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Burnets in the Tatra Mts., Podhale region, Mt. Babia Góra region and Pieniny Mts. - Part II

(Lepidoptera, Zygaenidae)

by

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The second part of the continuing field work on burnet moths (Zygaenidae) in the Polish Tatra Mountains, Podhale region, Pieniny Mountains and the region of Babia Góra (Dąbrowski, 2007) is discussed in three separate chapters containing observations made after the publication of the first part for the years 2005-2016.

Key words: South Poland; Tatra National Park and Czarny Dunajec vicinity; distribution; burnet species: *Z.* (*Z.*) *viciae* ([Den. & Schiff.]), *Z.* (*Z.*) *lonicerae* (Schev.), *Z.* (*Z.*) *filipendulae* (L.), *Z.* (*M.*) *purpuralis* (Brünn.), *Z.* (*M.*) *minos* ([Den. & Schiff.]); peat bogs; drained fallow meadows; biology; ecology; survival strategy.

Introduction: In the first part (Dąbrowski, 2007) observations made of burnets covering the period of 1952-2005 were introduced (Fig. 1). It includes a list of species and subspecies together with their geographical ranges (Fig. B), inter-individual variability, biology, habitats, risk of extinction, parasites and other natural enemies and digestive plants. These observations, covering half a century, are still continuing because of the increasing dynamics of changes in habitats shaped mainly by anthropopression (human activities). They have become, apart from the global changes related to climate changes - including the local climate of the test area - most crucial because of the complex of factors that are vital in connection with the disappearance and extinction of many animal and plant species. This applies to most of the burnets as well.

1. New habitat of *Zygaena* (*Mesembrynus*) *purpuralis* (Brünnich, 1763) and *Zygaena* (*Mesembrynus*) *minos* ([Denis & Schiffermüller], 1775) in the vicinity of Czarny Dunajec

In the research area both species are known from the Pieniny Mts. region (Dąbrowski, 2007). We have observed a single specimen of *Z.* (*M.*) *purpuralis* (Brünn.) beteween Pieniny Mts., and Nowy Targ in the Dunajec valley on the southern hillsides of Gorce Mts., (680-900m asl). Since the 1970s burnet habitats have started to disappear rapidly, similar to those of other Lepidoptera species, because of the increasing intensification of cultivation and chemicalization of meadows.
In the 1990s, more and more aggressive and uncontrolled and chaotic urban development occurred, resulting in the irreversible interference and destruction of the habitats of living butterflies and moths.

The pressure of human activities and its resulting consequences do not bypass the National Parks. So far in the Tatra National Park single specimens of *Z.* (*M.*) *purpuralis* (Brünn.) have been found; this species appearing to be relatively more numerous, with *Z.* (*Z.*) *filipendulae* (L.), only on the slope of Żar in the Western Tatras Mts.

However, with the decision of the Tatra National Park authorities, despite the protests of entomologists (Batkowski in 1972; Dąbrowski, 1981, 2007; Krzywicki, 1963), this, one of the most valuable TNP ecosystems of xerothermic mountain grasslands, has been earmarked for artificial afforestation, and the habitat has ceased to exist. Carried out consistently, with considerable afforestation effort and cost, led in half a century to the creation of homogeneous artificial spruce atresia of active screes and, consequently, the elimination of communities of numerous xerothermophilous plant and animal species, including species listed in the red books. Yet it has a place in the TNP, where theoretically, all species should be under absolute, both active and passive, protection.

The discovery of a unique secondary habitat formed on set-aside, and then extensively exploited, meadows around the Czarny Dunajec (Fig. A) allowed us to make observations on both the Burnets species under discussion, which occur there in great numbers. This is particularly important, because in larger populations mutations appear more often, leading to significant changes which accelerate the evolutionary processes (e. g., genetic drift).

During the eight-year period of observation 3 apples, 1 banana and 1 pear, with streaks of the front wings and rear wings brown, were found. This shows the direction of genetic drift, which gives preference in these populations to this extremely rare colour aberration. However, no yellow specimen has been found despite the rather numerous specimens with parts of the hind-wings coloured vermillion-yellow within the pcu - an1 - an2 veins. Also no yellow specimens were found in other burnet species occurring on these meadows.

In Europe, *Z.* (*M.*) *purpuralis* (Brünn.) and *Z.* (*M.*) *minos* ([Den. & Schiff.] species are still in the process of speciation - „nascent" - as shown by the population studies carried out on them since the 1950s (Dąbrowski, 1986; Naumann et al., 1983, 1999; Patočka, 2009; Povolný, 1951; Toll, 1947). An important contribution to the understanding of the sympatric speciation processes of these species has been the work of the school of Professor Clas Naumann and his collaborators at the University of Bielefeld (Naumann et al., 1983).

The results of six years of monitoring of the parasitism of burnet species involving the discovery of parasitism of at least 20 caterpillars and 20 pupae of five burnet species collected before the eclosion are presented in Table I.

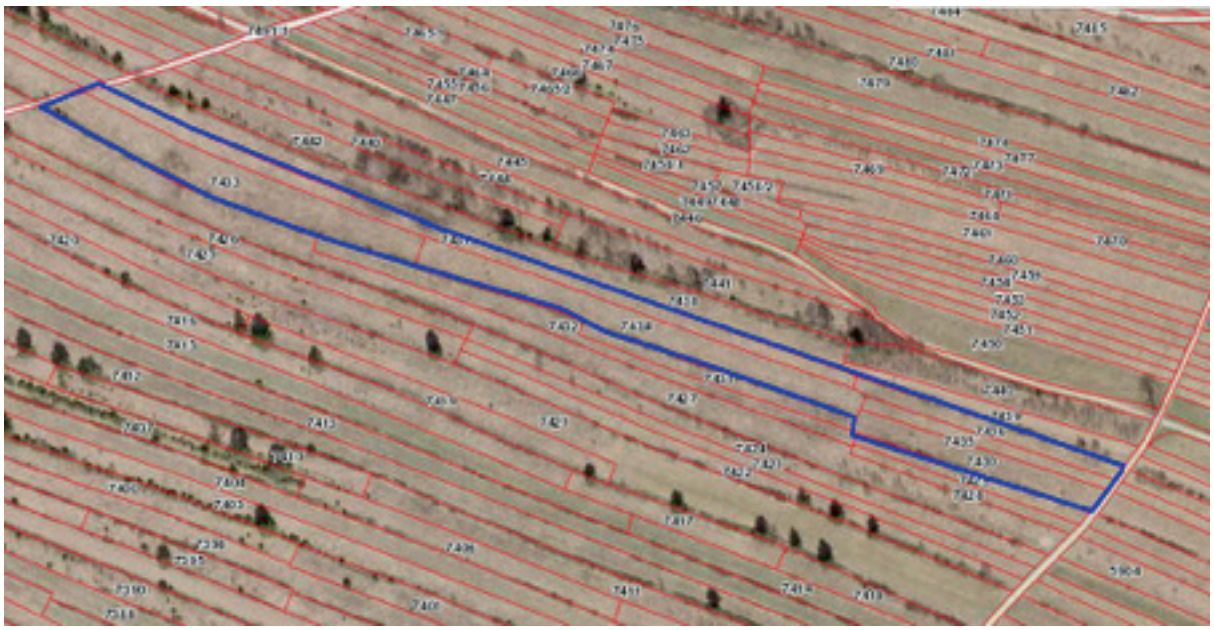

Fig. A: Map of meadows researched in 2005-2016, including plots 7430, 7433, 7434, 7435, 7436, and 7437 - boundaries of the researched meadow. [c.a. 1,6 ha]. (Oryg.)

Year ›	2010	2011	2012	2013	2014	2015
% of parasites / species						
Z. purpuralis (Brünn.)	0	0	0	0	0	0
Z. minos ([D. & S.])	0	0	0	0	0	0
Z. viciae ([D. & S.])	25%	31%	24%	22%	34%	28%
Z. filipendulae (L.)	34%	36%	30%	28%	20%	21%
Z. lonicerae (Schev.)	38%	34%	25%	25%	16%	22%

Table I. The percentage of Burnet parasitism present in their habitat in the Czarny Dunajec vicinity.

There was a lack of data about parasitism of *Z.* (*M.*) *purpuralis* (Brünn.) and *Z.* (*M.*) *minos* ([Den. & Schiff.]) from Podtatrze and TPN area.
Both of these species - beyond Pieniny - occurred very rarely and singly on the area studied or, as in *Z.* (*M.*) *minos* ([Den. & Schiff.]), was not disclosed. Because of this the study of parasitism was not possible. It was the discovery of the habitat in the Czarny Dunajec, where every year they occur in large numbers, that led to the present systematic study. It became apparent in this area that there were no parasitic winged insects (Diptera) and sawflies (Hymenoptera) in the e. l. caterpillars and pupae that were collected and reared. This result was surprising.

Zygaena (*Z.*) *viciae* ([Den. & Schiff.]) - since 1960 the number of these species has been increasing in this area of Poland. The following parasitic wasps have been bred: *Itoplectis curticauda* (Kriechb.); *Brachymeria intermedia* Nees., and parasitic flies: *Exorista larvarum* (L.) and *Phryxe magnicornis* Zett.
Zygaena (*Z.*) *filipendulae* (L.) - the number of moths in the entire area is decreasing. The following parasites have been bred: Sawflies: Hymenoptera: *Apechtis capulifera* (Kriechb.), *Chraman extensor* (L.), *Cotesia limbatus* Marsh., and Diptera: *Exorista larvarum* (L.).
Zygaena (*Z.*) *lonicerae* (Schev.) - populations persist at a constant level with slight seasonal variations. The following parasitic wasps (Hymenoptera) have been bred: *Heplectis viduata* (Grav.), *Mesostenus funebris* (Grav.), *Pristomerus orbitalis* Holmgr., *Charops cantotor* (Deg.), *Aleoides bicoror* (Spin.), *A. esebecki* Htg., *Meteorus unicolor* (Wesm.), *Brachymeria intermedia* Ness., *Neochrysocharis aratus* Walk., alaso the parasitic Dipteran: *Exorista larvarum* (L.).

Spiders play an important role among other natural enemies of burnets. Quite often imagines were found caught in the webs of such species as *Araneus* (Photo. 11), Four spotted orb-weaver, *Araneus quadratus* Clerc, and Cross orb-weaver (Common Cross Spider) *A. diadematus* Clerc. or were attacked on flowers by the crab spider - *Misumena* (pictured) [Goldenrod Crab Spider] *M. vatia* (Clerc.).

Burnets are get caught randomly, but with such a large population it does not have a significant effect on them. Occasionally we observed ant attacks (Formica sp.) (Photo. 13). *Mecoptera* sp. quite often eliminate the burnet pupae gnawing at them through the cocoons. Such characteristic damage is most often caused by the Common Scorpionfly- *Panorpa communis* L. (Photo. 22). In the studied area, they attack the cocoons containing pupae of *Z.* (*Z.*) *lonicerae* (Schev.), *Z.* (*Z.*) *viciae* ([Den. & Schiff.]) and *Z.* (*Z.*) *filipendulae* (L.).

Such predation occurs particularly on drained wetland meadows on exploited high peat bogs. In small burnet populations this can cause significant reduction in their numbers. Birds ignore both, caterpillars and burnet moths, because of their repulsive smell and toxic properties.
From two of the species occurring in this biotope: *Z.* (*M.*) *purpuralis* (Brünn.) and *Z.* (*M.*) *minos* ([Den. & Schiff.]), moths emerge from the first half of June in very large numbers and even en masse up to the second half of that month; sometimes even up to the end of July. Parasites of caterpillars and pupae (!) were not found in them. The third species in terms of numbers *Z.* (*Z.*) *viciae* ([Den. & Schiff.]) suffers little from parasitism of the caterpillars and pupae; moths begin their flight a few days later. *Z.* (*Z.*) *filipendulae* (L.) - most numerous of the species in the 1960s has become progressively rarer. The last specimens of *Z.* (*Z.*) *osterodensis* Reiss were found in the area in the 1980s.

Due to the importance of this ecosystem for fauna, where there exists in a small area so many populations of insects and plants, including protected species which are recorded in the Polish Red Books of plants and animals, including more than 140 species of butterflies and moths (Lepidoptera), it should be covered by partial protection invoked for ecological reasons and located on the „Natura 2000" area.

How long can this particularly important biotope for the fauna of this region exist? Currently, it depends only on the owners of these meadows. If they should decide to apply nitric fertilizers on them, within a few years they will be drowned by nitrophilous grasses, and hundreds of butterfly and moth species and other invertebrates will die, as has already happened on those plots surrounding intensively fertilized large meadows. Currently a natural invasion of shrubs and trees is in progress. Also in this case anthropopressure (human activities) can disrupt the natural evolution of the species living in this enclave. The only salvation would be to legitimize this habitat as covered by active protection „ecological use". This would require buying only about 1.8 hectares of set-aside meadows. Active protection would then only consist of the autumn mowing and removal of mown grass and the removal of overgrown meadow shrubs and trees every two to three years.

Discussion: The species under discussion here had begun to split up probably during or after the interglacial invasion of Anatolian and Caucasian refugium. So far, moths cannot be extracted with absolute certainty and determined according to the characteristics of habitus, and the morphology of their genital apparatus. On the other hand, the caterpillars of both species which feed on distinct species of food-plants differ in coloration.

The work of Professor Clas Naumann and his school (Naumann et al., 1983)* represents significant progress in the study of these two species. However, it revealed a certain gap in their methods: research on acquiring materials ab ovo from laboratory breeding and research on cross breeding of these species was not implemented..

On average, of one hundred specimens flying in the habitat studied near the Czarny Dunajec, about 20% cannot be determined with certainty as to which species they belong by the morphology of the external habitus characteristics and ♂ and ♀ genitals (e. g., Photos. 11, 13). So it does not differ from previously published material of Naumann's school. An overview of the larger series of moths held in European collections confirms this picture (Naumann et al., 1983; Naumann et al., 1999, and own observations).

By contrast, repeated determination of predation of white-cream caterpillars on the leaves of thyme (*Thymus* sp.) is an important observation (photo. 6).

So far it has been assumed that the caterpillars of *Z.* (*M.*) *minos* ([Den. & Schiff.]) are monophagous, associated only with burnet-saxifrages feeding mainly on Burnet-saxifrage *Saxifrage* (*Pimpinella*) *saxifraga* L. and much less sporadically on Greater Burnet-saxifrage *Saxifrage* (*P.*) *maior* (L.) Huds.

2. Survival strategy in populations of burnet moths (Lep., Zyg.) in the peat bog ecotones of the Czarny Dunajec area

Abstract: The authors present their observations of egg-laying by burnet moths on the leaves of trees: grey willow (*Salix* sp.), Scots Pine (*Pinus sylvestris* L.) and other tall plants (*Cirsium* spp.) in the ecotones of high peat bogs and meadows, which are often flooded with water. They deviate from the previously observed behaviour of burnets in which the rule is to lay eggs directly on low food-plants of certain species.

Introduction: The nominative subspecies *Z. l. lonicerae* (Shev.) encompasses the European valleys and meadows situated in the lower montane area - Tatra National Park. A characteristic feature of these populations occurring in the Nowy Targ Basin (Figs. 3, 4) is their adaptation to wetland habitat: edges of bogs, marshes and wet meadows. Similar adaptation has been described in Germany in Baden-Württemberg (Ebert et al., 1994).
Such biotopes are usually inhabited by *Z.* (*Z.*) *trifolii* (Esp.), but at the present time its presence has not been confirmed. Since the mid - 1960s the number of imagines has been increasing from year to year and by the end of the 1990s we had been finding up to 130 specimens per 1 ha of grasslands on the edges of drained bogs. The population of the nominative subspecies occurred here with *Adscita* (*A.*) *statices* (L.), and (*Z.*) *filipendulae* (L.), *Z.* (*Z.*) *viciae* ([Den. & Schiff.]), *Z.* (*Z.*) *osterodensis* Reiss and *Z.* (*M.*) *purpuralis* (Brünn.). A similar increase in the number of moths like Z. (Z) *lonicerae* (Shev.) characterizes the populations of *Z.* (*Z.*) *viciae* ([Den. & Schiff.]) in the area studied. By contrast, the burnet moth (*Z.*) *filipendulae* (L.) became increasingly rare during the study period, and two other species probably became extinct. They are *Z.* (*Z.*) *osterodensis* Reiss - the last specimens, 2 ♂♂, 1 ♀, were found on 29.VI.1985, and *Z.* (*M.*) *purpuralis* (Brünn.)., 1 ♂, on 17.VII.1970.

The biotopes discussed here are characterized by the periodic flooding of the meadows situated within the bogs and meadow - forest ecotones area where for decades drainage operations of the land have been carried out. In June and July this happens during intense rainfall. In the spring, the water from the melting snow periodically submerges low-growing food-plants of burnet moths.

Discussion: Burnet ♀♀ usually lay their eggs directly on the food-plants. After a few to several days, hatching caterpillars join directly in feeding on their leaves until autumn, when they prepare in their first stage (instar) to overwinter in the leaf litter at the plant roots.
The occurrence of *Z.* (*Z.*) *trifolii* (Esp.) has been recorded only in the Pieniny Nat. Park, where a few moths were observed at local, now

disappearing, sites at the headwaters and on drying-out marshes during the 1970s (Dąbrowski, 2007; Zarzycki & Dąbrowski, 1986).

The nearest localities where Z. (Z) *lonicerae* (Shev.) occur, only on arid xerothermic grasslands, are located on the southern slopes of the Pieniny National Park. This population does not tend to occupy wetlands and wet meadows, as is the case in the region of Podhale, TNP and the region of Babia Góra Mt. There the species that occurred was Z. (Z) *trifolii* (Esp.), which has probably become completely extinct in this area.

Among examples observed of so-called. „Survival strategy" in Zygaenidae include:

a.) Protandry, occurring in many species of Lepidoptera. The ♂♂ emerge from a few to several days earlier and actively seek later emerged ♀♀.

b.) An example of the other described strategy of survival was observed in cultures of *Z.* (*Z.*) *ephialtes* (L.) (Dryja, 1959; Holik, 1933). It was found that most of the caterpillars hatching from eggs deposited singly, after overwintering, reach the pupal stage in June the following year, the imagines emerging in July. However a small proportion do not undergo further transformation, wintering again and pupating only after two years. In individual cases the caterpillars can overwinter even longer and moths even emerge after three years (Dryja, 1959).

c.) *Zygaena* (*Z.*) *lonicerae* (Shev.) observed laying eggs on thistles, willows and pines is another example of a survival strategy. A similar phenomenon has been observed in some localities of this species in the Volga region and Siberia (pers. comm. by the late Dr. W. G. Tremewan). The ♀♀ lay eggs, on the average, at a height of 0.5-1.8 m. above the meadow surface. Thus caterpillars by gnawing out of the eggs laid on the leaves of thistles, willow and pine trees are protected from drowning. Of course they do not feed on these plants, and only await the subsidence of the water from the backwaters. They reach food- plants by dropping on to drooping filaments (Photos. 7-10).

3. New habitats of burnet moths (*Zygaena* F.) at the Tatrzański National Park

These localities are located in the region of the Western Tatras and Mt. Giewont in TNP:

1. *Zygaena* (*M.*) *purpuralis* (Brünnich, 1763): Mt. Giewont; 1350-1450 m asl., 22.VII.2013, ♂.
2. *Zygaena* (*M.*) *purpuralis* (Brünnich, 1763): Jamborowy Wierch; 1350-1450m asl., 22.VII.2013, 1 ♂.
3. *Zygaena* (*Z.*) *viciae* ([Den. & Schiff.], 1775): Jamborowy Wierch; 1350-1450m asl., 9.VIII.2009, about 5 specimens; Jamborowy Wierch; 10.VIII.2010; 1350-1450m asl., about 6 specimens; Jamborowy Wierch; 1350-1450m asl., 8.VIII.2012., about 5 specimens; Jamborowy Wierch; 1350-1450m asl, 19.VIII.2013., about 3 specimens; Dolina Tomanowa Niżna, Tomanowa - Polana, 14.VII.2009., 1300 m asl., 1 specimen.

Systematic review

Explanation of symbols used: * – species currently exists; # – species disappearing rapidly; ? – species not found, but occurrence possible; +? – probably extinct species

Family: Zygaenidae
Subfamily: Procridinae
Genus: *Adscita* Retzius, 1783
Synonyms: *Ino* Leach, 1810; *Procris* Fabricius, 1897 - Subgenus: *Adscita* Retzius, 1783
Synonyms: *Procris* s. str.
1.* *Adscita* (*Adscita*) *statices statices* (Linnaeus, 1758) - Genus: *Rhagades* Wallengen, 1863
Subgenus: *Rhagades* Wallengen, 1863
2. +? *Rhagades* (*Rhagades*) *pruni callunae* (Spuler, 1910)
Subfamily: Zygaeninae
Genus: *Zygaena* Fabricius, 1775
Synonym: *Anthrocera* Scopoli, 1777
Subgenus: *Mesembrynus* Hübner, [1819]
3. +? *Zygaena* (*Mesembrynus*) *cynarae cynarae* (Esper, 1789)
4. +? *Zygaena* (*Mesembrynus*) *brizae brizae* (Esper, 1800)
5. *# *Zygaena* (*Mesembrynus*) *minos normanna* Verity, 1922
6. *# *Zygaena* (*Mesembrynus*) *purpuralis purpuralis* (Brünnich, 1763)
Subgenus: *Zygaena* Fabricius, 1775
7. * *Zygaena* (*Zygaena*) *loti achilleae* (Esper, 1780)
8. +? *Zygaena* (*Zygaena*) *osterodensis osterodensis* Reiss, 1921
9. * *Zygaena* (*Zygaena*) *viciae viciae* ([Denis & Schiffermüller], 1775
10. +? *Zygaena* (*Zygaena*) *ephialtes peucedani* Esper, 1780
11. *# *Zygaena* (*Zygaena*) *angelicae angelicae* Ochsenheimer, 1808
12. *# *Zygaena* (*Zygaena*) *filipendulae filipendulae* (Linnaeus, 1758)
13. +? *Zygaena* (*Zygaena*) *trifolii trifolii* (Esper, 1783)
14. * *Zygaena* (*Zygaena*) *lonicerae lonicerae* (Scheven, 1777)

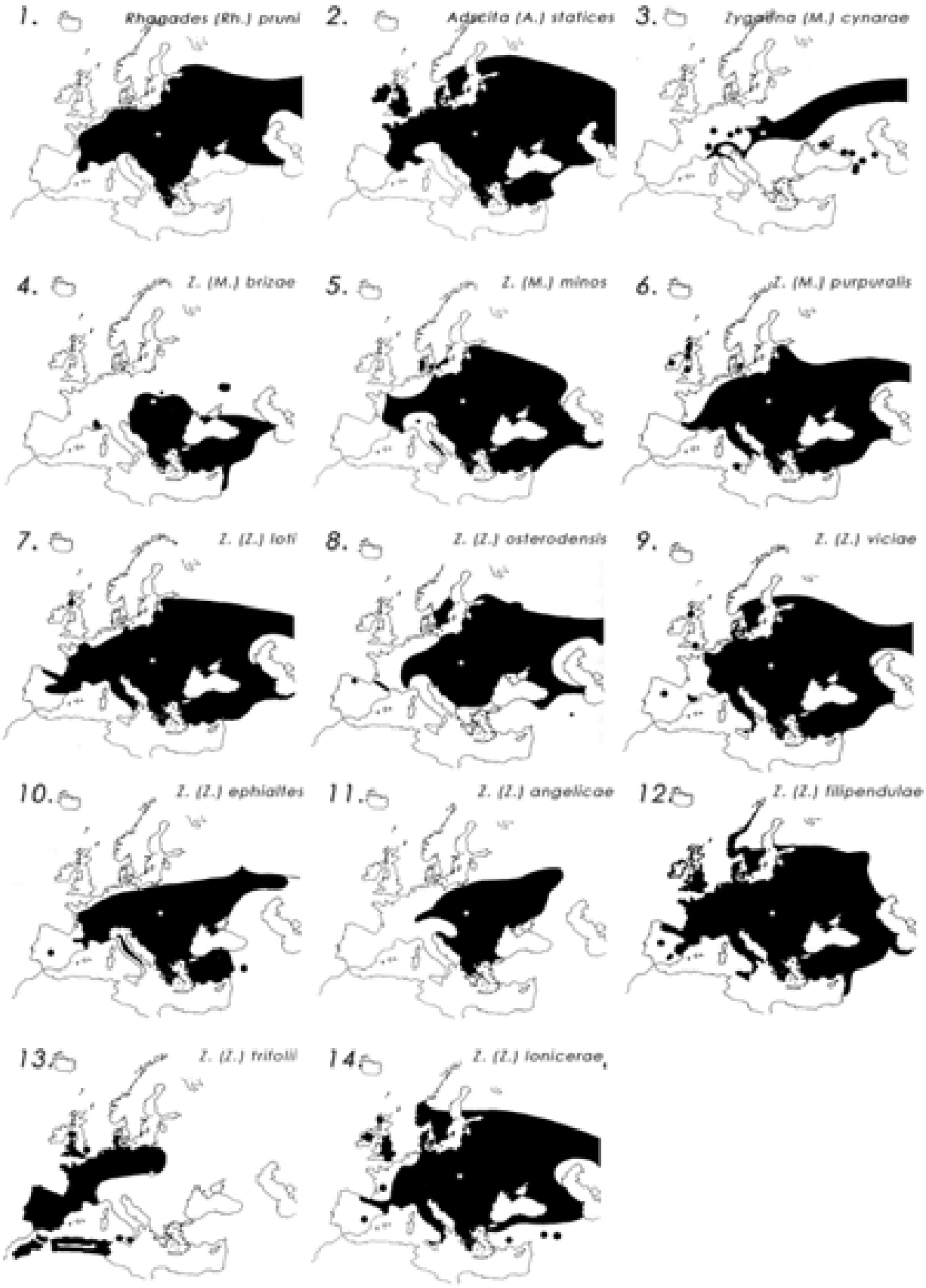

Fig. B: The geographical ranges of species discussed.

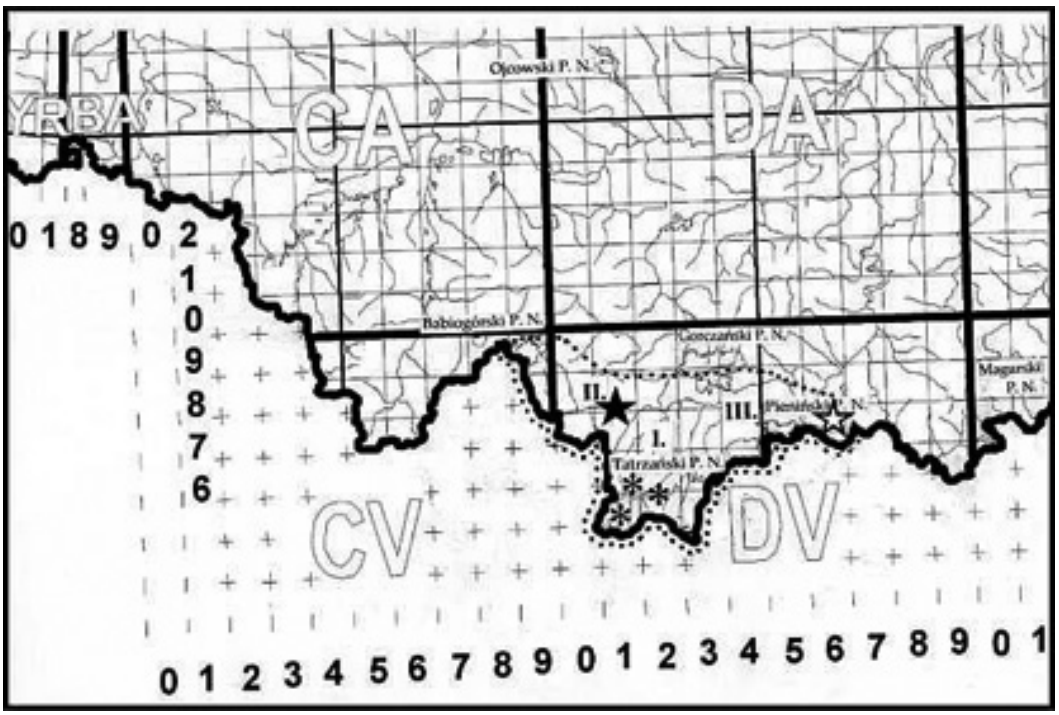

Fig. C: Investigated area on UTM map. Regions: I - Podhale; II - Babia Góra with Babia Góra Nat. Park and Polish part of Orawa; III - Pieniny Mts. With Pieniński Nat. Park and Orawsko - Spiskie plateau; Tatra Mts. and Tatra Nat. Park. (Oryg.)

★ Site of observations in Pieniny Nat. Park;
* Site of observations in Tatra National Park; • • • • • • Boundary of investigated area;
Frontier between Poland and Slovakia.

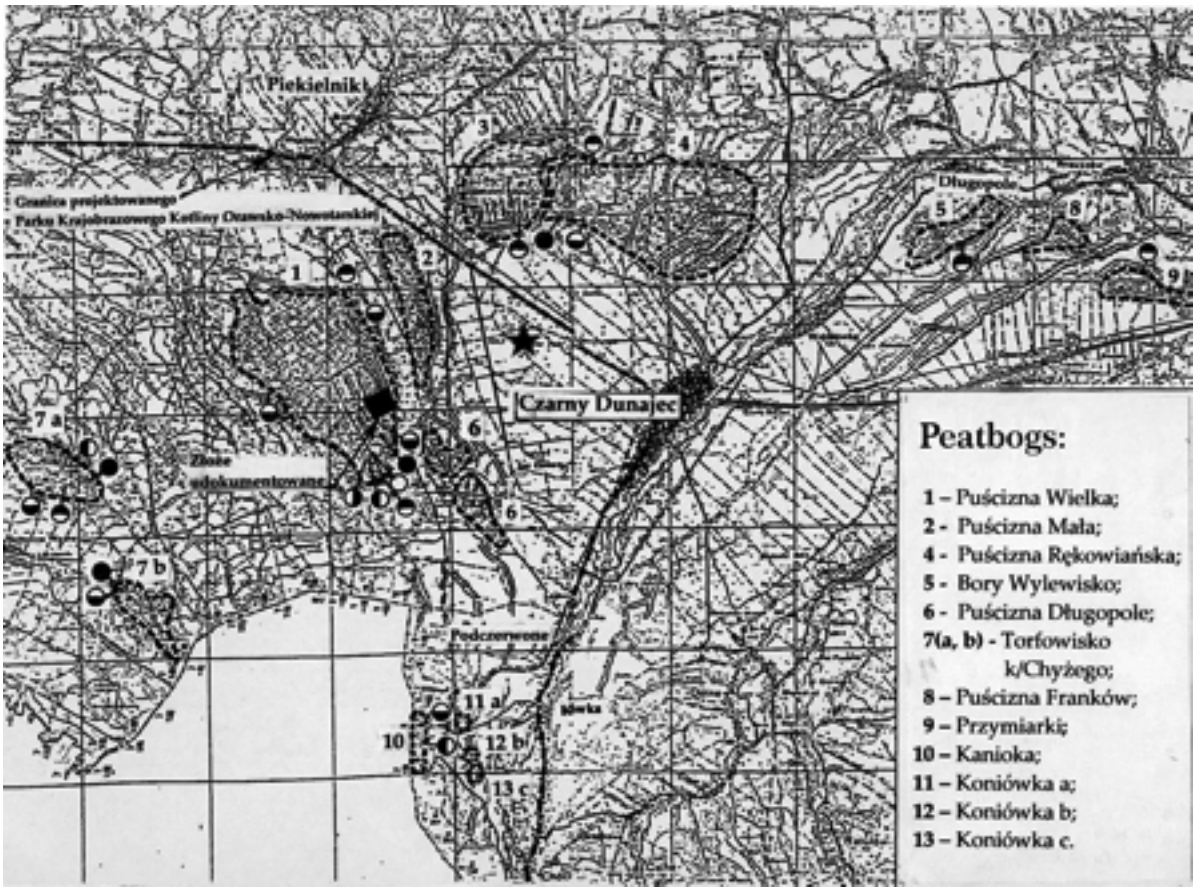

Fig. D: Occurrence of Zygaenidae in vicinity of Czarny Dunajec (Nowotarsko - Orawska Valley) (Oryg., on the substrate of map according to Płaskociński, 2002).

Concluding remarks: Anthropopressure (human activities) on living habitats is driving ahead of the development of natural evolutionary processes. This dominant factor influences the evolution and zoogeography not only of the taxa discussed here; it is also the cause of the disappearance of a growing number of animal and plant species, reducing the biodiversity in all environments of life. Until the mid-fifties of the twentieth century insect collectors had been catching them freely outside of national parks and nature reserves. This activity underwent a gradual reduction in the second half of the twentieth century. Permits for catching invertebrates began to be required, not only in national parks and nature reserves, but also in state forests, landscape parks and biosphere reserves. In the twenty-first century, thanks to the activity of environmental and political organizations, more and more countries prohibit any harvesting and collecting of invertebrates throughout all territories.

In this context, the role of natural history museums should be increasing. However, the resources of evidence are generally stored in underfunded and unprofessionally run museums. They permanently undergo irreversible losses in Europe (Andreone et al., 2014) and Poland (Dąbrowski, 2014). Meanwhile, the development of genetics, taxonomy and other natural sciences compel more frequent revision of plant and animal species described in earlier publications. Furthermore, specimens stored even in the Polish Academy of Sciences and Skills' natural history museums, universities, etc., continue to degrade. Voucher specimens from the areas devastated by anthropopressure and climate change are being lost. The main reasons, among other things, are improper maintenance, poor exposure, and even disposal of the collections. The uncontrolled trade of insects is developing on international markets and on the Internet, and there are even recorded instances of stealing from museum collections.

A drastic example are the museums of national parks. It is apparent that many of them do not have sufficient funds to meet the budget. They do not have the money to alleviate depreciation. Therefore expensive museum investments and exhibitions lack the funds for their maintenance. This explains indirectly the liquidation of collections. Lack of money to maintain the proper condition of both the building and the collections result in the building being protected first, only then possibly the collections. Hence the lack of motivation for keeping the valuable collections, not to mention their digitalization and adequate description on the Internet.

Decision-makers do not appreciate or even ignore the importance of natural history museums. It threatens further rational progress in ecological, conservation and fauna studies. To continue them is becoming more difficult because of the lack of ability to compare the currently existing species with „banks" of local taxa stored in museums.

Financial support earmarked by the EU is mostly already wasted at the level of ministries. Designation of reserves or ecological projects break down through bureaucratic blockades. Instead, expensive simulated acts are implemented. These usually have a quite negative impact on the biodiversity of scientifically valuable living habitats and endangered species.

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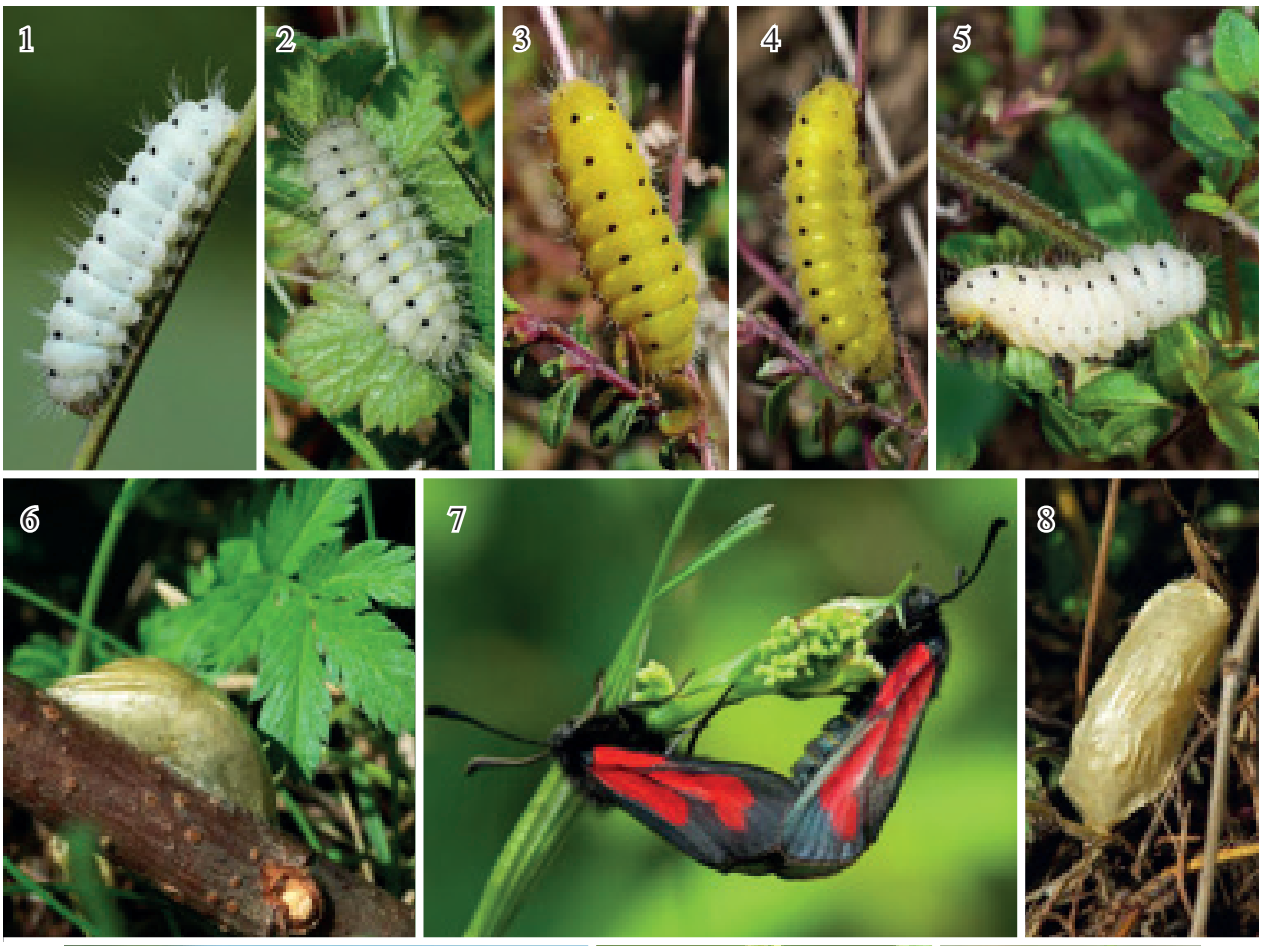
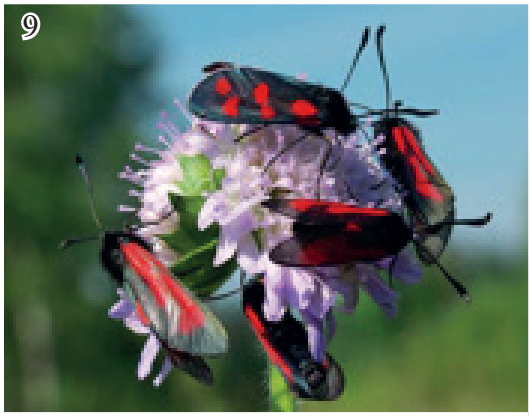
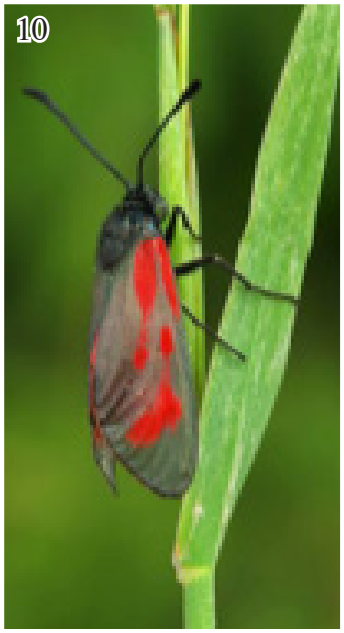






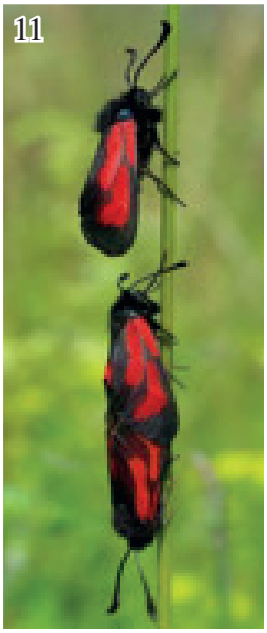


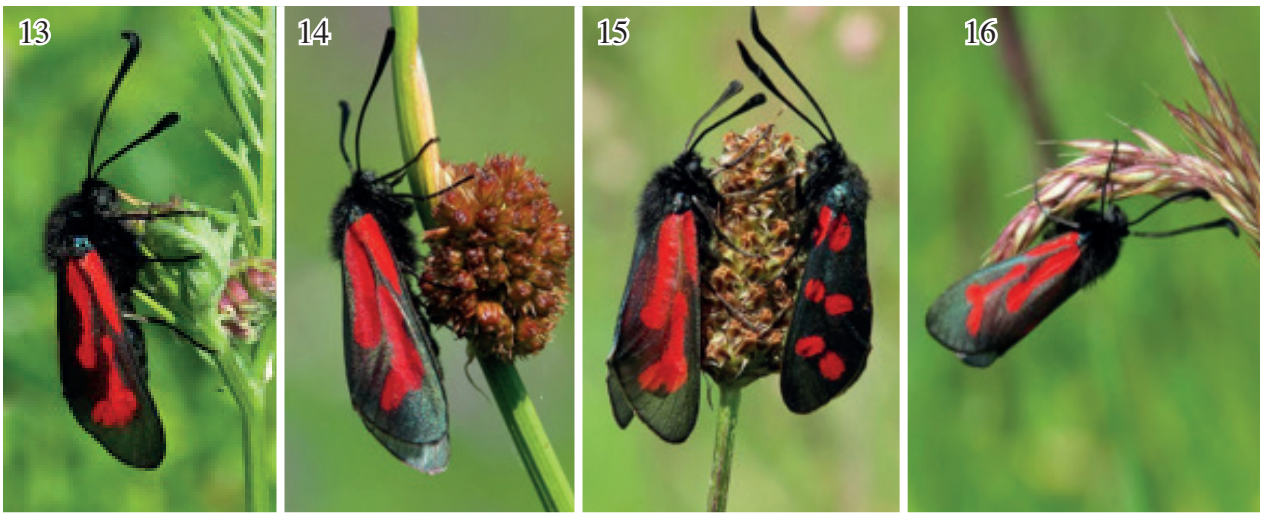
Fig. 1, 2, 5, 8, 10, 12: *Zygaena* (*M.*) *minos* ([Den. & Schiff.], 1775); (1) caterpillar; (2) caterpillar on *Pimpinella saxifraga* L.; (5) caterpillar on *Thymus* sp.; (8) pupa in the cocoon; (10) ♀; (12) copula.

Fig. 3, 4, 6: *Z.* (*M.*) *purpuralis* (Brünnich, 1763); (3, 4) caterpillar on *Thymus* sp.; (6) pupa in the cocoon;

Fig. 7: *Z.* (*M.*) *purpuralis* (Brünnich, 1763) ♂ x *Z.* (*M.*) *minos* ([Denis & Schiffermüller], 1775) ♀.

Fig. 9: Group of *Z.* (*Z.*) *filipendulae* (L.), below ♂ *Z.* (*M.*) *purpuralis* (Brünn.) and 1 ♂, 2 ♀♀ *Z.* (*M.*) *minos* ([Den. & Schiff.]) on *Scabiosa* sp.

Fig. 11: *Z.* (*M.*) *purpuralis* (Brünnich, 1763) ♂ and copula of *Z.* (*M.*) *minos* ([Den. & Schiff.])?



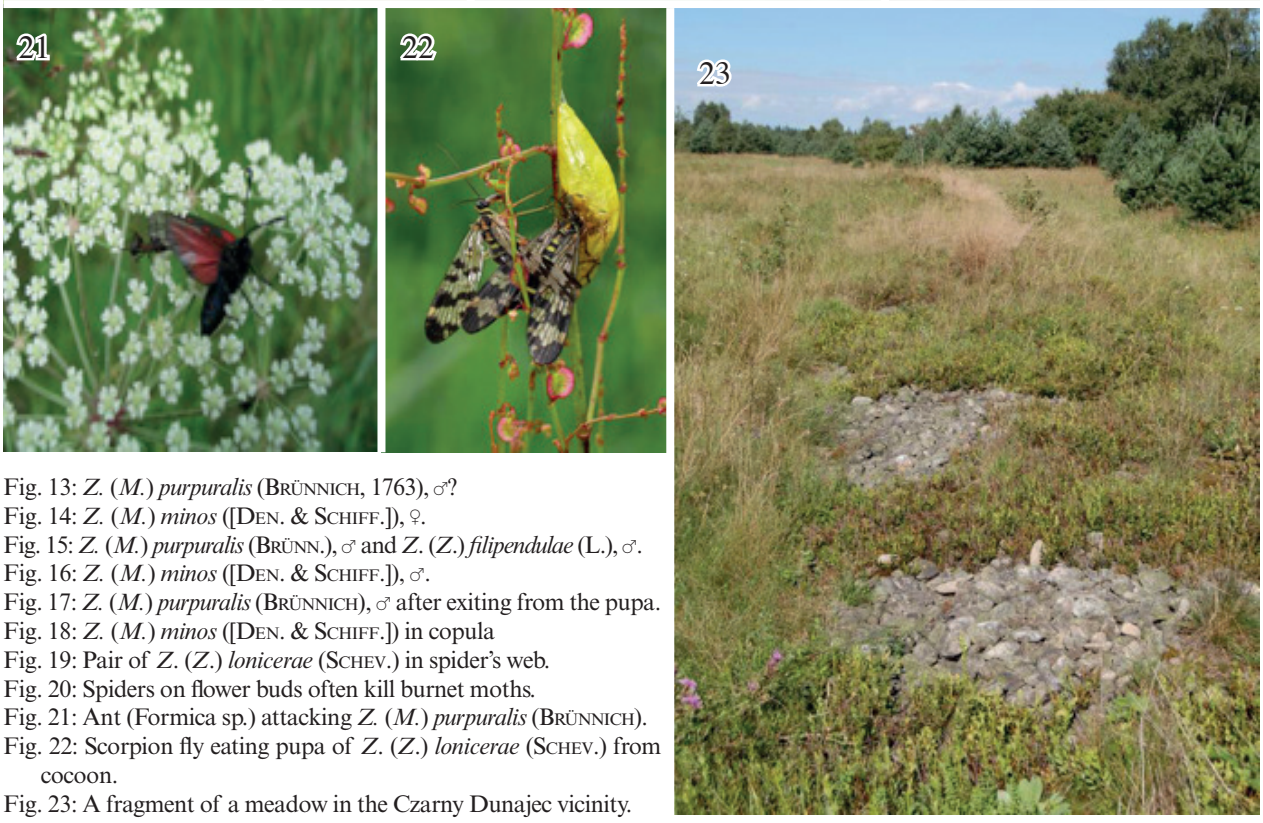


Fig. 13: *Z.* (*M.*) *purpuralis* (Brünnich, 1763), ♂?
Fig. 14: *Z.* (*M.*) *minos* ([Den. & Schiff.]), ♀.
Fig. 15: *Z.* (*M.*) *purpuralis* (Brünn.), ♂ and *Z.* (*Z.*) *filipendulae* (L.), ♂.
Fig. 16: *Z.* (*M.*) *minos* ([Den. & Schiff.]), ♂.
Fig. 17: *Z.* (*M.*) *purpuralis* (Brünnich), ♂ after exiting from the pupa.
Fig. 18: *Z.* (*M.*) *minos* ([Den. & Schiff.]) in copula
Fig. 19: Pair of *Z.* (*Z.*) *lonicerae* (Schev.) in spider's web.
Fig. 20: Spiders on flower buds often kill burnet moths.
Fig. 21: Ant (Formica sp.) attacking *Z.* (*M.*) *purpuralis* (Brünnich).
Fig. 22: Scorpion fly eating pupa of *Z.* (*Z.*) *lonicerae* (Schev.) from cocoon.
Fig. 23: A fragment of a meadow in the Czarny Dunajec vicinity.

Fig. 24: Meadows in Czarny Dunajec viewed from south to north.
Fig. 25: Meadows in Czarny Dunajec viewed from north to south.

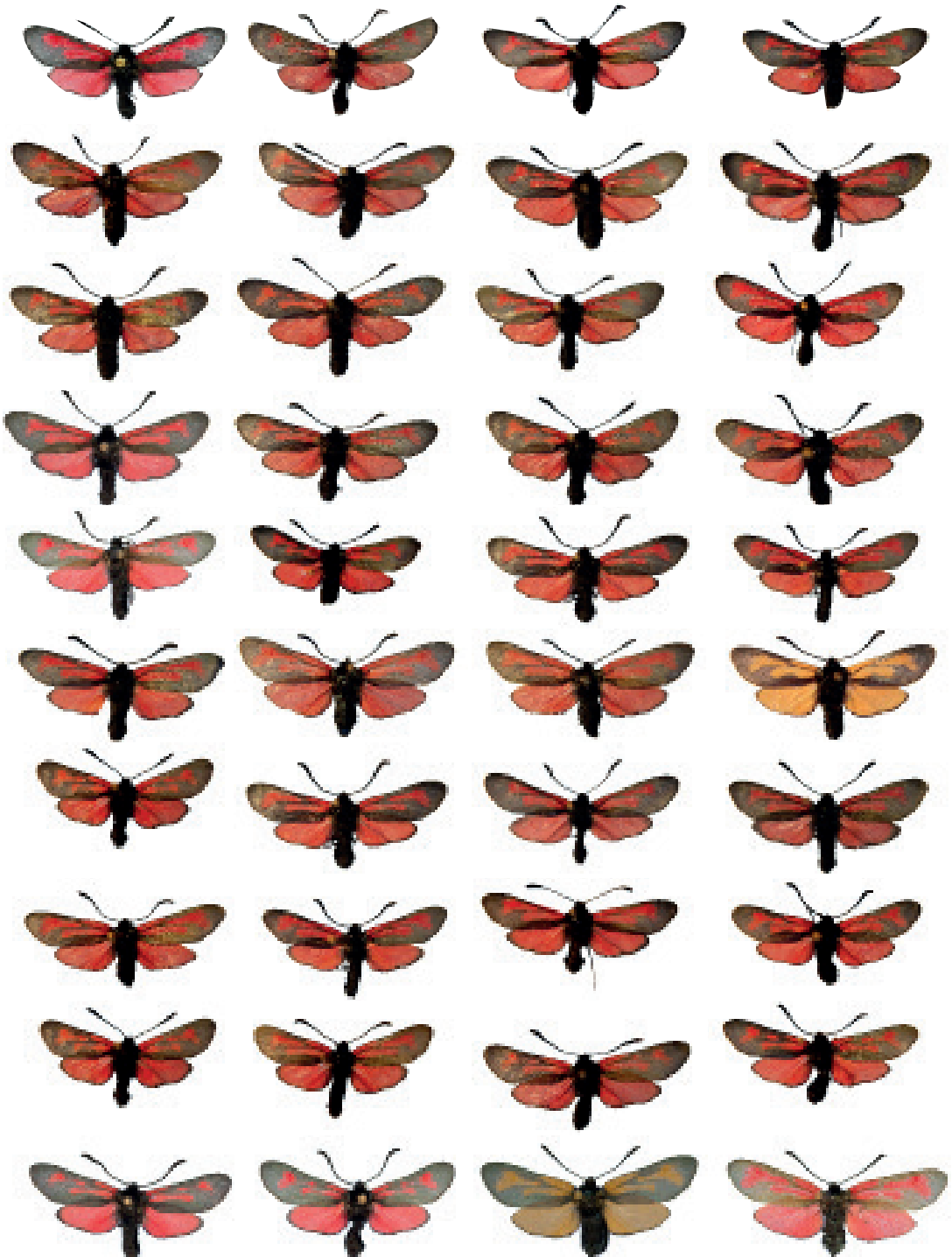


Fig. 25: Individual variation of *Zygaena* (*M.*) *purpuralis* (Brünnich, 1763) and *Zygaena* (*M.*) *minos* ([Den. & Schiff.], 1775) from the habitat in the Czarny Dunajec in the years 2005-2016.

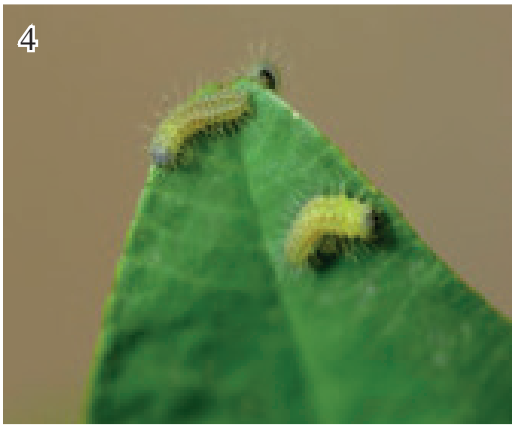


Fig. 1-4, 7: *Zygaena* (*Zygaena*) *lonicerae lonicerae* (Scheven, 1777); (1) eggs on pine needles; (2) eggs on a willow leaf; (3) hatching caterpillars on a willow leaf; (4) caterpillars waiting for the possibility of transition to a food-plant; (7) caterpillars living on the tall thistles in marshy meadows.
Fig. 5, 6: Habitat of burnets inundated during local flooding.

Ad Part III

Fig. 1: *Zygaena* (*M.*) *purpuralis* (Brünnich, 1763), ♂, 17. VII. 2016; Giewont, 1500 m asl.

Fig. 2: Jamborowy Wierch 1350-1450-m asl., biotope of *Zygaena* (*M.*) *purpuralis* (Brünnich, 1763) and *Zygaena* (*Z.*) *viciae* ([Denis & Schiffermüller], 1775).