

1. Contestant profile

▪ Contestant name:	Anna Łazuka
▪ Contestant occupation:	student
▪ University / Organisation	University of Silesia, Faculty of Biology and Environmental Protection
▪ Number of people in your team:	4 (including the leader)

2. Project overview

Title:	A comprehensive inventory of entomo- and arachnofauna of Limestone Quarry „Górażdże” with particular emphasis on xerothermic species of auchenorrhynchs, heteropterans, orthopterans, coleopterans, lepidopterans and arachnids.
Contest: (Research/Community)	Research
Quarry name:	Limestone Quarry “Górażdże”

A comprehensive inventory of entomo- and arachnofauna of Limestone Quarry „Górażdże” with particular emphasis on xerothermic species of auchenorhynchans, heteropterans, orthopterans, coleopterans, lepidopterans and arachnids.

Project leader:

Anna Łazuka¹

660688222
dragonia@onet.eu

Other researchers:

Dr inż. Marcin Walczak¹
Dr Artur Taszakowski
Mgr Krzysztof Broda²

University of Silesia:

¹Faculty of Biology and Environmental Protection

²Faculty of Earth Sciences

Abstract

The research led within the Góraźdże Limestone Quarry were performed from May to September 2018. The subject of study were two different groups of arthropods: insects and arachnids. 8 study sites were designated, including 2 sites with wetland assemblages, 1 with xerothermic assemblage, 1 with ruderal plant assemblage and 4 with forest assemblages. The result of the study was a comprehensive and detailed faunal inventarisation encompassing 71 different species of insects and 8 species of arachnids. In the gathered material there are also many species rare or new for the region as well as invasive species, which should be covered by continuous monitoring. Xerothermic assemblages should be properly protected, because they are habitat for many valuable species.

Final report

Introduction:

The Limestone Quarry "Górażdże" was the main subject of several faunal inventory projects, including the winning project of The Quarry Life Award 2014 competition entitled „A comprehensive inventory of herpetofauna of the Limestone Quarry "Górażdże", with particular emphasis on rare species, as a basis for the preparation of guidelines for the environmentally friendly rehabilitation" as well as projects focused on protection of fauna, like Quarry Life Award 2016 project entitled "The active protection of the bees together with 3d-nature visualization of Górażdże limestone quarry". However, up until the day of writing the following project report on the area of the chosen quarry there was no comprehensive inventory of insects and other arthropods performed, with exception of the wild bees of course. Within the quarry many different plant species, limestone outcrops and limestone debris occur creating a rich habitat for very diverse insect and arachnid assemblage. The Quarry is inhabited by various arthropods, including members of orders of Orthoptera, Coleoptera, Lepidoptera, suborders of Auchenorrhyncha, Heteroptera and spiders (Araneae) as well as other arachnids (Opiolines). The Orthoptera order (commonly known as "grasshoppers") is characterized by elongated body, two pairs of unequal wings, big, orthognatic head with biting mouth apparatus. Their third pair of appendages is strongly specialized allowing performing long jumps and emitting sounds via stridulation. These insects can be big or medium in size and are distributed globally, but they are the most diverse in subtropics and tropics as they prefer sunny and warm environments. The order of Coleoptera is one of the most numerous among the whole Insecta classis. The coleopterans are characterized by complete metamorphosis, first pair of wing forming massive elytra and biting mouth apparatus with characteristic morphology. These insects are cosmopolitan, they can live in various environments both on land and in fresh water. Butterflies (Lepidoptera) are very diversified and numerous order of cosmopolitan insects. They are characterized by complete metamorphosis and big, colorful and unequal wings. The wing surface is covered by small scales, what derived the orders name. The Auchenorrhyncha is the phylogenetically old Hemiptera suborder with cosmopolitan distribution. They are the most diverse in tropics, but they can be also noted in subpolar areas. Their body is oval in shape and are generally quite small (approx. 10mm in length). Most of their species are fitophagous (they feed on plants juices), what is possible thanks to their proboscis (called rostrum). The heteropterans are an suborder of Hemiptera (bugs) characterized by incomplete metamorphosis, small body size and shortened elytra (hemelytrae). Their use they proboscis both to feed on plants and other insects. Finally, the Arachnids, especially spiders (Araneae) possess the diversified on cephalothorax and abdomen body and eight legs. Mostly they are predators hunting with their sophisticated web.

The Górażdże Quarry was chosen for this investigation because of the fact that the natural habitats of insects and arachnids (such as grasslands) are being transformed for example into crop fields and those animals have found their new habitats inside the quarries. Unfortunately, the xerothermic assemblages are being lost as well, so similar assemblages occurring within the Quarry, shown by the previous research, were investigated in detail.

The main aims of our project were the comprehensive faunal of the species of insects and arachnids living in „Górażdże” Quarry. Basing on the identification of rare and endangered species we were able to propose the protection requirements for the habitats inhabited by those animals according to the proper laws. The results of the investigation may also be used as a base for further educational efforts showing the local community the biodiversity of the quarry.

Methods:

The investigated material was gathered during five days of fieldworks. In the designated during first day sites the animals were caught by sweeping nets. Gathered insects and arachnids were poisoned in so killing jars (a jar with cotton filled with ethyl acetate).

Then, during the laboratory works, the gathered specimens, after the fixation in 70% alcohol, were prepared according to entomological and arachnological methodology with entomological pins and glue boards. Some specimens were preserved in alcohol for further investigations with different specifications.

The specimens were identified basing on scientific literature, and properly described. The database was created and the entomo- and arachanofaunal biodiversity of the Quarry was investigated with statistical methods. Every calculation was performed in Microsoft ExCell, version Microsoft Office 2010. The following figures were created in CorelDRAW v.12 from Corel.

Study areas (sites):

- 1) Reed-bed like assemblage with predominance of *Phragmites australis* and *Schoenoplectus lacustris* [50°32'10"N, 18°01'01"E];
- 2) Ruderal plant assemblage with a predominance of *Calamagrostis epigejos*, partially overgrown by young seedlings of *Populus nigra* [50°32'08"N, 18°01'15"E];
- 3) Xerothermic assemblage of the Festuco-Brometea, classis, partially overgrown by single fruit trees of genus *Prunus* [50°31'58"N, 18°01'15"E];
- 4) Reed-bed like assemblage with predominance of *Phragmites australis*, overgrowing by *Alnus glutinosa* [50°31'54"N, 18°01'24"E];
- 5) Mixed forest with predominance of *Tilia cordata* and *Betula pendula* [50°31'49"N, 18°01'30"E];
- 6) Mixed forest with predominance of *Tilia cordata* and *Betula pendula* [50°31'50"N, 18°01'47"E];
- 7) Mixed forest with predominance of *Tilia cordata* and *Betula pendula* [50°31'49"N, 18°02'07"E];
- 8) Mixed forest with predominance of *Tilia cordata* and *Pinus sylvestris* [50°31'55"N, 18°02'36"E];

Results:

During the research 71 species of insects (930 specimens) and 8 species of arachnids (over 50 specimens) were gathered. Among the insects, according to the number of gathered specimens were two species of ants: *Formica cinerea* and *Lasius niger* (over 200 specimens). However, the highest number of identified species is recognized among fulguromorphans and cicadomorphans. In total 24 species of these insects were gathered (aprox. 130 specimens). The analysis of the scientific sources (Gębicki et al. 2013, Musik et al. 2018) proved the high faunistic value of gathered planthoppers and leafhoppers because as many as 16 species were not noted from the area of Lower Silesia, so they are new for this area. Among them there are species rare in the scale of whole country or even whole Europe as well. Species like *Chloriona unicolor* (Herrich-Schäffer, 1835) and *Zygina schneideri* (Günthardt, 1974) were recognized in Poland for the first time just a few years ago. Among the rare planthoppers and leafhoppers there is also an invasive species *Stictocephala bisonia* Kopp et Yonke, 1977, also new in Polish entomofauna (Świerczewski & Stroiński 2011).

Second in number of species insect group were the butterflies (Lepidoptera). 11 species were gathered, mostly daylight taxa with only few exceptions of night thriving moths.

The next rich in species were the heteropterans counting 10 species (70 specimens). Unfortunately, they are mostly represented by common in Poland taxa.

The next numerous group recognized in the Quarry where the grasshoppers (Orthoptera) – 7 species (over 100 specimens). In the gathered material there were also identified the representatives of some other insect orders such as coleopterans (6 species, more than 100 specimens), dipterans (4 species, and unidentified species), hymenopterans (4 species, and unidentified species), mantises (1 species), mecopterans (1 species), psyllids (1 species). Among the coleopterans, species worth to mention is *Harmonia axyridis* (Pallas, 1773).

The other investigated group were the arachnids. Unfortunately the most of the gathered species were juvenile instars or young females, very hard to identify. The arachnids were mostly gathered on sites 1 and 3. In may the most abundant species was *Tetragnatha montana* (Simon, 1874), but at the end of the summer the most numerous were *Araneus diadematus* Clerck, 1757 and *Pardosa lugubris* (Walckenaer 1802). Only one species of Opliones - *Phalangium opilio* Linnaeus, 1758 was identified.

Tab. 1. List of identified species.

No.	Order	Species	Site
Insecta			
1	Orthoptera	<i>Chorthippus biguttulus</i> ssp. <i>biguttulus</i> (Linnaeus, 1758)	2
2		<i>Chorthippus dorsatus</i> (Zetterstedt, 1821)	3
3		<i>Chorthippus parallelus</i> (Zetterstedt, 1821)	3
4		<i>Conocephalus discolor</i> (Thunberg, 1815)	2
5		<i>Metrioptera roeselii</i> (Hagenbach, 1822)	2
6		<i>Oedipoda coerulescens</i> (Linnaeus, 1758)	1
7		<i>Tettigonia viridissima</i> Linnaeus, 1758	1

8	Mantodea	<i>Mantis religiosa</i> (Linnaeus, 1758)	3	
9	Neuroptera	<i>Chrysoperla carnea</i> (Stephens, 1836)	5	
10	Mecoptera	<i>Panorpa</i> sp.	6	
11	Fulgoromorpha (Aucherrnoryncha)	<i>Chloriona unicolor</i> (Herrich-Schäffer, 1835)	1	
12		<i>Dictyophara europaea</i> (Linnaeus, 1767)	3	
13		<i>Pentastiridius beieri</i> (Wagner, 1970)	2	
14	Cicadomorpha (Aucherrnoryncha)	<i>Aphrophora alni</i> (Fallén, 1805)	5	
15		<i>Arthaldeus pascuellus</i> (Fallén, 1826)	4	
16		<i>Athysanus argentarius</i> Metcalf, 1955	1	
17		<i>Balclutha calamagrostis</i> Ossiannilsson, 1961	2	
18		<i>Cercopis sanguinolenta</i> (Scopoli, 1763)	3	
19		<i>Chlorita paolii</i> (Ossiannilsson, 1939)	3	
20		<i>Errastunus ocellaris</i> (Fallén, 1806)	3	
21		<i>Fieberiella septentrionalis</i> Wagner, 1963	3	
22		<i>Kybos rufescens</i> Melichar, 1896	6	
23		<i>Kybos virgator</i> (Ribaut, 1933)	7	
24		<i>Lepyronia coleoptrata</i> (Linnaeus, 1758)	3	
25		<i>Paramesus major</i> Haupt, 1927	1	
26		<i>Psammotettix alienus</i> (Dahlbom, 1850)	2	
27		<i>Psammotettix poecilus</i> (Flor, 1861)	2	
28		<i>Rhytidodus decimusquartus</i> (Schrank, 1776)	8	
29		<i>Stictocephala bisonia</i> Kopp et Yonke , 1977	1, 2, 3, 5, 6	
30	<i>Stictocoris picturatus</i> (Sahlberg, 1842)	3		
31	<i>Tremulicerus fulgidus</i> (Fabricius, 1775)	2		
32	<i>Turrutus socialis</i> (Flor, 1861)	2		
33	<i>Viridicerus ustulatus</i> (Mulsant et Rey, 1855)	4		
34	<i>Zygina schneideri</i> (Günthardt, 1974)	3		
35	Psylloidea	<i>Psylla alni</i> (Linnaeus, 1758)	4	
36	Heteroptera	<i>Adelphocoris lineolatus</i> (Goeze, 1778)	1	
37		<i>Aelia acuminata</i> (Linnaeus, 1758)	2	
38		<i>Carpocoris purpureipennis</i> (De Geer, 1773)	3	
39		<i>Coriomeris denticulatus</i> (Scopoli, 1763)	2	
40		<i>Cymus</i> sp.	2, 3	
41		<i>Eurygaster testudinaria</i> (Geoffroy, 1785)	2, 4	
42		<i>Graphosoma lineatum</i> ssp. <i>italicum</i> (Müller, 1766)	3	
43		<i>Lygus</i> sp.	3	
44		<i>Rhopalus subrufus</i> (Gmelin, 1790)	5	
45		<i>Stenodema calcarata</i> (Fallén, 1807)	2	
46		Coleoptera	<i>Cantharis fusca</i> Linnaeus, 1758	2, 3
47			<i>Chrysomela populi</i> Linnaeus, 1758	2, 4
48			<i>Cryptocephalus</i> sp.	3
49			<i>Harmonia axyridis</i> (Pallas, 1773)	2, 3
50			<i>Stenurella bifasciata</i> (Muller, 1776)	7, 8
51			<i>Trypocopris vernalis</i> Linnaeus, 1758	4
52	<i>Cantharis fusca</i> Linnaeus, 1758		5, 6	
-	Unidentified members of Curculionoidea family		1, 2, 3, 4, 5	
53	Lepidoptera	<i>Aglais io</i> (Linnaeus, 1758)	2	
54		<i>Aglais urticae</i> (Linnaeus, 1758)	3	
55		<i>Agrostis segetum</i> (Denis & Schiffermüller, 1775)	2	
56		<i>Argynnis paphia</i> (Linnaeus C., 1758)	4	
57		<i>Coenonympha pamphilus</i> (Linnaeus, 1758)	2	
58		<i>Deilephila porcellus</i> (Linnaeus, 1758)	1	
59		<i>Gonepteryx rhamni</i> (Linnaeus, 1758)	2, 3	
60		<i>Melanargia galathea</i> (Linnaeus, 1758)	4	

61		<i>Minoa murinata</i> (Scopoli, 1763)	3
62		<i>Polyommatus icarus</i> (Rottemburg, 1775)	3
63		<i>Zygaena filipendulae</i> (Linnaeus, 1758)	3
64	Diptera	<i>Calliphora vicina</i> (Robineau-Desvoidy, 1863)	3
65		<i>Haematopota pluvialis</i> (Linnaeus, 1758)	1
66		<i>Tipula paludosa</i> Meigen, 1830	1, 4
67		<i>Trypocopris vernalis</i> (Linnaeus, 1758)	5
68	Hymenoptera	<i>Apis mellifera</i> Linnaeus, 1758	2, 3
69		<i>Formica cinerea</i> (Mayr, 1853)	5, 6, 7
70		<i>Lasius niger</i> (Linnaeus, 1758)	6, 8
71		<i>Vespula vulgaris</i> (Linnaeus, 1758)	3
-		Unidentified members of Tenthredinidae family	2, 3, 4
Chelicerata			
72	Opiliones	<i>Phalangium opilio</i> Linnaeus, 1758	1
73	Araneae	<i>Araneus diadematus</i> Clerck, 1757	1, 4, 5
74		<i>Linyphia triangularis</i> (Clerck, 1758)	5
75		<i>Segestria senoculata</i> (Linnaeus, 1758)	7
76		<i>Tetragnatha montana</i> (Simon, 1874)	7
77		<i>Pholcus phalangioides</i> (Fuesslin, 1775)	(in the buildings)
78		<i>Pisaura mirabilis</i> (Clerck, 1758)	7
79		<i>Pardosa lugubris</i> (Walckenaer 1802)	8

Discussion:

The history of invertebrate research, mostly insects, on the area of Silesia and adjacent areas spans more than 210 years (Weigel 1806). The result of such a long research is a quite good but fragmentary stage of knowledge of entomo- and arachnofauna in the region. The results of this project rise the amount of knowledge on many species, with the special emphasis on species rare or new for Lower Silesia faunas. In the presented list there are as many as 16 new rare or new for the area species of leafhoppers and planthoppers. Worth to mention are such species as *Chloriona unicolor* i *Zygina schneideri*, the taxa recognized in Poland just a few years ago. *Ch. unicolor* is a monophag living on *Phragmites australis* for the first time met in Poland in 2008 and known only from 4 localities. Similar value for the insect research has *Z. schneideri*. Among other very interesting species there is *Mantis religiosa* encountered on the site 3. Only one specimen has been found – an adult male. This is an protected species, so its presence in the Quarry has to be confirmed in the future. That is why to protect and cultivate the xerothermic assemblage of Festuco-Brometea classis. To do so it is worth to start cyclical mowing in the spring, before the flowering of plants, mechanical plucking of seedlings or seasonall breeding of sheeps or goats.

The next interesting group of arthropods are the invasive species. Among them especially interesting is *S. bisonia* originating in North America, which for few decades is spreading across Europe (Gębicki et al. 2013). *S. bisonia* is considered as dangerous pest feeding on orchards, and its population should be continuously monitored (Seliak, 2002). Another dangerous invasive species is *Harmonia axyridis*. This species can potentially influence the native ecosystems or even threaten the native ladybugs populations (Przewoźny et al. 2007).

Even among the spiders there was an alien species observed – synantropic *Pholcus phalangioides*. This species was encountered inside the Quarry buildings. It has minor ecological influence, but the fact that it hunts much bigger synantropic spiders like *Tetragnatha montana* is interesting.

At the end it is worth to mention the arthropod groups which could be much more numerous in this report. To this group belong the moths (Lepidoptera), coleopterans of the family Curculionoidea and the spiders of the Salticidae group or the genus *Pardosa*. Those groups were hard to catch during our study because of many reasons. The main obstacle in the gathering of lepidopterans was the lack of possibility to enter the Quarry during night, in case of coleopterans and most of the spiders we had problems in finding good specialists to work with.

Most of the gathered insects and arachnids represent the very common taxa. However, the number of gathered species, including the common ones, show the biodiversity of the investigated area. Despite the very harsh anthropopression the area of the Quarry is a very interesting locality for future faunistic studies. What is more, all above shows how important is a proper recultivation of former mining areas.

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Raport` s graphic appendix

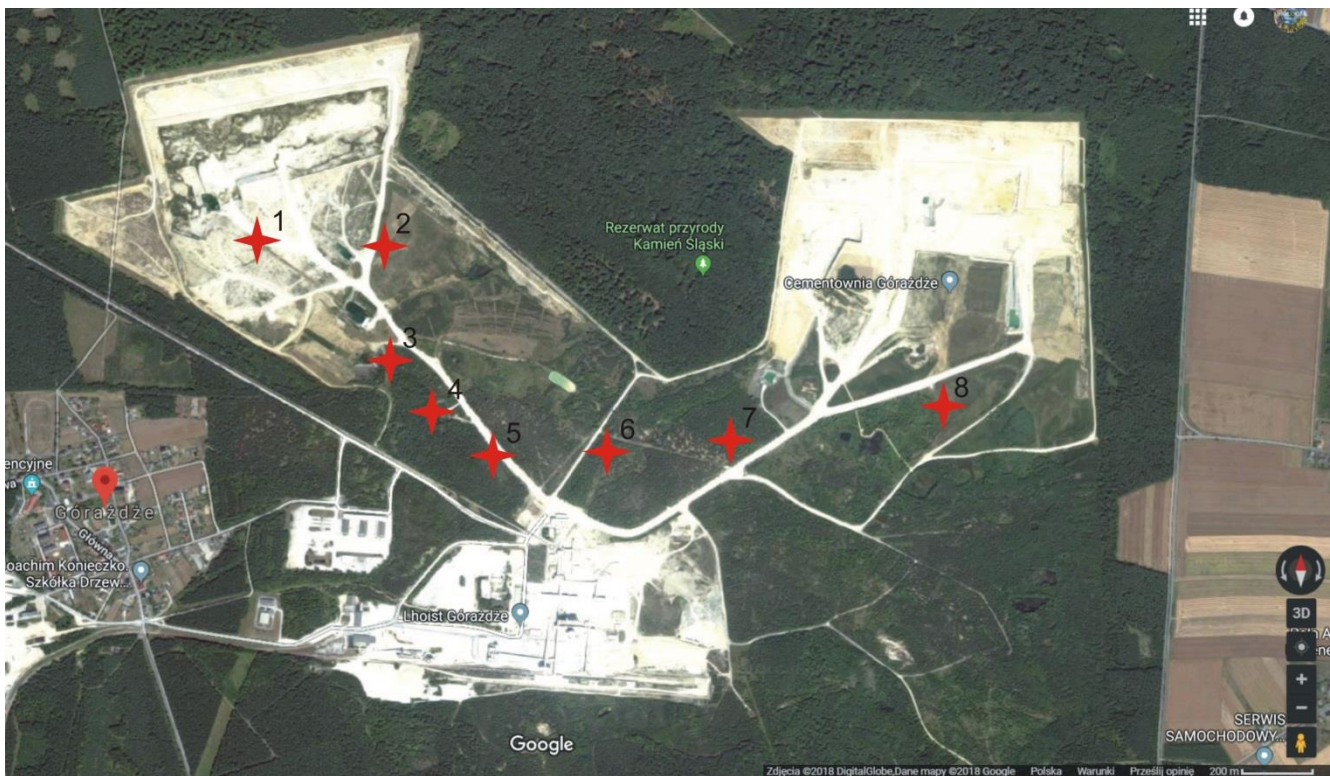


Fig. 1. Map of investigated localities (sites).

To be kept and filled in at the end of your report

<p>Project tags (select all appropriate):</p> <p>This will be use to classify your project in the project archive (that is also available online)</p>	
<p>Project focus:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Beyond quarry borders <input checked="" type="checkbox"/> Biodiversity management <input type="checkbox"/> Cooperation programmes <input type="checkbox"/> Connecting with local communities <input type="checkbox"/> Education and Raising awareness <input checked="" type="checkbox"/> Invasive species <input type="checkbox"/> Landscape management <input type="checkbox"/> Pollination <input type="checkbox"/> Rehabilitation & habitat research <input checked="" type="checkbox"/> Scientific research <input type="checkbox"/> Soil management <input checked="" type="checkbox"/> Species research <input type="checkbox"/> Student class project <input type="checkbox"/> Urban ecology <input type="checkbox"/> Water management <p>Flora:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Trees & shrubs <input type="checkbox"/> Ferns <input checked="" type="checkbox"/> Flowering plants <input type="checkbox"/> Fungi <input type="checkbox"/> Mosses and liverworts <p>Fauna:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Amphibians <input type="checkbox"/> Birds <input checked="" type="checkbox"/> Insects <input type="checkbox"/> Fish <input type="checkbox"/> Mammals <input type="checkbox"/> Reptiles <input checked="" type="checkbox"/> Other invertebrates <input checked="" type="checkbox"/> Other insects <input type="checkbox"/> Other species 	<p>Habitat:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Artificial / cultivated land <input type="checkbox"/> Cave <input type="checkbox"/> Coastal <input checked="" type="checkbox"/> Grassland <input checked="" type="checkbox"/> Human settlement <input checked="" type="checkbox"/> Open areas of rocky grounds <input type="checkbox"/> Recreational areas <input type="checkbox"/> Sandy and rocky habitat <input type="checkbox"/> Screes <input checked="" type="checkbox"/> Shrub & groves <input type="checkbox"/> Soil <input type="checkbox"/> Wander biotopes <input checked="" type="checkbox"/> Water bodies (flowing, standing) <input checked="" type="checkbox"/> Wetland <input checked="" type="checkbox"/> Woodland <p>Stakeholders:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Authorities <input type="checkbox"/> Local community <input type="checkbox"/> NGOs <input type="checkbox"/> Schools <input checked="" type="checkbox"/> Universities