (5.a), the region of Wielkopolska-Pomerania Lowlands (7.) and the Mesoregion of the Wielkopolska Lake District (7.b).

According to the division of the country into physical and geographical mesoregions (Kondracki, 2001), the area is located in the Mesoregion of Non-Alpine Central Europe, the Province of the Central-European Lowland, the Subprovince of the South Baltic Lake District, the Macroregion of the Toruń-Eberswald Ice-Marginal Valley (1), the mesoregion of the Toruń Basin, the Macroregion of the Wielkopolska Lake District (2), the mesoregion of the Inowrocław Plain.

According to the division of Poland into geobotanical regions by Szafer and Pawłowski (1972), the forest division is located in the following units of the geobotanical division: the Baltic Divide, the Subdivide of the Great Valleys; the Region of Wielkopolska and Kujawy; the Kuyavian District.

In accordance with the regulation of the Toruń Provincial Governor as of the 10th of December 1992, the military training ground was granted the status of the protected landscape referred to as “the Dune area to the south of Toruń” (Burak, 2001).

3. Methods

Lichenological studies were carried out in 1998–2001 and 2009 by E. Adamska at 33 sites (Fig. 2) in the artillery training area near Toruń.

Some of the species were identified in the field, while specimens of others were deposited at the Herbarium of the Department of Geobotany and Landscape Planning, Nicolaus Copernicus University in Toruń (TRN). Data on the occurrence of lichens were collected from all available substrates: bark of trees – in particular roadside trees, twigs of *Calluna vulgaris*, wood, sandy soil and concrete constructions – bunkers, shelters, concrete rubble. Protected species were not collected. Due to the limited access to the training ground and, consequently, time restrictions on each stay in the study area, more detailed fieldwork was not possible.

The collected specimens of lichens were identified using the standard lichenological methods, based mainly on the paper by Smith et al. (2009) as well as several identification keys and monographs. The names of taxa were accepted mainly after Diederich et al. (2015), Czyżewska & Kukwa (2009), except for taxa from the genera *Teloschistaceae* Zahlbr. (ARUP et al. 2013), *Verrucaria* Schrad. (Krzewicka, 2012), the group of *Lecanora dispersa* (Śliwa, 2007) and the species: *Cladonia arbuscula* s.l. (Piercey-Normore et al. 2010), *C. floerkeana* and *C. uncialis* (Santesson et al. 2004) and *L. saxicola* (Laundon, 2010).

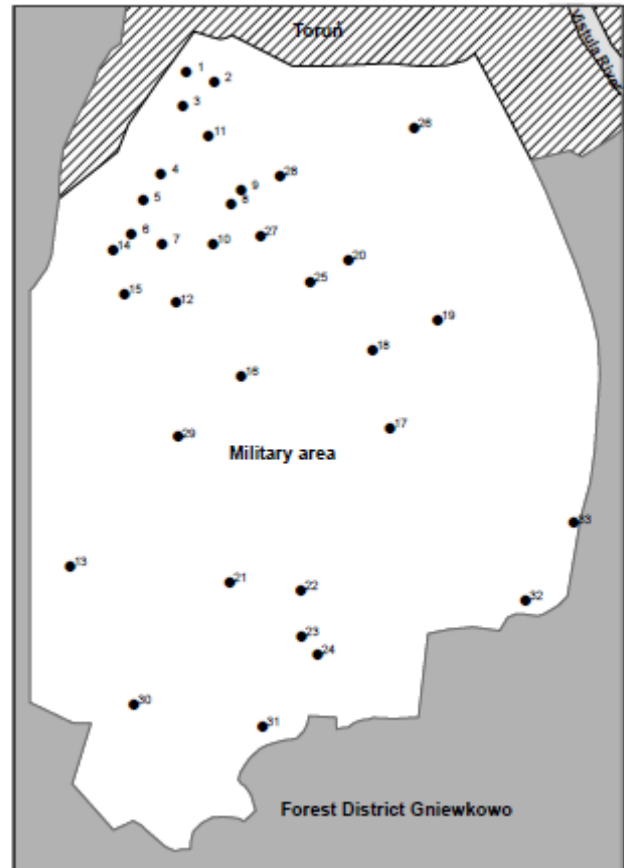


Figure 2. Location of the 1–33 localities (black dots) on the military area

Specimens from the genus *Lepraria* not subjected to TLC (Orange et al. 2001) were defined as *Lepraria* sp. and *Cladonia* from the group of *chlorophaea* – as *Cladonia chlorophaea* s.l. Threat categories of lichens in Poland were quoted after Cieśliński et al. (2006). The conservation status of lichen species was collated in accordance with the Regulation of the Minister of the Environment (2014).

Taxa were listed in alphabetic order. The list contains information on lichens' substrates and the list of sites at which a given taxon was found.

List of localities

- 1 – bifurcation concrete roads; 52°59'20"N, 18°35'30"E;
- 2 – trench – South, concrete foundations; 52°59'00"N, 18°35'10"E;
- 3 – crossroads; 52°58'50"N, 18°35'00"E;
- 4 – Droga Popiołowa – east; 52°58'05"N, 18°34'30"E;
- 5 – Droga Popiołowa – crossroads; 52°57'50"N, 18°34'20"E;
- 6 – Góra Żymierskiego; 52°57'40"N,

18°34'05"E; **7** – shelter; 52°59'00"N, 18°35'10"E; **8** – road S, Góra Krzyżowa; 52°57'40"N, 18°35'40"E; **9** – road S, Góra Krzyżowa; 52°57'50"N, 18°35'50"E; **10** – Droga Wudecka, dry lake; 52°57'30"N, 18°35'30"E; **11** – Góra Sypka – E; 52°58'30"N, 18°35'20"E; **12** – Góra Partyzantów, Góra Bodnara; 52°57'00"N, 18°35'00"E; **13** – field of fire Kijewo – N; 52°54'10"N, 18°35'20"E; **14** – Góra Żymierskiego – N, bunker and the ruins of buildings; 52°57'20"N, 18°34'05"E; **15** – Góra Krzywoustego – slope S; 52°56'50"N, 18°34'20"E; **16** – Góra Orla; 52°56'00"N – 52°55'45"N, 18°35'50"E – 18°35'30"E; **17** – Góra Taras – slope S; 52°55'50"N, 18°38'20"E; **18** – Góra Zegarek; 52°56'25"N, 18°38'20"E; **19** – Góra Bombowiec – slope S; 52°56'40"N, 18°39'20"E; **20** – by the roadside Warszawska; 52°57'15"N, 18°37'45"E; **21** – Góra Rezerwat; 52°54'05"N, 18°36'05"E; **22** – Góra Pieczenia; 52°54'05"N, 18°37'10"E; **23** – Góra Pieczenia in the direction of the road Służewska; 52°53'35"N, 18°37'15"E; **24** – by the roadside Służewskiej; 52°53'25"N, 18°37'25"E; **25** – Góra Czarniecki, Góra Ucho, Góra Warszawska – slope S; 52°57'51"N – 52°56'55"N, 18°37'00"E – 18°37'30"E; **26** – Piaski; 52°59'00"N, 18°38'20"E; **27** – Góra Dziwak; 52°57'20"N, 18°36'40"E; **28** – Góra Wiesława; 52°58'10"N, 18°36'30"E; **29** – Droga Wudecka – barrier; 52°55'30"N, 18°35'10"E; **30** – Stare Grabie – gravel pit; 52°55'30"N, 18°35'00"E; **31** – Maciejewo; 52°52'40"N, 18°36'40"E; **32** – Road to Otloczyn; 52°55'00"N, 18°41'50"E; **33** – Otloczyn railway station; 52°55'00"N, 18°41'50"E.

4. Results and discussion

A total of 96 lichen taxa and 4 species of lichenicolous fungi were identified in the artillery range near the city of Toruń. The list of lichen species includes taxa, the identification of which is certain: *Cladonia* cf. *pyxidata* subsp. *po-cillum*, *Peltigera* cf. *polydactylon* and taxa identified to the genus level: *Lepraria* sp. Furthermore, e.g. specimens of *Candelaria concolor* (Dick.) Stein s.l. were not collected, so there is no certainty that they included recently described specimens of *C. pacifica* M. Westb. & Arup (Westberg & Arup, 2011). No subspecies were distinguished within the species *Cladonia uncialis* (subsp. *uncialis* and *biuncialis*), because the species was not collected from all sites.

For comparison, Gilbert (2000) reported the occurrence of ca. 150 taxa of lichens during lichenological studies conducted in military areas of Great Britain. His paper, however, dealt mainly with epilithic species growing on a military airport apron. The author reports also epigeic species found on spreads of gritty soil, including species from the genus *Cladonia*, but also *Collema tenax*, *Leptogium gelatinosum* and *Catapyrenium sguamulosum* (cf. Ceynowa-Gieldon et al., 2004). *Cladonia furcata* and *C. rangi-*

formis (Gilbert, 2000) occurred in large numbers near the edge of the airport apron.

During mycological and lichenological investigations in 7 former Soviet military forest divisions, Motiejūnaitė (1996) identified over two times more taxa than reported from the military training ground near Toruń – 204 species of lichenized, lichenicolous and resinicolous fungi. Similarly to the training ground near Toruń, Motiejūnaitė's list included epigeic taxa, as well as taxa growing on the wood, bark of trees and rock substrates.

When conducting lichenological studies in Žemaitija National Park (Lithuania), the author reported 273 taxa, including 113 taxa from the military areas (Motiejūnaitė, 2007).

Dingová & Pišút (2010) report sites of *Cladonia glauca* found in the military area Kotlina (SW Slovakia) on sandy soil.

Out of the total number of species found on the military training ground near Toruń, 16 species are on the Red List of threatened lichens in Poland (Cieśliński et al., 2006) (Table 1), including: 1 Critically Endangered (CR) – *B. subcana*; 3 Endangered (EN) – *Physconia distorta*, *Ramalina fraxinea*, *Tuckermanopsis sepincola*; 9 Vulnerable (VU) – *Bryoria fuscescens*, *Cetraria islandica*, *Peltigera canina*, *P. polydactylon*, *P. praetextata*, *Ramalina farinacea*, *Stereocaulon condensatum*, *Tuckermanopsis chlorophylla*, *U. hirta*; 2 Near Threatened (NT) – *Evernia prunastri*, *Hypogymnia tubulosa* and 1 species Least Concern (LC) – *Phaeophyscia sciastra*.

Consistent with the Regulation of the Minister of the Environment on the wild species of fungi in Poland from 2014 (Regulation, 2014), 17 taxa are protected (Table 2), including 4 strictly protected taxa: *Bryoria subcana*, *Peltigera praetextata*, *Ramalina fraxinea*, *Tuckermanopsis sepincola* and 13 partially protected: *Bryoria fuscescens*, *Cetraria islandica*, *Cladonia arbuscula*, *C. ciliata*, *C. portentosa*, *C. rangiferina*, *Hypogymnia tubulosa*, *Peltigera canina*, *P. polydactylon*, *Ramalina farinacea*, *Stereocaulon condensatum*, *Tuckermanopsis chlorophylla*, *Usnea hirta*.

For comparison, out of 66 lichen species identified in the area of the planned nature reserve "Diabelskie Pustacie" used by the army (Ciaciura et al., 2006) and located in the commune of Borne Sulino, nine species are on the list of threatened lichens in Poland, i.e.: *Bryoria subcana*, *Pycnothelia papillaria*, *Usnea hirta*, *U. subfloridana*, *Tuckermanopsis chlorophylla*, *Cetraria islandica*, *Peltigera canina*, *Hypogymnia tubulosa* and *Vulpicida pinastri*.

A total of 36 epigeic lichen species were found on the military training ground near Toruń, as well as 34 taxa of epiphytes, 19 species of lichens on concrete constructions (walls of shelters and bunkers) and 13 species on the wood. Twenty five species of epigeic lichens occurred on heaths, including abundant occurrence of species from the genus *Cladonia*. *Stereocaulon condensatum* occurred

in large numbers with well-developed thalli and apothecia. Whereas Ciaciura et al. (2006) reported 32 epigeic species (nearly half of the lichen taxa identified in the study area), including mostly taxa from the genus *Cladonia*. Those taxa, similarly to taxa from the Toruń training ground, occurred in large numbers in deforested areas, on heaths, and contrary to Toruń – also in open pine forests and occasionally on peat bogs.

A total of 33 epiphytic lichens were found in the area of the planned nature reserve “Diabelskie Pustacie”; they occurred in pine forests encroaching on heathlands and peat bogs (Ciaciura et al., 2006). Epiphytic lichens from the training ground near Toruń occurred on the bark of roadside trees.

Corniculario-Corynephoretum is one of the most common associations identified on the military training ground in Toruń, dominated by e.g. *Cetraria aculeata*, *Cladonia foliacea*, *Cladonia macilenta* and *C. verticillata*. A total of 30 lichen species were identified in the association *Arctostaphylo-Callunetum* – the species-richest association occurring in the central part of the Toruń training ground, on dune slopes and flat areas. Taxa from the genus *Cladonia* dominate, including mainly: *Cladonia arbuscula* s.l., *C. cervicornis*, *C. coccifera*, *C. cornuta*, *C. deformis*, *C. furcata*, *C. gracilis*, *C. macilenta*, *C. portentosa*, as well as *C. subulata* and *Stereocaulon condensatum*. *Cladonia cariosa*, *C. cenotea*, *Baeomyces rufus* and *Trapeliopsis granulosa* (cf. Gugnacka-Fiedor & Adamska, 2010) occur less frequently. A similar species composition is reported by Adamska (2010) from Zadroże Dune located in the vicinity of the military ground and from the area of Toruń city (Adamska, 2013, 2014).

Scientific research and protection measures aimed at preservation of valuable habitats are largely hampered in areas used by the army. Krenz et al. (2013) describe the impact of the military use on the preservation of dry heaths based on the example of SAC Colbitz-Letzlinger Heide in Germany.

Also Ciaciura et al. (2006) emphasize the necessity of implementing the active protection which prevents the secondary succession in phytocoenoses of heaths and grasslands.

The following abbreviations are used: * – names of lichenicolous fungi, on the bark of: Bp – *Betula pendula*, Cv – *Calluna vulgaris*, Fe – *Fraxinus excelsior*, Ps – *Pinus sylvestris*, Po – *Populus* ssp., Pt – *Populus tremula*, Rp – *Robinia pseudoacacia*, Qr – *Quercus robur*, So – *Salix* ssp.; 1–33 – number of localities.

List of species

1. *Athallia holocarpa* (Hoffm.) Arup, Frödén & Søchting [*Caloplaca holocarpa* (Hoffm.) A. E. Wade] – on concrete; 7, 10, 14.
2. **Athelia arachnoidea* (Berk.) Jülich – on *Lecanora conizaeoides*; 6, 8, 9, 11, 19, 21, 25, 26, 32.
3. *Baeomyces rufus* (Huds.) Rebert. – on soil, on psammophilous grasslands and heathlands; 17.
4. *Bryoria fuscescens* (Gyeln.) Brodo & D. Hawksw. – Bp, on wood; 6, 17, 29.
5. *Bryoria subcana* (Stizenb.) Brodo & D. Hawksw. – on wood; 30.
6. *Buellia griseovirens* (Sm.) Almb. – Bp, Qr, on wood; 17, 29.
7. *Buellia punctata* (Hoffm.) A. Massal. – Bp, Pt; 17, 29, 31.
8. *Calogaya decipiens* (Arnold) Arup, Frödén & Søchting [*Caloplaca decipiens* (Arnold) Blomb. & Forss.] – on concrete; 7.
9. *Calogaya pusilla* (A. Massal.) Arup, Frödén & Søchting [*Caloplaca pusilla* (A. Massal.) Zahlbr.] – on concrete; 7.
10. *Candelaria concolor* (Dickson) B. Stein s.l. – Rp; 30.
11. *Candelariella aurella* (Hoffm.) Zahlbr. – on concrete; 7, 10, 14.
12. *Cetraria aculeata* (Schreb.) Fr. – on soil, on psammophilous grasslands; 1–6, 8, 11, 17–19, 25–28, 30.
13. *Cetraria islandica* (L.) Ach. – on soil, on psammophilous grasslands and heathlands; 1, 3, 4, 8, 11, 19, 26, 28.
14. *Circinaria calcarea* (L.) A. Nordin, S. Savić & Tibell – on concrete; 14.
15. *Cladonia arbuscula* (Wallr.) Flot. subsp. *beringiana* Ahti [*C. arbuscula* subsp. *squarrosa* (Wallr.) Ruoss] – on soil, on heathlands; 2, 4, 8, 17, 19, 25, 26, 28.
16. *Cladonia arbuscula* subsp. *mitis* (Sandst.) Ruoss – on soil, on heathlands; 1–3, 6, 8, 11, 14–21, 25–28.
17. *Cladonia cariosa* (Ach.) Spreng. – on soil, on psammophilous grasslands and heathlands; 6.
18. *Cladonia cenotea* (Ach.) Schaer. – on soil, on psammophilous grasslands and heathlands; 19.
19. *Cladonia cervicornis* (Ach.) Flot. – on soil, on psammophilous grasslands and heathlands; 1–4, 6, 10–12, 14, 18–20, 26.
20. *Cladonia chlorophaea* (Sommerf.) Spreng. s.l. – on soil, on heathlands; 2, 10, 11, 13–16, 26, 28.
21. *Cladonia ciliata* Stirt. – on soil; 26.
22. *Cladonia coccifera* (L.) Willd. – on soil, on psammophilous grasslands and heathlands; 4, 5, 14, 16, 17, 20, 21.
23. *Cladonia coniocraea* (Flörke) Spreng. – Bp, Ps, on wood; 2, 4, 11, 13, 14, 28, 29.

24. *Cladonia cornuta* (L.) Hoffm. – on soil, on psammophilous grasslands and heathlands; 1–6, 8, 10, 15–17, 19–22, 26, 28–30, 32.
25. *Cladonia crispata* (Ach.) Flot. – on soil, on psammophilous grasslands and heathlands; 4.
26. *Cladonia deformis* (L.) Hoffm. – on soil, on heathlands; 1, 6, 13, 17, 21, 27.
27. *Cladonia digitata* (L.) Hoffm. – Bp, Ps, on wood; 2, 11, 14, 29.
28. *Cladonia fimbriata* (L.) Fr. – on soil, on psammophilous grasslands and heathlands; 1, 2, 4, 10, 11, 14, 16, 20, 26, 30.
29. *Cladonia floerkeana* (Fr.) Flörke [*C. macilenta* subsp. *floerkeana* (Fr.) V. Wirth] – on soil, on psammophilous grasslands and heathlands; 5, 10, 11, 14, 17, 21, 26, 28.
30. *Cladonia foliacea* (Huds.) Willd. – on soil, on psammophilous grasslands; 1, 2, 4, 5, 10–12, 14, 26, 29.
31. *Cladonia furcata* (Huds.) Schrad. subsp. *furcata* – on soil, on psammophilous grasslands and heathlands; 1, 2, 5, 6, 11, 12, 14, 17, 19–21, 26, 29, 30, 32.
32. *Cladonia glauca* Flörke – on soil, on psammophilous grasslands and heathlands; 4, 28.
33. *Cladonia gracilis* (L.) Willd. – on soil, on psammophilous grasslands and heathlands; 1, 2, 4–6, 10, 11, 12, 14, 17, 19, 20, 21, 26, 29.
34. *Cladonia macilenta* Hoffm. – on soil, on psammophilous grasslands and heathlands; 1, 2, 3, 4, 5, 6, 8, 10, 11, 14, 16, 19, 20, 26, 27, 28, 29.
35. *Cladonia phyllophora* Hoffm. – on soil, on psammophilous grasslands and heathlands; 1–5, 10, 11, 13, 14, 16, 17, 19, 21, 26–29.
36. *Cladonia pleurota* (Flörke) Schaer. – on soil, on heathlands; 4–6, 10, 11, 14, 17, 19, 21, 26, 29.
37. *Cladonia portentosa* (Dufour) Coem. – on soil, on heathlands; 1, 2, 5, 6, 15, 17, 19, 26, 27, 29.
38. *Cladonia* cf. *pyxidata* subsp. *pocillum* (Ach.) Schaer. – on soil; 4.
39. *Cladonia rangiferina* (L.) F. H. Wigg. – on soil, on psammophilous grasslands; 3, 11.
40. *Cladonia rangiformis* Hoffm. – on soil, on heathlands; 24, 26, 30.
41. *Cladonia squamosa* Hoffm. – on soil, on psammophilous grasslands and heathlands; 1, 6, 17, 28, 29.
42. *Cladonia subulata* (L.) F. H. Wigg. – on soil, on psammophilous grasslands and heathlands; 1, 2, 4–6, 11, 13, 14, 26, 30.
43. *Cladonia uncialis* (L.) F. H. Wigg. – on soil, psammophilous grasslands; 1–6, 8, 10–12, 14–17, 19–21, 25, 26, 28–30, 32.
44. **Chylococcum hypocenomyces* D. Hawksw. – on tallus *Hypocenomyce scalaris*; 29, 30, 31.
45. *Coenogonium pineti* (Schrad. ex Ach.) Lücking & Lumbsch – Ps; 4, 9, 29.
46. *Diploschistes muscorum* (Scop.) R. Sant. – on soil and *Cladonia* sp. squamules; 11, 19, 30, 33.
47. *Evernia prunastri* (L.) Ach. – Bp, Po, Qr, Sa; 4, 11, 29, 30, 31.
48. *Flavoplaca citrina* (Hoffm.) Arup, Frödén & Søchting [*Caloplaca citrina* (Hoffm.) Th. Fr.] – on concrete; 2, 7, 10, 12, 16.
49. *Flavoplaca flavocitrina* (Nyl.) Arup, Frödén & Søchting [*Caloplaca flavocitrina* (Nyl.) A.E. Wade] – on concrete; 7, 12.
50. *Hypocenomyce scalaris* (Ach.) M. Choisy – Bp, Ps, Po, Qr; 4, 8, 9, 20, 29–31.
51. *Hypogymnia physodes* (L.) Nyl. – Bp, Cv, Ps, Qr, on wood, on heathlands; 1–6, 8–12, 14–17, 19–21, 25, 26, 28–32.
52. *Hypogymnia tubulosa* (Schaer.) Hav. – on wood; 30.
53. *Lecania cyrtella* (Ach.) Th. Fr. – Pt; 29, 31.
54. *Lecanora albescens* (Hoffm.) Flörke – on concrete; 7, 10, 12.
55. *Lecanora chlarotera* Nyl. – Po; 31.
56. *Lecanora conizaeoides* Cromb. – Bp, Cv, Ps, Qr, Rp, on wood; 1–32.
57. *Lecanora dispersa* (Pers.) Sommerf. – on concrete; 10, 12.
58. *Lecanora hagenii* (Ach.) Ach. – Bp, Pt; 17, 29, 31.
59. *Lecanora saxicola* (Pollich) Ach. [*L. muralis* (Schreb.) Rabenh., *Protoparmeliopsis muralis* (Schreb.) M. Choisy] – on concrete; 2.
60. *Lecidella stigmatea* (Ach.) Hertel & Leuckert – on concrete; 10, 12.
61. *Lepraria* sp. – Bp, Ps, Po, Qr; 4, 8, 9, 11, 16, 20, 29, 30, 31.
62. **Lichenocodium erodens* M. S. Christ. & D. Hawksw. – on *Hypocenomyce scalaris* tallus, *Hypogymnia physodes* and *Lecanora conizaeoides* apothecia; 4–6, 12, 14, 15, 20, 21, 25, 26, 32.
63. **Lichenocodium lecanorae* (Jaap) D. Hawksw. – on *Lecanora conizaeoides*; 1, 2, 12, 14, 15
64. *Parmelia sulcata* Taylor – Bp, Fr, Po, Pt, Qr, So, on wood; 4, 11, 29, 30, 31.
65. *Parmeliopsis ambigua* (Wulfen) Nyl. – Bp; 11, 12, 29, 31, 32.
66. *Peltigera canina* (L.) Willd. – on soil; 10, 11, 14, 26.
67. *Peltigera* cf. *polydactylon* (Neck.) Hoffm. – on soil; 26.
68. *Peltigera didactyla* (With.) J. R. Laundon – on gravel; 11, 15, 16, 26, 28, 30.
69. *Peltigera praetextata* (Sommerf.) Zopf – on gravel; 26, 30.
70. *Peltigera rufescens* (Weiss) Humb. – on soil; 14, 15, 24, 26, 27, 30, 33.
71. *Pertusaria amara* (Ach.) Nyl. – Qr; 29.
72. *Phaeophyscia nigricans* (Flörke) Moberg – on concrete; 2, 12.

73. *Phaeophyscia orbicularis* (Neck.) Moberg – on concrete; 2, 7, 10, 12, 16.
74. *Phaeophyscia sciastra* (Ach.) Moberg – on concrete; 16.
75. *Phlyctis argena* (Spreng.) Flot. – Pt; 17, 29, 31.
76. *Physcia adscendens* H. Olivier – Fr, Po, Pt; 4, 11, 29, 30, 31.
77. *Physcia caesia* (Hoffm.) Fűrnr. – on concrete; 2, 7, 10, 12, 16.
78. *Physcia tenella* (Scop.) DC. – Po; 31.
79. *Physconia distorta* (With.) J. R. Laundon – Po; 31.
80. *Physconia grisea* (Lam.) Poelt – Po; 31.
81. *Placynthiella icmalea* (Ach.) Coppins & P. James – Bp, Po, Ps, Pt, on soil and wood; 16, 20, 29, 30, 31.
82. *Placynthiella uliginosa* (Schrad.) Coppins & P. James – on soil; 26, 30.
83. *Platismatia glauca* (L.) W.L. Culb. & C. F. Culb. – Bp; 16, 20, 29.
84. *Polycauliona candelaria* (L.) Frödén, Arup & Söchting [*Xanthoria candelaria* (L.) Th. Fr.] – Bp, Po, Pt; 4, 29, 31.
85. *Polycauliona polycarpa* (Hoffm.) Frödén, Arup & Söchting [*Xanthoria polycarpa* (Hoffm.) Rieber] – Bp, Po, Pt; 4, 29, 30, 31.
86. *Pseudevernia furfuracea* (L.) Zopf – Bp, Po, on wood; 4, 20, 29, 30.
87. *Ramalina farinacea* (L.) Ach. – Po; 4, 20, 31.
88. *Ramalina fraxinea* (L.) Ach. – Fr, Po; 4, 31.
89. *Rusavskia elegans* (Link) S. Y. Kondr. & Kärnefelt [*Xanthoria elegans* (Link) Th. Fr.] – on concrete; 2, 7, 10, 12, 16.
90. *Sarcogyne regularis* Körb. – on concrete; 2, 7, 16.
91. *Scoliosporium chlorococcum* (Stenh.) Vězda – Fr, Po, Pt, on wood; 4, 11, 29, 30, 31.
92. *Stereocaulon condensatum* Hoffm. – on soil, on psammophilous grasslands and heathlands; 26.
93. *Trapeliopsis flexuosa* (Fr.) Coppins & P. James – on wood; 4, 16, 29, 30, 31.
94. *Trapeliopsis granulosa* (Hoffm.) Lumbsch – on soil, on psammophilous grasslands and heathlands; 2, 12, 14, 26, 27, 29, 30.
95. *Tuckermanopsis chlorophylla* (Willd.) Hale – Bp; 16, 29.
96. *Tuckermanopsis sepincola* (Ehrh.) Hale – Bp; 6.
97. *Usnea hirta* (L.) F. H. Wigg. – Bp, Po; 4, 29.
98. *Verrucaria muralis* Ach. – on concrete; 2, 7, 10, 12, 16.
99. *Verrucaria nigrescens* Pers. – on concrete; 2, 7, 12, 16.
100. *Xanthoria parietina* (L.) Th. Fr. – Bp, Po, Pt; 4, 29, 31.

Table 1. The lichen species of military area near Toruń included in the red list of threatened lichens in Poland (Cieśliński et al., 2006)

Category of threat	Species	Number of species
CR	<i>Bryoria subcana</i>	1
EN	<i>Physconia distorta</i> , <i>Ramalina fraxinea</i> , <i>Tuckermanopsis sepincola</i>	3
VU	<i>Bryoria fuscescens</i> , <i>Cetraria islandica</i> , <i>Peltigera canina</i> , <i>P. polydactylon</i> , <i>P. praetextata</i> , <i>Ramalina farinacea</i> , <i>Stereocaulon condensatum</i> , <i>Tuckermanopsis chlorophylla</i> , <i>Usnea hirta</i>	9
NT	<i>Evernia prunastri</i> , <i>Hypogymnia tubulosa</i>	2
LC	<i>Phaeophyscia sciastra</i>	1

Explanations: CR – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Near Threatened; LC – Least Concern

Table 2. The list of protected species occurring in military area (Regulation of the Minister of the Environment of 2014).

Status of protection	Species	Number of species
OS	<i>Bryoria subcana</i> , <i>Peltigera praetextata</i> , <i>Ramalina fraxinea</i> , <i>Tuckermanopsis sepincola</i>	4
OC	<i>Bryoria fuscescens</i> , <i>Cetraria islandica</i> , <i>Cladonia arbuscula</i> , <i>C. ciliata</i> , <i>C. portentosa</i> , <i>C. rangiferina</i> , <i>Hypogymnia tubulosa</i> , <i>Peltigera canina</i> , <i>P. polydactylon</i> , <i>Ramalina farinacea</i> , <i>Stereocaulon condensatum</i> , <i>Tuckermanopsis chlorophylla</i> , <i>Usnea hirta</i>	13

Explanations: OS – strictly protected; OC – partially protected

5. Conclusions

As evidenced by the preliminary lichenological studies, the military training ground near Toruń is an interesting area because of the lichens occurring there. Military operations conducted in this area contributed to the preservation of valuable habitats, including mainly heaths and grasslands. Active conservation is recommended to preserve the nature of this place, in particular the abundance of lichens.

Further detailed lichenological studies on the training ground are advisable to obtain full data on the species composition and the distribution of lichens.

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