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ARTYKUŁ ORYGINALNY

Zieleń miejska Gdyni jako środowisko występowania parazytoidów z podrodziny Pimplinae (Hymenoptera, Ichneumonidae)

Urban greenery of Gdynia as a habitat for parasitoids of the subfamily Pimplinae (Hymenoptera, Ichneumonidae)

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Streszczenie

Zieleń miejska charakteryzuje się dużym zagęszczeniem i różnorodnością gatunkową rosnących tam roślin. W związku z tym jest środowiskiem występowania różnych grup owadów, m.in. szkodników i entomofagów. Celem badań było ustalenie składu gatunkowego i liczebności parazytoidów z podrodziny Pimplinae zasiedlających tereny zieleni miejskiej. Badania prowadzono w latach 2009–2016 w Gdyni. Zastosowano metodę czerpakowania i zbierania martwych owadów z plaży. Zgromadzono 442 osobniki należące do 45 gatunków Pimplinae. Stanowiły one 66,18% gatunków wykazach z tego środowiska i 32,61% gatunków stwierdzonych w Polsce. Dominowały następujące gatunki: *Tromatobia lineatoria* (14,26%), *Scambus inanis* (10,41%), *Zaglyptus varipes* (7,92%), *Tromatobia ovivora* (7,70%), *Acropimpla pictipes* (6,57%), *Scambus calobatus* (5,43%) i *Gregopimpla inquisitor* (5,21%). Wśród parazytoidów wyróżniono trzy grupy troficzne, do których należały parazytoidy fitofagów, Arachnida i Aculeata. Najliczniejszymi były parazytoidy fitofagów [34 gatunki (75,55%)].

Słowa kluczowe: Pimplinae, Ichneumonidae, parazytoidy, zieleń miejska, Gdynia

Abstract

Urban greenery is defined by the high density and species diversity of plants. As such, it is a habitat for various groups of insects, including pests and insectivores. This study aims to determine the species composition and abundance of parasitoids of the subfamily Pimplinae in urban green spaces. The study was conducted between 2009 and 2016 in Gdynia. Sweep-net sampling and collecting dead insects from the beach were used. A total of 442 specimens belonging to 45 species of Pimplinae were collected. They represented 66.18% of the species listed in this habitat and 32.61% of the species found in Poland. The dominant species included *Tromatobia lineatoria* (14.26%), *Scambus inanis* (10.41%), *Zaglyptus varipes* (7.92%), *Tromatobia ovivora* (7.70%), *Acropimpla pictipes* (6.57%), *Scambus calobatus* (5.43%) and *Gregopimpla inquisitor* (5.21%). Three trophic groups were distinguished among the parasitoids, including parasitoids of phytophagous insects, i.e. Arachnida and Aculeata. Parasitoids of phytophagous insects were the most abundant [34 species (75.55%)].

Key words: Pimplinae, Ichneumonidae, parasitoids, urban greenery, Gdynia

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Wstęp / Introduction

Urban greenery is an essential structural element of a city's biocoenosis as it fulfils many social and ecological functions. Urban green vegetation, such as parks or gardens, fundamentally enriches the agglomeration's biocoenosis. It is defined by the high density and species diversity of plants. As such, it can perform the very important natural function of preserving the diversity of flora and fauna in this habitat (Beatley 2000; Robinson and Lundholm 2012; Milanowska and Janicka 2016). Therefore, urban green spaces provide environmental conditions conducive to the development of various groups of animals, including insects. These include phytophagous insects that, when feeding, impair the health of the plants. Beneficial insects, including entomophages, can also thrive in this habitat. These include parasitoids of the family Ichneumonidae (Hymenoptera, Apocrita), which reduce the abundance of plant pests. One of the subfamilies of this family is the Pimplinae, which are among the dominant subfamilies in among others agrocoenoses or orchard habitats (Piekarska-Boniecka et al. 2015, 2018). These entomophages represent ecto- and endoparasitoids of the eggs, larvae and pupae of many phytophagous species belonging to the orders Lepidoptera, Coleoptera, Hymenoptera and Diptera (Gauld et al. 2002; Yu 2012).

As chemical plant protection in the city is difficult and sometimes impossible due to the presence of humans and animals, research was undertaken on parasitoids of the subfamily Pimplinae found in urban greenery.

This study aims to determine the species composition and abundance of parasitoids of the subfamily Pimplinae in urban green spaces.

Materiały i metody / Materials and methods

The study was carried out between 2009 and 2016 in the urban greenery of the city of Gdynia (54°31'08''N 18°31'54''E). Insects were caught and collected at three sites: Kępa Redłowska (KR), Arka Tennis Club (ATC) and Redłowska Clearing (RC) (fig. 1).

Rys. 1. Lokalizacja stanowisk badawczych w terenach zieleni miejskiej w Gdyni (KRR – Kępa Redłowska, ATC – Arka Tennis Club, RC – Redłowska Clearing)

Fig. 1. Location of research sites in urban green areas in Gdynia (KRR – the Kępa Redłowska, ATC – the Arka Tennis Club, RC – the Redłowska Clearing)

Kępa Redłowska (KR) – its western and northern parts include urban areas, while the eastern part is a landscape reserve established in 1938 to protect, among other things, the cliffed coast with a living cliff. The lower part of the cliff contains deciduous trees, mainly *Robinia pseudoacacia*, *Acer platanoidea*, *Fagus sylvatica*, *Alnus glutinosa* and *Betula pendula*. The beach, located under a landslide cliff, sits on the reserve's eastern boundary.

Arka Tennis Club (ATC) – the Club's grounds are surrounded on three sides by a deciduous forest with an admixture of pine trees. Clay courts were built on the former stadium. The slopes of the stadium are covered with trees and shrubs, mainly *Betula pendula*, *Populus tremula*, *Acer platanoides*, *Tilia cordata*, *Quercus* spp., *Corylus avellana*, *Hippophae rhamnoides*, *Salix* spp., *Sambucus nigra*, *Rosa canina* and *Cytisus scoparius*. Part of the former stadium is covered with ruderal vegetation, and a wet meadow has developed on the former training pitch. The ruderal vegetation consists of *Ononis repens*, *Trifolium repens*, *Melilotus albus*, *Lotus* spp., *Medicago* spp., *Daucus carota*, *Echium vulgare*, *Convolvulus arvensis*, *Linaria arvensis*, *Helichrysum arenarium*, *Berteroa incant*, *Hypericum* spp., *Tragopogon pratensis*, *Bellis perennis*, *Taraxacum officinale*, *Cirsium avense*, *Tanacetum vulgare*, *Solidago virgaurea*, *Solidago canadensis*, *Achillea millefolium* and *Hieracium umbellatum*.

Redłowska Clearing (RC) – is an erosion valley which slopes are overgrown by deciduous forest with *Fagus sylvatica* and its bottom with *Cornus sericea*. The northern part of the clearing has an undeveloped area covered with ruderal vegetation, and reeds have grown in the depression. The ruderal vegetation includes *Melilotus albus*, *Melilotus officinalis*, *Trifolium repens*, *Astragalus glycyphyllos*, *Ononis repens*, *Cytisus scoparius*, *Echium* spp., *Daucus carota*, *Tanacetum vulgare*, *Erigeron canadensis*, *Solidago canadensis*, *Cirsium arvense* and *Urtica dioica* (Lis and Kowalczyk 2017).

Hymenoptera specimens were sampled using sweep-netting. This method was used because the research was carried out in different time intervals and years. Furthermore, the study primarily aimed to determine the species composition of parasitic Hymenoptera found in urban greenery and this method, in the authors' opinion, was the most suitable. In addition, insects washed up on the beach were collected. Sweep-net sampling was performed weekly from June to September, between 12.00 p.m. and 2.00 p.m. Insects were mainly collected from tree and shrub leaves and ruderal vegetation. Targeted sweep-netting was carried out at heights ranging from 50 cm to 15 m, depending on the height of the plants. Insects were collected from the beach three times a week from September to November, between 12.00 p.m. and 2.00 p.m. The dead insects were gathered at random. At the Kępa Redłowska (KR) site, the study was conducted between 2009 and 2016, and insects washed up on the beach were collected. The studies were conducted at the Arka Tennis Club (ATC) site in 2014–2015 and at the Redłowska Clearing (RC) site in 2015. Sweep-net sampling was employed at both locations.

The collected biological material was stored in a 75% ethanol solution denatured with methanol in test tubes.

Hymenoptera species were identified according to Kasparyan (1981).

Wyniki i dyskusja / Results and discussion

Between 2009 and 2016, 442 parasitoids were collected in the urban greenery of Gdynia. The abundance of these entomophages was not analysed because the insects were caught using different methods and in different years. The Kępa Redłowska (KR) site was studied for seven years, the Arka Tennis Club (ATC) site for two years and the Redłowska Clearing (RC) site for a year.

Forty-five species of parasitoids of the subfamily Pimplinae were found (tab. 1). They accounted for 66.18% of Pimplinae species reported from this habitat in Poland and 32.61% of species found in Poland (Bogdanowicz et al. 2007). An earlier study by Sawoniewicz (1982) of the urban greenery of Warsaw showed a greater species diversity of this subfamily, as 68 species were found there. Lower species diversity of these parasitoids than the one in the present study was demonstrated in urban green areas in Wielkopolska, as 36 species were caught in Poznań (Piekarska-Boniecka 2004) and 31 in Kórnik (Piekarska-Boniecka et al. 2009a).

The dominant species in the urban greenery of Gdynia included the following seven species: *Tromatobia lineatoria* (S39) (14.26%), *Scambus inanis* (S34) (10.41%), *Zaglyptus varipes* (S43) (7.92%), *Tromatobia ovivora* (S41) (7.70%), *Acropimpla pictipes* (S1) (6.57%), *Scambus calobatus* (S33) (5.43%) and *Gregopimpla inquisitor* (S13) (5.21%) (tab. 1). Species of the genera *Tromatobia* and *Zaglyptus varipes* are ectoparasitoids of Arachnida egg deposits. Species of the genera *Scambus*, *Acropimpla pictipes* and *Gregopimpla inquisitor* are larval ectoparasitoids of the orders Lepidoptera, Coleoptera and Hymenoptera (Yu 2012). Previous research on parasitoids of green areas in Wielkopolska urban agglomerations did not indicate the dominance of these species (Piekarska-Boniecka et al. 2009a; Rzańska et al. 2015; Rzańska and Piekarska-Boniecka 2016). Piekarska-Boniecka et al. (2009a), Rzańska et al. (2015) and Rzańska and Piekarska-Boniecka (2016) demonstrated the dominance of the species *Itoplectis alternans*, *Itoplectis maculator* and *Pimpla contemplator*. The results of the present study only confirmed the presence of these entomophages in the urban green environment of Gdynia but did not show their high abundance.

Among the species dominating the urban greenery of Gdynia, four species reduce the abundance of plant pests feeding in this habitat, while the remaining three regulate the abundance of Arachnida in urban green areas. Plant

Tabela 1. Wykaz gatunków, liczba osobników (N) i indeks dominacji (D) zgrupowań Pimplinae występujących w zieleni miejskiej w Gdyni w latach 2009–2016

Table 1. The list of species, the number of specimens (N) and the dominance index (D) of Pimplinae communities in the Gdynia urban green areas in 2009–2016

	Gatunek Species	Sites – Stanowiska							
		Rezerwat Kępa Redłowska Kępa Redłowska Reserve (KRR)		Klub Tenisowy Arka Arka Tennis Club (ATC)		Polanka Redłowska Redłowska Clearing (RC)		ogółem total	
		N	D	N	D	N	D	N	D
S1	*Acropimpla pictipes* (Gravenhorst, 1829)	28	9.53%	1	0.76%	–	–	29	6.57%
S2	*Apechthis quadridentata* (Thomson, 1877)	6	2.03%	2	1.52%	–	–	8	1.71%
S3	*Apechthis rufata* (Gmelin, 1790)	6	2.03%	–	–	–	–	6	1.36%
S4	*Dolichomitus curticornis* (Perkins, 1943)	–	–	–	–	1	6.25%	1	0.23%
S5	*Dolichomitus mesocentrus* (Gravenhorst, 1829)	4	1.36%	–	–	1	6.25%	5	1.14%
S6	*Dolichomitus messor* (Gravenhorst, 1829)	–	–	3	2.28%	–	–	3	0.68%
S7	*Dolichomitus tuberculatus* (Fourcroy, 1785)	–	–	1	0.76%	–	–	1	0.23%
S8	*Endromopoda detrita* (Holmgren, 1860)	–	–	17	12.79%	2	12.50%	19	4.30%
S9	*Endromopoda nitida* (Brauns, 1898)	–	–	–	–	7	43.75%	7	1.59%
S10	*Ephialtes manifestator* (Linnaeus, 1758)	1	0.34%	–	–	–	–	1	0.23%
S11	*Fredegunda diluta* (Ratzeburg, 1852)	2	0.68%	–	–	–	–	2	0.46%
S12	*Gregopimpla bernuthii* (Hartig, 1838)	–	–	2	1.52%	–	–	2	0.46%
S13	*Gregopimpla inquisitor* (Scopoli, 1763)	23	7.83%	–	–	–	–	23	5.21%
S14	*Itoplectis alternans* (Gravenhorst, 1829)	17	5.79%	3	2.28%	–	–	20	4.53%
S15	*Itoplectis maculator* (Fabricius, 1775)	1	0.34%	–	–	–	–	1	0.23%
S16	*Itoplectis tunetana* (Schmiedeknecht, 1914)	5	1.69%	–	–	–	–	5	1.14%
S17	*Liotryphon caudatus* (Ratzeburg, 1848)	9	3.07%	–	–	–	–	9	1.94%
S18	*Liotryphon crassiseta* (Thomson, 1877)	6	2.03%	1	0.76%	–	–	7	1.59%
S19	*Liotryphon cydiae* (Perkins, 1942)	1	0.34%	–	–	–	–	1	0.23%
S20	*Liotryphon punctulatus* (Ratzeburg, 1848)	18	6.13%	–	–	–	–	18	4.07%
S21	*Perithous divinator* (Rossi, 1790)	1	0.34%	1	0.76%	–	–	2	0.46%
S22	*Pimpla contemplator* (Mueller, 1776)	–	–	5	3.79%	2	12.50%	7	1.59%
S23	*Pimpla flavicoxis* (Thomson, 1877)	1	0.34%	–	–	–	–	1	0.23%
S24	*Pimpla insignatoria* (Gravenhorst, 1807)	–	–	1	0.76%	–	–	1	0.23%
S25	*Pimpla melanacrias* (Perkins, 1941)	–	–	2	1.52%	–	–	2	0.46%
S26	*Pimpla rufipes* (Miller, 1759)	–	–	3	2.28%	–	–	3	0.68%
S27	*Polysphincta boops* (Tschek, 1869)	3	1.02%	1	0.76%	–	–	4	0.91%
S28	*Polysphincta rufipes* (Gravenhorst, 1829)	–	–	1	0.76%	–	–	1	0.23%
S29	*Polysphincta tuberosa* (Gravenhorst, 1829)	1	0.34%	–	–	–	–	1	0.23%
S30	*Pseudorhyssa nigricornis* (Ratzeburg, 1852)	–	–	1	0.76%	–	–	1	0.23%
S31	*Scambus brevicornis* (Gravenhorst, 1829)	–	–	5	3.79%	–	–	5	1.14%
S32	*Scambus buolianae* (Hartig, 1838)	1	0.34%	5	3.79%	–	–	6	1.36%
S33	*Scambus calobatus* (Gravenhorst, 1829)	23	7.83%	1	0.76%	–	–	24	5.43%
S34	*Scambus inanis* (Schrank, 1802)	32	10.89%	14	10.56%	–	–	46	10.41%
S35	*Scambus nigricans* (Thomson, 1877)	1	0.34%	13	9.90%	2	12.50%	16	3.62%
S36	*Scambus planatus* (Hartig, 1838)	1	0.34%	5	3.79%	–	–	6	1.36%
S37	*Scambus sagax* (Hartig, 1838)	3	1.02%	–	–	–	–	3	0.68%
S38	*Theronia atalantae* (Poda, 1761)	–	–	1	0.76%	–	–	1	0.23%
S39	*Tromatobia lineatoria* (Villers, 1789)	61	20.75%	2	1.52%	–	–	63	14.26%

Tabela 1. Wykaz gatunków, liczba osobników (N) i indeks dominacji (D) zgrupowań Pimplinae występujących w zieleni miejskiej w Gdyni w latach 2009–2016 – cd.

Table 1. The list of species, the number of specimens (N) and the dominance index (D) of Pimplinae communities in the Gdynia urban green areas in 2009–2016 – continued

Gatunek Species		Sites – Stanowiska							
		Rezerwat Kępa Redłowska Kępa Redłowska Reserve (KRR)		Klub Tenisowy Arka Arka Tennis Club (ATC)		Polanka Redłowska Redłowska Clearing (RC)		ogółem total	
		N	D	N	D	N	D	N	D
S40	*Tromatobia ornata* (Gravenhorst, 1829)	–	–	2	1.52%	–	–	2	0.46%
S41	*Tromatobia ovivora* (Boheman, 1821)	29	9.87%	5	3.79%	–	–	34	7.70%
S42	*Zaglyptus multicolor* (Gravenhorst, 1826)	6	2.03%	–	–	1	6.25%	7	1.59%
S43	*Zaglyptus varipes* (Gravenhorst, 1829)	2	0.68%	33	25.00%	–	–	35	7.92%
S44	*Zatypota discolor* (Holmgren, 1860)	1	0.34%	–	–	–	–	1	0.23%
S45	*Zatypota percontatoria* (Mueller, 1776)	1	0.34%	1	0.76%	–	–	2	0.46%
Łączna liczba osobników Total number of specimens		294	100%	132	100%	16	100%	442	100%
Łączna liczba gatunków Total number of species		30		27		7		45	

pests likely found on the trees and shrubs that make up urban vegetation and are also shown to be hosts for the dominant species indicated in this study include *Hyphantria cunea* (Dr.), *Operophtera brumata* (L.), *Gracilaria syringella* (F.), *Phyllonorycter salictella* (Zell.), *Malacosoma neustria* (L.), *Leucoma salicis* (L.), *Lymantria disbar* (L.), *Lymantria monacha* (L.), *Orgyia antiqua* (L.), *Adoxophyes orana* (F. v. R.), *Archips rosana* (L.), *Archips xylosteana* (L.), *Hedya nubiferana* (Haw.), *Hedya variegana* (Hbn.), *Pandemis cerasana* (Hbn.), *Rhyacionia buoliana* (Denis & Schiff.), *Spilonota ocellana* (Denis & Schiff.), *Yponomeuta cognatella* (Hbn.) (Lepidoptera), *Apoderus coryli* (L.), *Balaninus glandium* (Marsh.), *Balaninus nucum* (L.) (Coleoptera), *Biorhiza pallida* (Ol.), *Gilpinia frutetorum* (F.), *Neodiprion sertifer* (Geoffr.), *Pontania proximal* (Lepel.) and *Tenthredo salicis* L. (Hymenoptera) (Yu 2012).

Analysis of the host stages parasitised by the parasitoid species identified in the urban greenery of Gdynia revealed three groups of entomophages. These included larval ectoparasitoids, pupal endoparasitoids and Arachnida ectoparasitoids. Larval ectoparasitoids predominated [25 species (55.55%)], while the number of species in the other groups was lower and equal at the same time [10 species each (22.22%)].

Analysis of the trophic relationships of the parasitoid species found in the urban greenery of Gdynia clearly shows that parasitoids of phytophagous insects predominated [34 species (75.55%)]. The second group was made up of Arachnida parasitoids (10 species (22.22%)]. Only one species, i.e. *Perithous divinator*, represented the *Aculeata parasitoids* (2.22%). Plant pest parasitoids included *Acropimpla pictipes*, *Ephialtes manifestator*, *Theronia atalantae* and species of the genera *Apechtis*, *Dolichomitus*, *Itoplectis*, *Endromopoda*, *Liotryphon*, *Pimpla* and *Scambus*. Arachnida parasitoids are species of the genera *Tromatobia*, *Zaglyptus* and *Zatypota*. This study confirmed the dominance of plant pest entomophages and the abundance of Arachnida parasitoids in urban greenery, as previous research by Piekarska-Boniecka et al. (2009b), Rzańska et al. (2014, 2015) and Rzańska and Piekarska-Boniecka (2016) found the dominance of these entomophages in this habitat.

The following species of Pimplinae were recorded for the first time in Polish urban green areas: *Dolichomitus curticornis*, *Endromopoda nitida*, *Fredegunda diluta*, *Gregopimpla bernuthii*, *Liotryphon cydiae*, *Pseudorhyssa nigricornis*, *Scambus buolianae* and *Scambus sagax*.

Wnioski / Conclusions

1. Green spaces in urban areas are an attractive habitat for parasitoids of the subfamily Pimplinae (Hymenoptera, Ichneumonidae).
2. These entomophages can reduce the abundance of plant pests feeding in this habitat and thus positively affect the health of the trees and shrubs growing there.
3. The composition of the dominant parasitoid species may vary according to the region of the country. Still, parasitoids of phytophagous insects are always the most abundant in the grouping structure of these entomophages.

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