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THE POST-EXPLOITATION AREAS IN CENTRAL POLAND AS A PLACE OF RARE KLEPTOPARASITIC AND PARASITIC SPECIES

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Abstract.
In the course of research on species diversity of wild living Aculeata on post-exploitation areas such as unused quarries and sandstones in the Świętokrzyskie Voivodeship in 2012-2014 rare (in terms of occurrence) kleptoparasitic Aculeata were found.

Key words*: kleptoparasitic stingers, parasitic stingers, rare stingers, local occurrences*

Introduction

Świętokrzyskie Voivodeship, and especially the closest vicinity of Kielce, abounds in places where utility stone and sand are extracted. In some of these areas the exploitation of these raw materials which were, for example, quartzite, dolomite or limestone, has ceased. These areas, since the abandonment of further extraction of material, begin to undergo natural plant and animal succession. Then completely different ecosystems are created from the surroundings which are forests, meadows, grasslands. Some of them are subject to devastation and are very rarely used later as recreational areas for residents of the Kielce agglomeration. Devoid of the influence of anthropopressure, these places can become secondary refuges of various groups of organisms such as *Aculeata*. Such disparate areas as disused quarries are places where petrophilous species can exist in addition to Eurotropical stingers. While in unused ones psamophilous species. Such areas become particularly important by increasing the mosaicity of habitats, as they can affect the growth of biodiversity - especially when there are agricultural areas next to them where agrotechnical treatments have been abandoned.

The attractiveness of disused quarries and sand pits can be evidenced not only by the number of species (species diversity), but also by the presence of species referred to as faunal values. These can include stingers that are valuable from the point of view of biodiversity conservation, protected by law, endangered, or those whose occurrence has been found in a small number of domestic sites.

Stinger (*Aculeata*) is a group of hymenoptera subtypes (*Hymenoptera, Apocrita*) belonging to three superfamilies: *Chrysidoidea*, *Vespoidea* and *Apoidea* (Gauld, Bolton 1996). The national fauna of these insects has about 1,100 species (Bogdanowicz et al. 2004). *Chrysidoidea* includes 7 families: *Bethylidae*, *Chrysididae*, *Dryinidae*, *Embolemidae*, *Plumaridae*, *Sclerogibbidae* and *Scolebythidae*. In Poland, this superfamily is represented only by species from the first 4 families (about 130 species). *Vespoidea* in the national fauna have representatives belonging to about 269 species of 7 families (*Vespidae*, *Tiphiidae, Sapygidae, Mutillidae, Pompilidae, Formicidae, Scoliidae*).

The last superfamily - *Apoidea* is not only the richest in species (about 16,000), but also includes most families (11 - *Heterogynaidae, Ampulicidae, Sphecidae, Crabronidae, Stenotritidae, Colletidae, Andrenidae, Halictidae, Melittidae, Megachilidae and Apidae*). Its representatives are concentrated in two informal groups - spheciformes and apiformes. The first one (digger-wasps) includes *Heterogynaidae, Ampulicidae, Sphecidae* and *Crabronidae* (Melo 1999), the last three of which appear in our fauna. The second one (bees) gathers the other families of *Apoidea* (Michener 2000), of which only endemic *Stenotritidae* do not have their representatives in Poland. The national fauna of this superfamily has a total of about 690 species, of which 220 belong to spheciformes (Wiśniowski 2004), and 470 to apiformes (Banaszak 2000).

Stingers are characterized by a huge variety of life strategies. This diversity manifests itself in many aspects of their behaviour. Analysing the relationships between individuals of the same species, we can see that the stingers have reached different levels of the community. In addition, we observe various ways of food preferences and obtaining larvae commission. This group also developed various strategies of securing the conditions for their offspring's development. Referring to the above information, it can be stated that the stingers include both lonely and properly social (eusocidal), predatory and herbivorous species, cultivating parasitism in various forms (parasitoids, kleptoparasites and social parasites). Kleptoparasitism in stingers - is a form of behaviour of some species of stingers, consisting of taking over or using for the other purpose the food obtained or prepared by other individuals of the same or a foreign species. Females of these species do not build nests and do not store food for their offspring and use nests and stocks of other species. The egg tossed by the kleptoparasite grows faster, and its larva eats the whole stock of the nest, and often also the egg and host larva. Parasitoids, unlike kleptoparazytoids, use the host to a certain extent of development (larval parasitism) for their own development. The host is not killed by them until they are pupated.

Objectives of the Work

The aim of this study was to verify whether and to what extent post-industrial sites (quarries and sand pits) can be secondary refuge sites for wild stinging species (including klectoparasites), allowing them to then possibly expand into adjacent areas. New occurrences of rare klectoparasitoid species in the Świętokrzyskie Province are presented, assessing for them the degree of attractiveness of fully anthropogenic habitats, which are disused sand pits and quarries.

Sampling and characteristics of places of harvested kleptoparasites

Research on wild living stingers was carried out in 2012-2014. The research material was collected using the Moericky traps method from the beginning of April to mid-October at two-week intervals. It was obtained from three unused quarries located in the Świętokrzyskie Voivodeship (in Wielka Wiśniówka - Masłów, in Zachełmie and Kostomłoty - "Mogiliki") and three, also unused, sandstones (in Borowa Góra, Mąchocice and Suchedniów) (Fig. 1).

The Moericke trap method was chosen because the Moericke traps on display function in the same way throughout the exposure (trapping occurs under the same weather conditions in all study plots). Line treant traps were not used, as this would have resulted in the extraction of material not always under the same weather conditions (rain, wind, cloud cover) on each plot (Banaszak

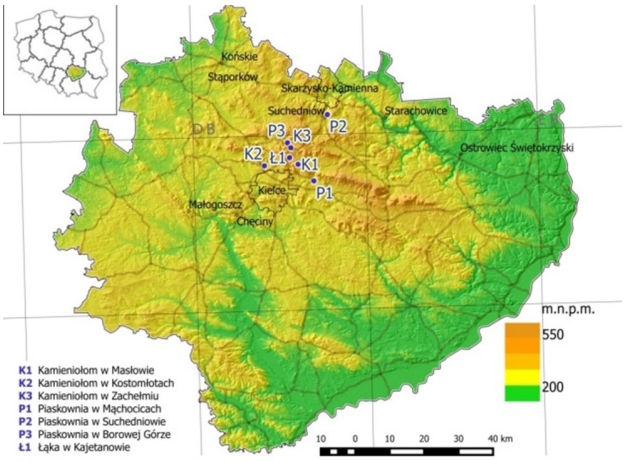

Figure 1. Location of research areas

1991). Four traps placed on a wire structure that kept them perched above the ground were staged at each test site. The use of such a structure reduced the entry of snails, ground beetles and voles into them, which had a great impact on keeping the sample clean. The traps were bowls 18 cm in diameter and 9 cm high, in white color. The choice of the color of the traps was dictated by the fact that this color is considered the most attractive for stinging insects (Banaszak i in. 1994). They were a minimum of 40 meters away from each other. The traps were filled halfway with a specially prepared liquid, 90% of which was water and 10% detergent. The latter played a role in reducing the surface tension of the water, which greatly increased the effectiveness (catchability) of the trap. Material from the traps was collected every two weeks.

The sand pit in Borowa Góra: located in the middle of pine forest near Borowa Góra (UTM: DB74, exact location - 50°58'53.1" N and 20°40'35.28" E) (Fig. 2-4 a) It is one of the most floristically diverse sites with an area of 0.34 ha. The bottom of the sandstone was overgrown with shrubs and undergrowth of trees with a 40% shortfall. Pine, which usually was less than 10 years old, was in majority. There were much fewer birches (*Betula pendula*), pedunculate oak (*Quercus robur*) and black alder (*Alnus glutinosa*) and gray alder (*A. incana*). The ground was well moistened here, which determines greater floristic diversity and a large fleece shortage (70%). On the highest degrees of quantification there are the emphases annual (*Erigeron annuus*) and woolly cottony (*Holcus lanatus*). The plants that also appeared in relatively large numbers: dissected strain (*Juncus effusus*), hairy sedge (*Carex hirta*), red fescue (*Festuca rubra*) flat-flowered poaceae (*Poa compressa*), common pruritus (*Lysimachia vulgaris*), field forget-me-not (*Myosotis arvensis*), goose cinquefoil (*Potentilla anserina*) and common brand (*Prunella vulgaris*).

The sand pit in Mąchocice: area of 0.26 ha, located in the central part of the village of Mąchocice Dolne (UTM: DB83, exact location - 50°52'58.61" N and 20o46'47.90"

E (Fig. 2-b). The sandstone is surrounded by fresh meadows on three sides, while the fourth one borders with the road and rural buildings. The exploitation of sand ceased in 1995. A field clover (*Trifolium arvense*), a grey bristle Corynephorus canescens and a sand shingle (*Jasione montana*) had the largest species share there. They occupy the largest surface and form a community from the class (*Koelerio glaucae-Corynephoretea canescentis*). The annual june (*Scleranthus annus*), minor nematodes (*Filago minima*), field nematode (*F. arvensis*), evening primrose (*Oenothera biennis*) and field gypsophila (*Gypsophila muralis*) were also recorded. The presence of these species makes it possible to classify this community into a compound (*Corynephorion canescentis*), i.e. to sandy brush-like grasslands, where the main building material is tufted grey briar grass.

The sand pit in Suchedniów: unused for 15-20 years, located on the northern outskirts of the city of Suchedniów, near the city cemetery (UTM: DB85, exact location - 51°3'6,65" W, and 20°50'41.17" E). The sandstone area of 0.35 hectares is located on the eastern side of the Kamionka River valley (Fig. 2-c). It is surrounded by a pine forest on three sides, and from the fourth (west) bordered by the flood plain of the Kamionka River. The layer of bushes is primarily pine (*Pinus sylvestris*) and robinia (*Robinia pseudoacacia*). In this layer, there were also invasive knotweed (*Reynoutria japonica*). The sand reed (*Calamagrostis epigejos*) was characterized by absolute domination, covering about 60% of the entire cover, which is 60%. In addition to the reed, red fescue (*Festuca rubra s. L*) also has a large share. and hairy sedge (*Carex hirta*). These three species give a specific, grassy physiognomy to this community. The remaining species are plants typical for sandy habitats: common pollen (*Berteroa incana*), polema (*Artemisia campestris*), sand-coloured glaze (*Jasione montana*), seven-ringed horn (*Cerastium semidecandrum*), June annual (*Scleranthus annuus*), gray briar (*Corynephorus canescens*) , sheep's fescue (*Festuca ovina*).

The quarry in Kostomłoty (Mogiłki) (Fig. 2-d) occurs between Kostomłoty I and Kostomłoty II - 10 km from Kielce. The geographic position of the quarry is determined by the following coordinates: UTM DB64; 50°55'57.31" N, 20°34'48.70" E. The area of the 1.20 ha quarry is within the Wzgórze Kostomłockie. Its walls reach 10 meters high and 150 meters long. This place is known for interesting folded forms and faults and mineralization in the scientific world. There are limestones, dolomites and upper Devonian margins here. The Upper Devonian limestone was exploited in the quarry, and their supply ceased in the 1990s. The bottom of the quarry is occupied primarily by herbaceous vegetation. The shrubs are isolated individually, among which pine (*Pinus sylvestris*) and 3 species of willow (*Salix spp.*) were recorded. The solid rock found in the substrate prevents plants from growing. Therefore, their coverage was small, amounting to about 30%. Three species dominated here - the sand reed (*Calamagrostis epigejos*), which is an ubiquitous and highly spreading species, as well as the rough whortle (*Leontoon hispidus*) and flattened pox (*Poa compressa*). The latter two species belong to the group of xerothermic plants, occurring mainly on the substrate rich in calcium carbonate. They are usually the basic components of calcareous xerothermic grasslands. Just as sporadically listed here - finnish (*Acinos arvensis*) and the rare and threatened extinction in the country, the Siberian bell (*Campanula sibirica*), ordinary carline (*Carlina vulgaris*), or the headwort (*Veronica spicata*). The remaining species came from various habitat groups. However, they shared the preference for relatively dry habitats. It included the sand thyme (*Thymus serpyllum*), the sandstone (*Arenaria serpyllifolia*), the Rhine chantra (*Centaurea stoebe*) and the hawthorn bittern (*Picris hieracioides*).

The quarry in Masłów: in which exploitation ceased after 1995. It is located in the Masłów commune. The main element of the landscape of the discussed area is the main range of the Świętokrzyskie Mountains, which is reflected in the convexity of the Masłowski Range with Wiśniówka (455.7 m above sea level). The "Wiśniówka" quartzite deposit with an area of approximately 49.1 ha includes an area with an elevation of approximately 385 m above sea level. up to about 457 m above sea level.

The quarry in Wiśniówka consists of two parts: the used one near the Zagnańsk commune and the unused one nearby Podwiśniówka, Marczakowa Dolina and Masłów. The latter area (Fig. 2-e) had the area of 4.40 ha and was the place of research, and its precise location is determined by the following coordinates: UTM - DB83; exact location - 50°55'31.33" W and 20°43'40,71" E. During the performance of botanical characteristics, the stand was heavily overgrown with shrubs and undergrowth of trees, especially on the walls of the quarry. Their short-circuit was about 30%. The most popular were common pine (*Pinus sylvestris*), aspen poplar (*Populus tremula*) and silver birch (*Betula pendula*). Among them one could meet the common crust (*Frangula alnus*), the sloe plum (*Prunus spinosa*) or the wild rose (*Rosa canina*). At the bottom of the quarry and on more steep rock walls, and also on gravel, where the soil layer was just being formed, few specimens of herbaceous plants were found. The unfavourable conditions for their development meant that their short-circuit was only about 20%. Two species predominated: red fescue (*Festuca rubra s. L.*) and hawkweed (*Hieracium pilosella*). Both are ubiquitous species, occupying strongly sunny and relatively dry places. Among other rare species, the following ones should be mentioned: Janowiec bacillus (*Genista tinctoria*), St. John's wort (*Hypericum perforatum*), rough warta (*Leontodon hispidus*), flattened plumage (*Poa compressa*) and common goldenrod (*Solidago virgaurea*). The remaining plant species were sporadic.

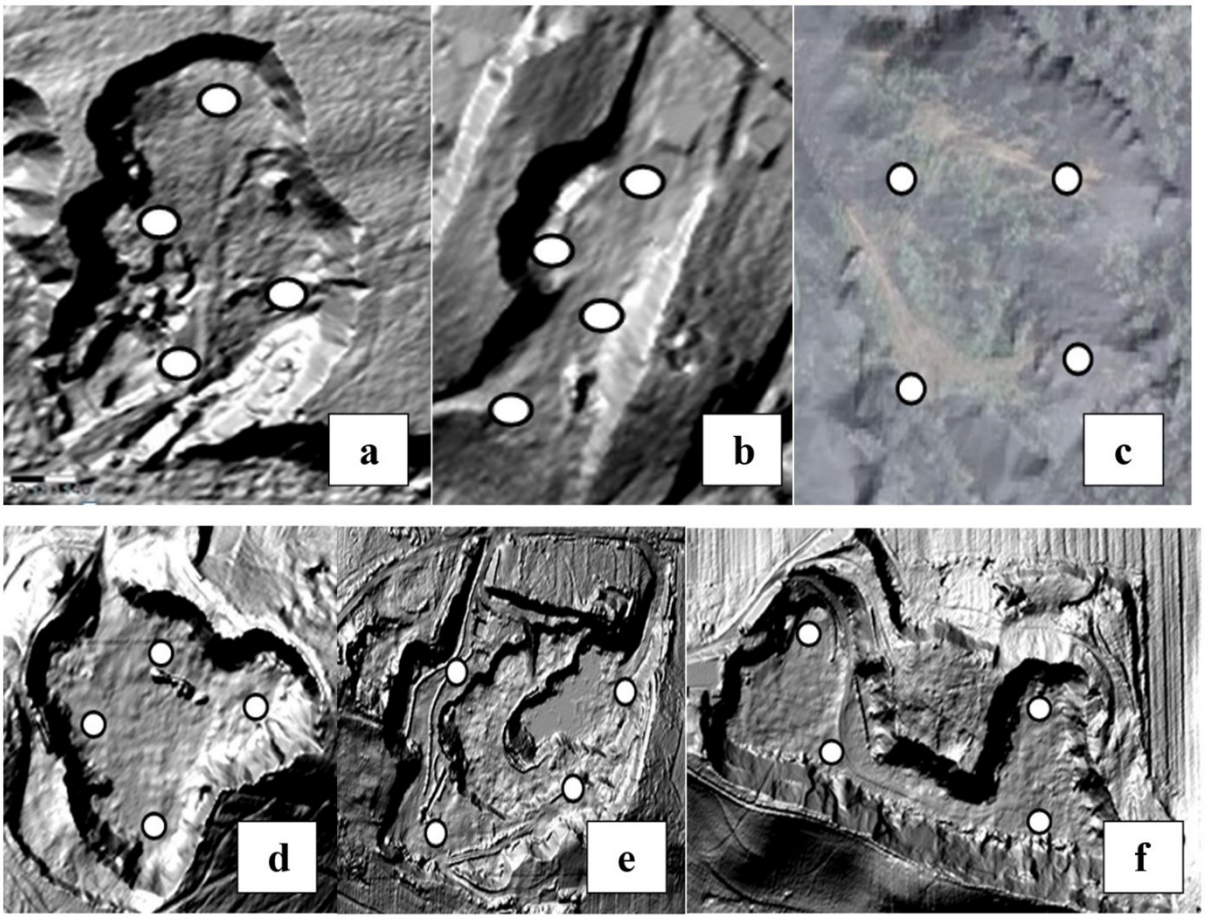

Figure 2. Location of the Moericky traps (O) in the sandstone in Borowa Góra - a; The sandstone in Mąchocice - b; The sandstone in Suchedniów - c; The quarry in Kostomłoty - d; the quarry in Masłów - e; the quarry in Zagnańsk - f. (surface formation based on the numerical terrain model - NMT)

The quarry in Zachełmie (UTM: DB74; exact location - 50°58'77" N and 20°41'26" E) is located south of the village of Zachełmie in the Zagnańsk commune. The quarry with the area of 4.48 ha (Fig. 2-f) is located on the western slope of Chełmowa Mountain (399.4 m above sea level) - the westernmost part of the Klonowski Mountain Range of the Świętokrzyskie Mountains (Strzyż & Kin 2011). In the 17th century, the quarry in Zachełmie was the source of local mining of dolomites and Devonian limestone, which after the Second World War was transformed into industrial exploitation of this resource. It was used mainly as a road stone and its mining lasted until 1987. Next, the quarry excavation was recognized as a natural monument, which in 2010 as a result of ordinance 5/2010 of the Regional Director for Environmental Protection in Kielce was transformed into an inanimate nature reserve (geological and soil type; sub-type - paleontological sites, tectonic and erosion forms, rocks, minerals), sediments, soils and dunes; due to the main type of ecosystem: type - rock; subtype - sedimentary rocks) (Strzyż & Kin 2011).

The reserve in Zachełmie was visited mainly due to the exposed contact of the Central Devonian dolomites (from before 395 million years) with conglomerates and Permian-Triassic sandstones (before 251 - 255 million years). However, recently this place has become a geological sensation on a global scale due to on the traces (tropes) found on the tetrapod - an intermediate link between fish and four-legged animals. This discovery shifted the dating of the first animal to land by about 18 million years back (Niedzwiedzki et al. 2009).

Physiognomy and the species composition of the plant cover is similar to the one in the quarry in Kostomłoty. The layer of bushes is negligible, in which only the common crust (*Frangula alnus*) and rose (*Rosa sp*) were recorded. In the undergrowth developing on the stony and gravel bottom of the quarry grass compressed (*Poa compressa*) and smaller burnet (*Sanguisorba minor*) dominated. Both of these species covered about half of the total coverage, which is 30%. Other listed plants are: sand reed (*Calamagrostis epigejos*), annual survivor (*Erigeron annuus*), Bauhina hawkweed (*Hieracium bauhinii*), rough harkwort (*Leontodon hispidus*), common (*Prunella vulgaris*), and marsh-thalas (*Alyssum alyssoides*), cornflower Rhine (*Centaurea stoebe*), Echium vulgaris (*Echium vulgare*), Legionella (*Lotus corniculatus*), Cicada (*Polygala comosa*).

Kleptoparasitic species found in the areas of the unused sandstones and quarries in the Świętokrzyskie Voivodeship

The rare species of kleptoparasites found on the anthropogenic surfaces were species (*Chrysis bicolor, C. graelsii, C. leachii, Scolia hirta, S. sexmaculata, Nomad bifasciata, N. facilis, N. furva, N sheppardana, Coelioxys mandibularis, Stelis odontopyga*) (Tab. 1, Fig. 4).

Chrysis bicolor (Lepeletier 1806) being a kleptoparazytoid of *dinetus pictus* and *Tachysphex obscuripennis*. caught in the quarry in Masłów. - it belongs to the LC category, it is a palearctic species whose occurrence has been recorded in Europe (Belarus, Belgium, British Isles, Bulgaria, Corsica, Croatia, Czech Republic, Estonia, Finland, France, Germany, Greece, Hungary , Italy, Latvia, Lithuania, Luxemburg, Poland, Sardinia, Sicily, Slovakia, Spain, Sweden, the Netherlands, Ukraine), North Africa and Eastern Russia (Amurskaya Oblast, Primorski Kray, Sakhalin) (Wiśniowski 2015). In our country, this species has been recorded in the Baltic Coast, the Pomeranian Lake District, Masurian Lake District, the Wielkopolska-Kujawska Lowland, the Mazurian Lowland, Podlasie, the Małopolska Upland, the Świętokrzyskie Mountains, the Lublin Upland, Roztocze, the Sandomierska Lowland, the Eastern Beskid and the Pieniny (Wiśniowski 2015).

Chrysis graelsii (Guerin-Meneville 1842) - a species also found in the literature under the name *Chrysis sybarita*, has the category VU. It is a species of Western Palearctic, whose occurrence was found in Europe (Albania, Austria, Belarus, Croatia, Czech Republic, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Poland, Portugal, Romania, Sardinia, Sicily, Slovakia, Spain, Switzerland and Yugoslavia), North Africa (Morocco), the Middle East (Turkey and Iran), Kyrgyzstan and Siberia and China (Wiśniowski 2015). In Poland, this species has been recorded on such lands as the Mazury Lake District, the Wielkopolska-Kujawska Lowland, the Mazowiecka Lowland, the Lower Silesia, the Upper Silesia, the Trzebnickie Hills, the Krakowsko-Wieluńska Upland, the Małopolska Upland, the Świętokrzyskie Mountains, the Sandomierska Basin, the Eastern Sudetes, the Western Beskids and the Pieniny (Banaszak 1980, Szczepko & Wiśniowski 2009, Wiśniowski 2015). This *Chrysididae* is a kleptoparazytoid *Euodynerus quadrifasciatus, E. dantici, Odynerus reniformis and O. spiricornis*, and a parazytoid *Osmia caementaria and O. rufa* (Banaszak 1980, Wiśniowski 2015). Its occurrence was found at the Masłów and Kostomłoty quarries.

Chrysis leachii (Shuckard 1836) - *Chrysididae* is a kleptoparazytoid of mainly such digger-wasps as *Tachysphex nitidus, Tracheolides quinquenotatus, Diodontus minutus, Miscophus bicolor* and *M. niger and Crabro quinquenotatus* (Banaszak 1980, Kunz 1994, Wiśniowski 2015). It has been found in the unused sand pit in Mąchocice. It is a sub-pontomediteranian species whose occurrence was recorded in Europe (Albania, Austria, Belgium, Bosnia and Herzegovina, Crete, Croatia, Czech Republic, Denmark, France, Germany, Greece, Hungary, Italy, Moldova, Poland, Romania, Sardinia, Sicily, Slovakia, Spain, Switzerland, the Netherlands, Ukraine and Yugoslavia) and North Africa (Tunisia) and the Middle East (Turkey and Iran) (Wiśniowski 2015). In Poland, its occurrence was found in the Pomeranian Lake District, the Wielkopolska-Kujawy Lowland, the Lower Silesia, the Małopolska Upland and in the Western Beskid (Banaszak 1980, Wiśniowski 2015).

Scolia hirta (Schrank, 1781) - a slender hunk appears in the Polish Red Book of Animals as an exposed species (VU). The slender hunk is widely displaced in the Palearctic. It lives in the area of North and West Africa (Turkey and Iran) and Central Asia (Kazakhstan), reaching eastwards up to Zabajkale. In addition, it inhabits western, central and southern Europe, as well as Ukraine and the south-western part of Sweden and Norway (Steinberg 1962, Osten 2013). In Poland, it was shown from the Baltic Coast (Czubiński & Urbański 1951, Marczak et al. 2012), the Pomeranian Lake District (Schröder 1921, Banaszak & Twerd 2009), the Masurian Lake District (Zięba & Żyła 2010, Marczak et al. 2012), Podlasie (Kowalczyk 1988ab, Banaszak & Twerd 2009, Marczak et al. 2012, Wiśniowski & Piotrowski 2013), the Wielkopolska-Kujawska Lowlands (Meyer 1919, Szulczewski 1950, Banaszak 1978, Zięba & Żyła 2010, Karg et al. 2011, Baraniak et al. 2013, Mielczarek 2013), Mazurian Lowland (Głowacki 1953, Tabor & Ciach 2006, Banaszak & Twerd 2009, Kowalczyk et al. 2009c, Zięba & Żyła 2010, Marczak et al. 2012, Miłkowski 2012), Lower Silesia (Dittrich 1911, Scholz 1911, Wiśniowski 1994, Zięba & Żyła 2010, Bena 2012), Wzgórza Trzebnickich (Dittrich 1911), the Western Sudetes (Banaszak & Twerd 2009), the Upper Silesia (Banaszak 2004), the Malopolska Upland and the Świętokrzyskie Mountains (Szczepko & Wiśniowski 2009; Marczak et al. 2012, Miłkowski 2012, Bonk & Sępioł 2013), Lubelska Upland (Marczak et al. 2012), Roztocze (Zięba & Żyła 2010) and Nizina Sandomierska (Niesiołowski 1949; Zięba & Żyła 2010). A slender hunk has not been found in the Carpathians yet. This species is a parasitoid, whose larvae exploit grubs of some beetles from the *Scarabaeidae* family (mainly the beetle crocus - *Cetonia aurata* and the marsh plague - *Oxythyrea funesta* and various species of uneven - *Anomala spp.*). *Scolia hirta* has been recorded in the sand pit in Suchedniów.

Scolia sexmaculata (Müller 1766) - a slender whitehead has a similar range of prevalence to the species discussed earlier. However, unlike the slender hunk, it was not found in Norway and Sweden, as well as in Lithuania and Turkey, but it was demonstrated from Georgia and Azerbaijan (Fallahzadeh & Saghaei 2010). In our country, it was found only from a few sites in the Wielkopolska-Kujawska Lowland (Meyer 1919, Kowalczyk et al.

2009c), the Mazowiecka Lowland (Szczepko & Wiśniowski 2006), the Lower and Upper Silesia (WIŚNIOWSKI 1994), the Cracow-Wieluń Upland (Kowalczyk & Kurzac 2002) and the Małopolska Upland (Kowalczyk et al. 2008b, Szczepko & Wiśniowski 2009). The development of *S. sexmaculata* is similar to that of *S. hirta*. It was taken in the unused sandstone in Mąchocice and it is the first site of this species in the Świętokrzyskie Mountains (Król 2015).

Coelioxys mandibularis (Nylander 1848) - it is a kleptoparasitic species with characteristically swollen mandibles, which allows distinguishing it from other representatives of this type. It inhabits northern, central and eastern Europe, as well as part of Asia. In Poland, he was found on the Baltic Coast, the Pomeranian Lake District, Podlasie, the Wielkopolska-Kujawska Lowland, the Mazowiecka Lowland, Wzgórza Trzebnickich, the Małopolska Upland and the Sandomierska Lowland (Banaszak & Planka 1981, Kowalczyk et al. 2004, Banaszak 2006, 2010a, 2010b; Banaszak & Kowalczyk 2007, Banaszak et al. 2006, Kowalczyk et al. 2008a, Kowalczyk et al. 2009b). This species is a kleptoparasite of some of the megachiles (*Megachile circumcincta, M. centuncularis, M. leachella, M. ligniseca, M. versicolor*), and sometimes also *Hoplitis papaveris* (Banaszak et al. 2001). This species was found in the quarry in Zachełmie.

Stelis odontopyga (Noskiewicz 1926) - *Hoplitis spinulosa* kleptoparazytoid species, occurring in Western Asia and in some warm regions of Europe (Turkey, Spain, France, southern Belgium, Italy, Croatia, Bosnia and Herzegovina, Switzerland, southern Germany, Hungary, Austria, Slovakia, Poland , Ukraine) (Celary 1995b). In Poland, *Stelis odontopyga* is known for its few positions on the Krakow-Wieluń Upland and the Malopolska Upland (Celary & Wiśniowski 2007). It is a summer species, flying from June to August and visits flowers of plants from the families: *Apiaceae, Asteraceae and Boraginaceae* (Celary 1995b). The species was found in the quarry in Zachełmie.

Nomada bifasciata (Olivier 1811) - West Paleartctic species of nomadic species living in North Africa (Tunisia, Algeria, Morocco) and southern and central Europe (Spain, France, Italy, Croatia, Slovenia, Austria, Hungary, Romania, Slovakia, Poland, Germany) (Celary 1995a). In Poland it has been recorded in Pomeranian Lake District, the Masurian Lake District, the Wielkopolska-Kujawy Lowland, the Krakow-Wieluń Upland and the Malopolska Upland (Banaszak 2010a, 2010c, Banaszak et al. 2006, Celary 1995a, Celary & Wiśniowski 2007). It is an early-spring nomadic *Andrena Gravida* kleptoparazytoid. It visits the flowers of *Euphorbia cyparissias L., Potentilla verna L., Salix spp.* and *Tussilago farfara L.* This species was found in the quarry in Kostomłoty.

Nomada facilis (Schwarz 1967) - late spring European species. In Europe, it is listed from Switzerland, Italy, Slovenia, Croatia, Greece, Romania, Hungary, Austria, Germany and Sweden. In Poland this nomad was found in very few sites on the Mazurian Lowland and the Krakow-Wieluń Upland (Celary 1995a, Celary & Wiśniowski 2007). The period of the nomad's appearance coincides with the host's flight time, which is *Andrena humilis* (Celary 1995a). This species was found in the Masłów quarry.

Nomada furva (Panzer 1798) – subponto-mediterreanian species from North Africa (Algeria) and Europe (Portugal, Spain, Italy, Croatia, Hungary, Romania, Ukraine, Slovenia, Austria, Switzerland, Germany, Poland and Belgium, European part of Russia - Bashkiria) and Asia Minor. In Poland, it has been recorded in the Upper Silesia, the Eastern Beskid (Banaszak 1984), Bory Tucholskie (Banaszak & Wendzonka 2002), the Wielkopolska-Kujawska Lowland (Banaszak 2010a, Cierzniak 2003) and the Malopolska Upland (Kowalczyk et al. 2009a). This species has two generations (the first one from May to June, and the second one from July to August) and it is a kleptoparazytoid of species such as *Evylaeus morio* and *E. leucopus* and *E. punctatissimus*. It visits the flowers of *Achillea millefolium L*., *Erigeron annuus (L.), Hieracium pilosella L., Taraxacum officinale L., Fragaria vesca L., Potentila erecta (L.), Heracleum sphondylium L. and Veronica chamaedrys L.* (Celary & Wiśniowski 2007) . The species was found in the sand pit in Borowa Góra.

Nomada sheppardana (Kirby 1802) - This nomadic population lives in North Africa (Tunisia, Algeria, Morocco) and most of the warm regions of Europe (France, Switzerland, Italy, Greece, Romania, Hungary, Austria, Slovakia, Poland, Germany, Belgium, United Kingdom and the European part of Russia). In our country, this species is known for its few sites located in the Pomeranian and the Masurian Lake District and Podlasie, as well as on the Krakow-Wieluń Upland and the Malopolska Upland, (Celary 1995, Celary & Wiśniowski 2001, Banaszak 2006, Banaszak et al. 2006, Banaszak & Kowalczyk 2007, Kowalczyk & Kurzac 2008, 2009, Kowalczyk et al. 2008a, 2009a). It has two generations, the first one from May to June and the second one from July to August. It is the kleptoparasite of several species of mellows (*Evylaeus morio* and *E. nitidiusculum* and *E. sextrigatum*). Imagines visit the flowers of the giant starflower *Stellaria holostea L.* and the snowwell speedwell Veronica *chamaedrys L*., and the common daisy *Bellis perennis* L. (Celary 1995a). The species was found in the sand pit in Borowa Góra.

In post-mining areas such as disused quarries and sand pits, detailed studies of the species diversity of wild stingers including klectoparasites have not previously been conducted. Most such studies were conducted in areas subjected to anthropopressure to a much lesser degree. Mainly these were national and landscape parks and nature reserves, or botanical gardens. However, despite the numerous publications within this group, the degree of understanding of stingrays varies greatly. Among the areas

where the entomofauna, including stingers, is best known are the Ojcow National Park (Dylewska, Wiśniowski 2003; Klasa, Partyka 2008), the Babia Góra National Park (Wołoszyn i in. 2003) and the Kampinos National Park (Banaszak, Plewka 1981, Szczepko, Wiśniowski 2009). Knowledge of the status of the stinger fauna in the remaining areas is incomplete and mainly concerns the presence of rare or protected or endangered species (Celary, Wiśniowski 2012; Wiśniowski, Werstak 2009; Szczepko, Kowalczyk 2006; Kowalczyk, Kurzac 2008). In the scientific literature you can find a lot of data on the structure of stingers grouping in areas not heavily influenced by our civilization. They concern, among others, areas such as fresh meadows, which are a typical habitat for wild stingers. This is due to the fact that they are rich clusters of flowering plants, which provide them with food in the form of nectar and pollen. In the Świętokrzyskie province, a decrease in the intensity of land cultivation has been observed for a long time, which results in, among other things, a decrease in the biodiversity of the fauna of stingers. The increase in anthropopression (including the impact of industry) is leading to progressive devastation and degradation of the environment, causing a decrease in food resources for these insects (Bąk Badowska 2012).

As a result of secondary plant succession causing, among other things, the overgrowth of shrubs and trees in the grasslands, the food base becomes poorer and shade increases. The effect of this process is also a decrease in the number of nesting sites (Bąk-Badowska 2012; Cierzniak i in 2005). The biodiversity of stingers is determined by the degree of environmental heterogeneity. An example is the forest ecosystem, which, due to the lack of open areas and the dominant woody and shrubby vegetation, and therefore a different vegetation cover from the meadow, has a different (simplified) structure of groupings of stingers in relation to it. Works describing stingrays in the forest phytocenosis are not very numerous (Celary, Plewa 2014; Wiśniowski 2000), much more often limited to specific groups (families) of *Aculeata* - mainly bees (Bąk Badowska 2012; Wiśniowski 2004). The presence in forests of places devoid of trees, such as mid-forest clearings, increases the food resources of stingers, resulting in an increase in diversity in these areas. *Aculeata* are most likely to choose open, warm and sunny areas. Meadows occupy one of the most important places among them, which shows the high attractiveness for this group of insects of this type of habitat (Svensson i in 2000). However, variation among stingrays in their preferences for nesting substrate means that some require habitats other than grasslands. Many species need drier and sunnier soil with a different texture than meadow soil. Such a function can be performed by disused sand pits and quarries (often also found in forests). Such sites can become secondary refuge sites for *Aculeata*. They can provide not only shelter and survival opportunities for stingers with specific habitat requirements (psammophiles and petrophiles) but also allow them to penetrate adjacent areas, which can be, for example, agricultural fields and orchards. Such sites become particularly important especially when land and other agricultural land is ceased to be cultivated, because they begin to undergo the process of plant succession. The process of overgrowing unused areas with shrubs and trees can reduce the number of attractive nesting sites The research, conducted on unused land after sand and utility stone mining, was designed to see to what extent these areas could become refugia for wild stingers. Increasing the number of refugia in the environment not only brings an increase in species diversity, but also raises the abundance of stingers. Unused sand pits and quarries appear to be attractive areas for stingers. However, they are often subject to devastation, as they are often used as illegal landfills or burned, or even "run over" by motorcycles or quads. The effect of such behavior is a drastic decrease in biodiversity, not only of the stingers fauna, but also of other groups of organisms.

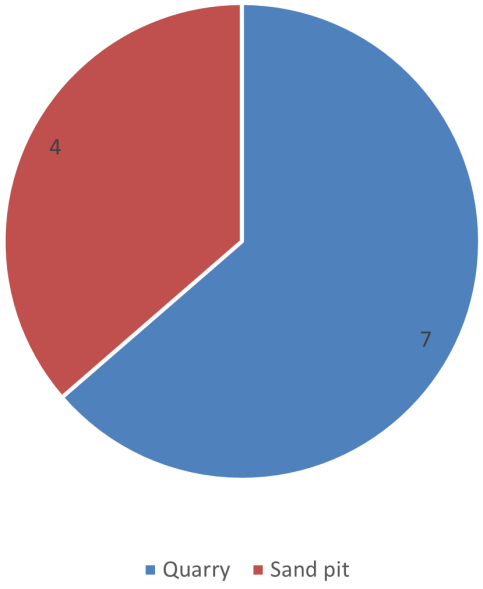

Figure 3. Occurrence of faunal values (species) of kleptoparasites on the territory of disused quarries and sand pits studied in the Świętokrzyskie province

Table 1. Kleptoparasitic species found in the areas of the unused sandstones and quarries in the Świętokrzyskie Voivodeship**.**

	The quarry in Kostomłoty	The quarry in Masłów	The quarry in Zachełmie	The sand pit in Mąchocice	The sand pit in Suchedniów	The sand pit in Borowa Góra
Chrysis bicolor		x				
Chrysis graelsii	x	x				
Chrysis leachii				x		
Scolia hirta					x	
Scolia sexmaculata				x		
Coelioxys mandibularis			x			
Stelis odontopyga			x			
Nomada bifasciata	x					
Nomada facilis		x				
Nomada furva						x
Nomada sheppardana						x

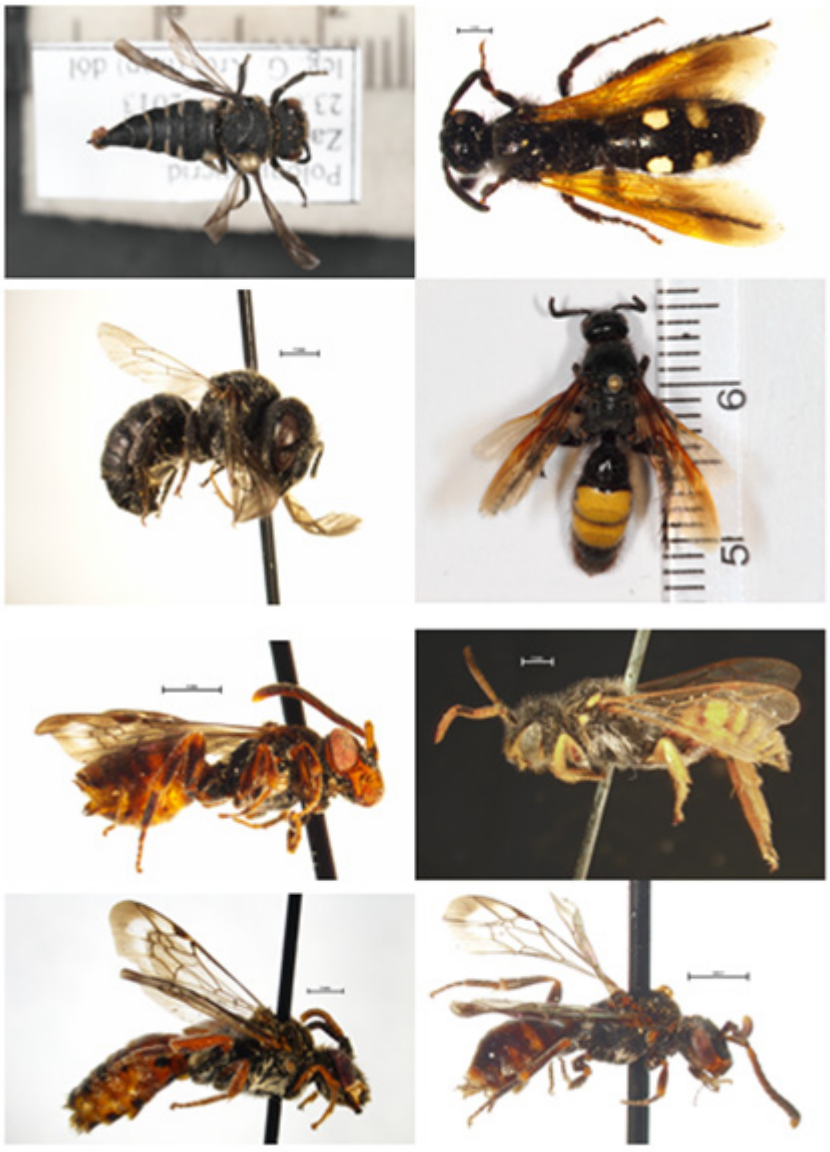

Figure 4. Photographs of ectoparasites and parasites caught on research surfaces

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