

P O L I S H J O U R N A L O F E N T O M O L O G Y
P O L S K I E P I S M O E N T O M O L O G I C Z N E

VOL. 78: 265-275

Bydgoszcz

30 September 2009

**Biology and ecology of the Jutta Arctic *Oeneis jutta* (HÜBNER, 1806),
(Lepidoptera: Nymphalidae)**

LECH KRZYSZTOFIAK, ANNA KRZYSZTOFIAK, MACIEJ ROMAŃSKI

Wigry National Park, Krzywe 82, 16-402 Suwałki, Poland

ABSTRACT. Data on biology and ecology of the butterfly *Oeneis jutta* occurring within Poland territory are presented. Two confirmed sites of this species located in the Augustowska Primeval Forest, on a raised bog with pine tree stand and in a forest – peat bog complex are described. The only food plant for *Oeneis jutta* caterpillars is *Eriophorum vaginatum*. Adult butterflies fly c.a. six weeks, starting from the early days of May. Males appear 7-9 days before females. Peak appearance falls on the turn of May and June. In Poland the species has one-year life cycle, i.e. one generation per year and overwinters as larvae. The main predator is the dragonfly *Orthetrum cancellatum*.

KEY WORDS: *Oeneis jutta*, Lepidoptera, Satyrinae, raised bog, Augustowska Primeval Forest, Poland, life cycle, ethology.

INTRODUCTION

Oeneis jutta (HÜBNER, 1806) is the only representative of the genus *Oeneis* HÜBNER, 1819 in Poland. Nowadays this genus is included into the subfamily *Satyrinae* (the Wood-nymphs or Satyrs) within the family *Nymphalidae* (the Brush-footed butterflies). Adult butterflies are medium-sized with brown-grey upper side of wings. In Poland, males have wing-spread of 50.8-57.4 mm, while females of 52.6-62.4 mm (KRZYSZTOFIAK et al. 2009). On wings, they possess black spots with grey-yellow margins and grey-yellow spots.

Oeneis jutta is a boreal element occupying a zone of light coniferous forests and bogs in northern Eurasia – from Scandinavia via northern Europe, Siberia, Mongolia and China to Tsukotsky Peninsula and North America (BUSZKO 1993, BUSZKO & MASŁOWSKI 2008, LUKHTANOV & EITSCHBERGER 2000, SCOTT 1986). In Europe, the species occurs only in Poland, Sweden, Norway, Finland, Russia, Byelorussia, Latvia, Estonia and Lithuania. On our continent, the southern border of his geographical range crosses Poland and Byelorussia

(KUDRNA 2002). Hitherto existing literature data on distribution of the *Oeneis jutta* in Poland have been of little precision. In the end of the 20ties of the 20th century, ROMANISZYN and SCHILLE (1929) reported the species from the neighbourhood of Suwałki city and KRZYWICKI (1966) recorded him in Suwałki district and in the north-eastern region of the country. DĄBROWSKI and KRZYWICKI (1982) located a site in UTM (Universal Transverse Mercator) grid as FE36 indicating the presence of *Oeneis jutta* in a south-western part of the Augustowska Primeval Forest. As a result of the recent survey (KRZYSZTOFIAK et al. 2009), two localities of *Oeneis jutta* were precisely determined: the first in the Wigry National Park in a strictly protected reserve the “Suche Bagno” bog and the second in the southern part of the Augustowska Primeval Forest near Skieblewo village. Both sites lie at a distance of about 30.5 km one from the other.

Oeneis jutta is a relict of the last glaciations occurring in Poland within a small area and threatened by extinction. Since 2001, the species has been protected by law according to the Decree of the Ministry of the Environment (ROZPORZĄDZENIE MINISTRA ŚRODOWISKA 2001) and since 2004 has been regarded as a species demanding active conservation strategy (ROZPORZĄDZENIE MINISTRA ŚRODOWISKA 2004). *Oeneis jutta* is also included as endangered species (EN) in “The Red List of Vanishing and Threatened Animals in Poland” (GŁOWACIŃSKI 2002) and in “The Polish Red Data Book of Animals” (GŁOWACIŃSKI & NOWACKI 2004).

Up to the present, no detailed studies on biology and ecology of *Oeneis jutta* in Poland have been conducted. In this publication, a part of results of the survey „Strategy of *Oeneis jutta* population development in the north-eastern Poland and perspectives of the species protection in the Wigry National Park” (Project No 2 P04F 003 30 supported financially by the Polish Science Budget in the years 2006-2009) is presented.

METHODS

Investigations were conducted in the Augustowska Primeval Forest in the years 2006-2008. Adult butterflies were observed in two localities: near Skieblewo village and in the “Suche Bagno” bog, while pre-imago forms only in the latter site. For thorough studies on a life cycle of the butterfly, special aviaries were built, into which fertilized females before egg-laying were placed. Observations on larvae development and subsequently on pupae were done every 1-3 weeks until imago emerged. During regular inspections, habits of caterpillars, localization of caterpillars and pupae and their size were documented. In both localities, habitats were described by phytosociological plots according to Braun-Blanquet’s method.

RESULTS

Habitat preferences

Oeneis jutta prefers quite peculiar habitat conditions and therefore his occurrence is restricted to raised bogs and clear marshy coniferous forests. Butterflies of this species were observed only in two localities. One of them is situated within a strictly protected area of the "Suche Bagno" bog in the Wigry National Park. The whole strictly protected part covers c.a. 28.5 ha and include a raised bog of forest type *Ledo-Sphagnetum magellanici*, a marshy coniferous forest *Vaccinio uliginosi-Pinetum* and intermediate vegetation between these two associations. *Oeneis jutta* individuals were found in a central part of the raised bog overgrown by loose and dwarf tree stand of thin trunks and characteristic dwindle crowns. Such environment is poor in plant species and has monotonous spatial form. The tree stand is composed nearly entirely of pine *Pinus sylvestris* with admixture of Downy birch *Betula pubescens* growing on margins and in intermediate parts towards the marshy coniferous forest. Pine trees here are of a peculiar shape – though they are 80 years old, their trunks are only 3-6 m high and breasts measurements 7-17 cm in diameter. Moreover, the trees are nearly branchless up to 1.5-2.0 m height and only at the top they possess little crowns.

Besides dwarf pines, the very typical component of such environment are dense patches of Wild rosemary *Ledum palustre* with admixture of Bog bilberry *Vaccinium uliginosum*. The ground cover flora is extremely poor, only one species – Cotton grass *Eriophorum vaginatum* is abundant. Additionally, in this layer one may find species characteristic for raised bogs, especially Sundew *Drosera rotundifolia*, Cranberry *Vaccinium oxycoccus*, Andromeda *Andromeda polifolia* and Heather *Calluna vulgaris*. Moss layer is composed mainly of peat mosses *Sphagnum magellanicum*, *S. rubellum* and *S. fuscum*, and in more desiccated places also of *Polytrichum strictum*.

Analyzing the structure of the described above environment together with flight-tracks of *Oeneis jutta* individuals, one may presume that the butterfly occurs in various density round an area of about 10 ha covered by the raised bog with dwarf tree stand.

The second site of *Oeneis jutta* is located in a forest-bog complex in the southern part of Augustowska Primeval Forest, between the villages Wyżarne (on the west) and Skieblewo (on the east). In the south, the area is bordered by Augustów-Lipsk road, while in the north adjoins a valley of Wolkuszanka river. The whole territory is composed of unusual mosaic of marshy and boggy habitats. There occur marshy coniferous forests *Vaccinio uliginosi-Pinetum* representing various succession phases, pieces of raised bogs with dwarf trees that distinctly differ from typical forms, and patches of boreal birch marshy forests and alder carr forests.

The area, around which *Oeneis jutta* was noticed covers c.a. 50 ha and is not homogenous. This peat bog complex has been partially affected by men and therefore some of its parts are difficult to be classified precisely. The northern part of the complex is covered by a quite homogenous patch of a peat bog with birch tree stand. In the west and the north, the

patch is surrounded by wet alder carr forests, frequently with strongly expanded bush layer. In the east, the peat bog adjoins a marshy forest, a bit more dry and with more rich flora, among which Greek valerian *Polemonium coeruleum* is quite abundant. The presence of this species could testify to meadow character of the area in the past. In the south, the peat bog patch borders the marshy coniferous forest *Vaccinio uliginosi-Pinetum*. In its southern part, share of dwarf pines increases and enclaves linking more distinctly to a raised bog of forest type *Ledo-Sphagnetum magellanici* appear. Apart from the tree stand, the bush layer as well as the ground cover and the moss layer all have species composition typical for this association.

At the south-western edge, the described above peat bog patch is separated from another more open bog by a belt of marshy coniferous forest. This part is associated by two larger deforested areas with mass development of Cotton grass *Eriophorum vaginatum* and quite significant share of Black crowberry *Empetrum nigrum*. South-westwards from the marshy coniferous forest belt begins the second patch similar to a raised bog with dwarf tree stand. Its structure is more distinctly of "hummock and hollow" character in comparison to the patch described above. Physiognomy and species composition are more adequate to *Ledo-Sphagnetum magellanici*, though this patch is not a typical form of a raised bog of forest type either. Pines, though dwarf and of very low forest quality class are more massive comparing to the trees from the "Suche Bagno" and grow much more densely. This habitat is more fertile than typical *Ledo-Sphagnetum magellanici*. The bog patch is surrounded by marshy coniferous forest *Vaccinio uliginosi-Pinetum* and only in the south-eastern part adjoins a patch similar to alder carr forest.

Food plants

Observations in other countries have proved that caterpillars of *Oeneis jutta* feed on leaves of Cotton grasses *Eriophorum*, e.g. on *E. vaginatum*, Sedges *Carex*, e.g. *C. concinna*, *Molinia caerulea* and of some species of Rushes *Juncus* and Manna grass *Glyceria* (OPLER & WRIGHT 1999, HENRIKSEN & KREUTZER 1982, PYLE 1981, LAYBERRY et al. 1998).

Observations on feeding caterpillars of *Oeneis jutta* in the bog „Suche Bagno" have proved that the only food plant for them is *Eriophorum vaginatum*.

For adult butterflies, a source of food (nectar) are flowers of *Ledum palustre*, *Vaccinium uliginosum*, *Vaccinium oxycoccus* and probably of *Andromeda polifolia*. Drinking off nectar from Wild rosemary flowers was reported also by other scientists (e.g. HOOPER 1973, LAYBERRY et al. 1998). No nourishment preferences have been noticed. The observed adults fed on nectar of listed above plants in similar proportion.

Phenology of appearance

During the study period (2006-2008), in the „Suche Bagno" area the earliest flights of adult butterflies were observed in the first week of May. In the beginning only males ap-

peared, 7-9 days earlier than females (protandry). As time went by and adults gained, sex structure of the population changed (Fig. 1). The greatest number of butterflies appeared on the turn of May and June and dominancy of males was still distinct. In the end of the first week of June, the number of adults rapidly decreased and among flying individuals females begun to prevail. The last butterflies (females) were noticed in the middle of June.

In the bog near Skieblewo village, adult butterflies appeared in similar periods. The first flying individuals were observed in the end of the first week of May, while the last ones – in the end of the first week of June.

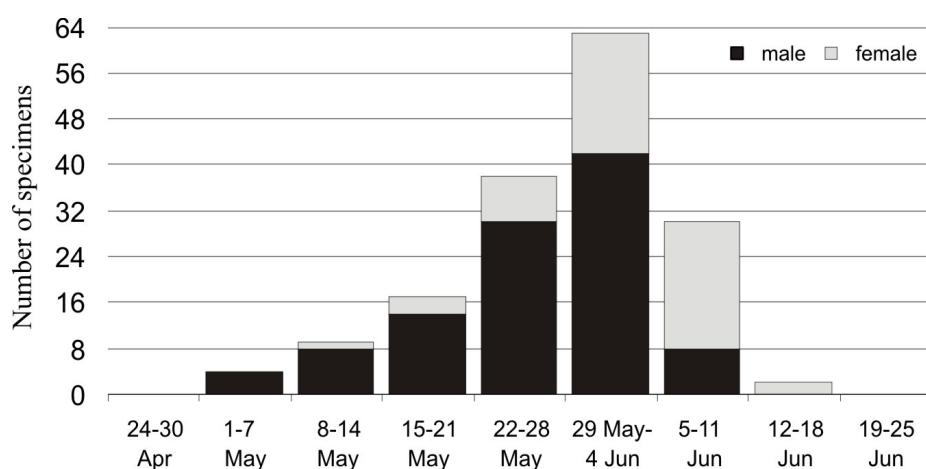


Fig. 1. Seasonal distribution of adult collection Jutta Arctic.

Life cycle

In Poland, *Oeneis jutta* has an annual complete life cycle. In the half-May, when first females appears, mating occurs. Fertilized females have been laying eggs from the second half of May till the first half of June. A mature female produces maximally 72 eggs. It takes several days for eggs to hatch and finally larvae (caterpillars) emerge from them. Caterpillars start to eat and meanwhile molt several times. In the end of the growing season (October), caterpillars reach a length of 27-31 mm (in a resting position) and prepare to overwinter. They spend this time hidden in peat mosses (*Sphagnum*) at a depth of several or a dozen or so centimeters. Caterpillars do not stay in the same place all the time, they may move along a peat column depending on temperature and ground water table. The authors noticed that when temperature had decreased, larvae moved down the pit but when water level had lifted up, they moved nearly up to the surface of the peat. Next year, in the end of April larvae transform into pupae which spend 20-24 days buried in *Sphagnum* layer. Afterwards,

adults emerge from pupae shells. Egg laying and imago appearance are expanded in time. Pupae stage may be still found in the end of May.

Egg: spherical or slightly ellipsoid, average dimensions 1.3 x 1.1 mm; outer casing built up of radiate pearly ribs; at the moment of laying colored white-creamy, but as embryo develops, inter-rib stripes become grey;

Larva (caterpillar): cigar-shaped, 30-34 mm long, anal segment bifurcate; body covered by short brown bristles, colored honey-yellow with darker brown-reddish back side which disappeared in the end of the growing season (October); along the whole body three brown stripes are present – a wider one on a back and narrower, sometimes weakly visible on both sides; head light brown with six black stripes;

Pupa: stocky, 16 mm long and 8 mm wide (at a widest point); body brownish-yellow with well visible outlines of wings, proboscis, legs and antennae, compound eyes and rows of spots on abdomen; free living, not anchored to a substrate;

Imago (adult butterfly): medium-sized with wing-spread of 43.0–62.4 mm, upper side of wings brown-grey with black spots encircled grey-yellow; females usually possess 3 spots on each fore wing and 2 spots on each hind wing, males have usually 3 spots on each fore wing and 1 spot on each hind wing; sometimes males have very small black spots or lack them and in this case only grey-yellow spots are present; females usually have 5 grey-yellow spots on each wing but males only 4 of them; underside of fore wings with similar pattern like upper side, while underside of hind wings with grey-tawny marble pattern and a central stripe slightly darker than background; dark elongated aromatic fields for attracting females distinctly visible on males' fore wings.

Ethology

Three aspects of *Oeneis jutta* behaviour are considered, i.e. reproduction, thermoregulation and nourishment. Results of observations presented below refer to populations from the two investigated localities in Poland: the “Suche Bagno” raised bog and the site near Skieblewo village.

Reproduction: *Oeneis jutta* has evolved specific reproduction behaviour. Similarly to many other insects (CARVALHO et al. 1998, FISCHER 1998), his males appear before females, 7-9 days earlier. Probably, such habit allow males to prepare better for mating, while later emerging of females may serve as defense strategy against predators. In a period of the sole males' appearance, short-distance flights of single males or peculiar patrols of 2-3 individuals flying one before another have been observed. These flights take place c.a. 2 m above a peat surface and last usually not longer than several seconds. When first females appear, males change their manners. They fly towards bases of tree trunks and then continue quite fluent upward flights along trunks until they reach first branches at a height of 1.5-2.0 m. Then they repeat identical flights along another trunk. In this way males search for females sitting on tree trunks. Females' flights are different, they move at a height of about 1.5 m and reaching a tree trunk sit on it.

When a male meet a sitting female, they both rise and fly together before mating. Mating adults usually sit on tree trunks, sometimes on tree branches or plants. When disturbed, they may start to fly again still being attached one to each other.

A female lay eggs by scattering them nearby a host plant. In all observed egg-laying cases, a butterfly sat on a tree trunk or branch, at a height not greater than 1 m above a peat bog.

Thermoregulation: For good functioning, butterflies must maintain optimum temperature of their bodies. Very often, their behavior involves thermoregulatory aspects like searching for places of suitable temperature or basking in direct sunlight (CASEY 1981 & SCHMIDT-NIELSEN 1997).

During field inspections, *Oeneis jutta* individuals were observed under various weather conditions and at different daytime. By cloudy weather and low air temperature, no flying individuals were recorded and flushed butterflies after flying upwards quickly sat down again on tree trunks or plants. Also, in the end of the day when air temperature decreased intensity of flights declined nearly to zero. By variable weather, butterflies begun to fly when sunlight rays occurred. However, when the sun was shaded by a cloud, butterflies remained motionless. Additionally, distinct tendency to prefer more open areas was noticed – the most of flying individuals occurred along a forest line, above small glades or in loose tree stand. Intensive flights were observed even when air temperature raised up to 30°C.

Very important role in butterflies' thermoregulation play their wings. Nearly all observed individuals folded their wings upwards when sitting on a substrate. Only in a few cases, after little rainfall and by a warm weather, they kept their wings spread perpendicular to sunrays. However, majority of the observed individuals had their wings put sideways so as to use the most of accessible sun energy

Nourishment: All observed caterpillars fed during day hours and only on Cotton grass *Eriophorum vaginatum*. A scheme of feeding was always the same: a caterpillar went onto a leave nearly to its apex, snapped off a piece several centimeters long and then begun to eat the remaining parts moving downwards. Feeding occurred by variable weather, sunny as well as cloudy. During the day, quite intensive feeding was interrupted by break intervals during which caterpillars hid among peat mosses. Attainability of food plants did not cause any problem as Cotton grass has grown densely within the whole area of investigated bogs.

Butterflies fed on nectar from flowers of Wild rosemary *Ledum palustre*, Bog bilberry *Vaccinium uliginosum* and Cranberry *Vaccinium oxycoccus*. Adults flew towards those plants, sat nearby their flowers, came closer and finally sucked nectar.

Predators: *Oeneis jutta* butterflies living in the „Suche Bagno” raised bog had two predators: a dragonfly Black-tailed skimmer *Orthetrum cancellatum* and the Crab spider *Misumena vatia*. Dragonflies that appeared numerously in a period of intensive *Oeneis jutta* flights, especially in the end of May pounced upon moving butterflies. Such hunting was observed many times and always finished by death of *Oeneis jutta* adults. An individual sitting on a pine tree is hardly visible for predators – in this position his coloration is of defense character as underside of wings folded upwards resembles texture of pine bark.

Adult butterflies fall a prey to Crab spiders when sucking nectar of Wild rosemary plants. Spiders that imitate colors of *Ledum* flowers wait on their prey on them. However, during the study only a few attacks of Crab spiders on *Oeneis jutta* butterflies were observed.

DISCUSSION

Oeneis jutta belongs to butterflies whose biology and ecology are poorly recognized. Not long ago, any research concerning that species was conducted in Poland, probably because of his rare occurrence. In other countries, mainly faunistic studies were performed (e.g. BELIK & YAKOVLEV 1998, FERRIS & BROWN 1981, GERASIMOV & PLJUSHTCH 2005).

Oeneis jutta is a polytypic species with numerous local populations distinguished as various subspecies, frequently differing very significantly one from the other. In Poland, one subspecies *Oeneis jutta jutta* (HÜBNER, [1806]) occurs, which prefers raised bogs and light marshy coniferous forests. In the United States, from Montana to Colorado occurs *O. jutta reducta* McDUNNOUGH, 1929 living on fens as well as in dry pine forests (FERRIS 1970, MASTERS & SORENSEN 1969).

Limited distribution of *Oeneis jutta* in Poland results from specificity of occupied habitats but mainly from isolation of localities and location on the south-western border of the species' range. Both populations of *Oeneis jutta* living in the Augustowska Primeval Forest have a high degree of isolation confirmed by results of the studies on their genetic variability (KRZYSZTOFIAK et al. 2009). Though the investigated localities differ in structure, they both represent wet habitats, suitable and typical for *Oeneis jutta jutta*. It is probable that the most important factors determining occurrence of this subspecies are: the presence of food plants, loose tree stand with many open areas, the presence of trees with branchless trunks up to the height of about 2 m and "hummock and hollow" structure of peat bogs. At both sites, the only food plant for caterpillars has been *Eriophorum vaginatum*. From among known host plants, only this species has grown here in large amounts. Other species do not occur in Poland at all, e.g. *Carex concinna* or are present but form small populations or occur on margins of localities, e.g. *Molinia caerulea*.

Loose and light tree stand create for butterflies suitable thermal conditions necessary to maintain the optimum body temperature. It is presumable that behaviour of *Oeneis jutta* is the resultant of thermoregulation and defense habits. On the one side, the insect exposes his body in such way as to use the most of solar radiation (energy), on the other – he assumes the best position to be hardly visible for potential predators. In this latter task, wing undersides are very helpful as their coloration and pattern excellently camouflage a butterfly on the background of pine bark.

Peculiar males' flights for searching and finding females are strictly confined to a tree shape. Branchless parts of trunks (up to c.a. 2 m height) create the main places for females

ready to mate. Therefore, this space is intensively penetrated by males. Similar habits were described from a raised bog with dwarf tree stand in Finland (KATWIJK 1978).

Caterpillars and pupae of *Oeneis jutta* live in a surface layer of a peat bog. During very rainy periods, a level of ground-water table significantly lifts up and causes danger for immobile pupae. Fortunately, "hummock and hollow" structure of a raised bog creates places where peat moss hummocks always protrude above the highest water level and in these places all pupae have been found. In case of caterpillars, movement along a peat profile was observed dependent on peat moisture and air temperature – higher water level caused caterpillars moving up, while lower temperature moving down the profile.

Climate conditions of North-eastern Poland allow to emerge first adults of *Oeneis jutta* in early days of May. In the years 2006-2008, butterflies were flying till half-June. However, observations from previous years indicated that the flight period could be expanded of more than a week but in that case first males appeared a week later. Adults' flight period is similarly extended in time within the whole range. However, as further northwards first appearance occurs later, concerning north Asiatic populations – from June till July while in north American populations from June till half-August (FERRIS & BROWN 1981). The basic factors regulating the period of adults' appearance are presumably air temperature and day-length. Simultaneously, they affect length of a whole life cycle of *Oeneis jutta*.

In Poland, where the south border of *Oeneis jutta* range runs, the species has one-year life cycle. In a more cool sites on a far north (the North America) he has two-year development (SCOTT 1986) and larva overwinters first year but larva or pupa – the second year. In some populations this process is synchronized so as succeeding generations of adults appear every other year.

Oeneis jutta butterflies from both Polish populations behave similarly like individuals in other described populations. It refers especially to behavioural thermoregulation that includes various habits allowing stabilization of inner body temperature at an optimum level. The very characteristic habits of males searching for females, commonly observed in our populations are confined to type and structure of the life environment. The same habits were observed in a similar environment in Finland (KATWIJK 1978). Butterflies occurring in the Augustowska Primeval Forest did not behave as typical territorial species – a male did not chase away other males (competing for females) from his area (the same area) like did males of *Oeneis jutta ascerta* in peat bogs in Minnesota (MASTERS & SORENSEN 1969). The only habits connected with relation among males were observed in the beginning of imago appearance when only males emerged. Presumably, joint males' patrols were not connected with territory demarcation.

As mentioned above, *Oeneis jutta* is a polytypic species. Numerous subspecies distributed round the whole Holarctis sometimes differ significantly in morphology, biology and ecology. The presented results together with another data (KRZYSZTOFIAK et al. 2009) have shown that these differences are visible in coloration and size of wings, habitat preferences, time of adults' flights, and length and character of the life cycle.

In Poland, *Oeneis jutta* belongs to the strongly endangered species. He occurs in habitats impacted by inconvenient transformations. Though some of them are of natural character, e.g. peat bogs' overgrowing as a result of succession, the others are of anthropogenic origin, e.g. drainage of wet areas. The described localities are isolated, especially the "Suche Bagno" raised bog. This fact in connection with weak migratory ability of *Oeneis jutta* endanger him to the lost of inner-population variability and as consequence to inbreeding depression.

The study was financed by the Polish Scientific Budget in the years 2006-2009 as a scientific project.

REFERENCES

- BELIK A.G., YAKOVLEV R.V. 1998. Confirmed occurrence of *Oeneis jutta* in the Altai mountains (Russia) with description of a new subspecies (*Lepidoptera: Nymphalidae, Satyrinae*). *Phegea* **26** (4): 131-139.
- BUSZKO J., MASŁOWSKI J. 1993. Atlas motyli Polski. I. Motyle dzienne (*Rhopalocera*). Grupa IMA-GE, Warszawa, 269.
- BUSZKO J., MASŁOWSKI J. 2008. Motyle dzienne Polski. Wydawnictwo Koliber, Nowy Sącz, 274.
- CARVALHO M.C., QUEIROZ P.C.D., RUSZCZYK A. 1998. Protandry and females-size fecundity variation in the tropical butterfly *Brassolis sophorae*. *Oecologia*. **116**: 98-102.
- CASEY T.M. 1981. Behavioral mechanisms of thermoregulation. [in:] B. HEINRICH (ed.) *Insect thermoregulation*. New York: Wiley, 79-114.
- DĄBROWSKI J.S., KRZYWICKI M. 1982. Ginące i zagrożone gatunki motyli (*Lepidoptera*) w faunie Polski. *Studia Naturae B*, 31, 1-171.
- FERRIS C.D. 1970. The feeding habits of *Oeneis jutta reducta*. *J. Lepid. Soc.*, **24**, **4**: 306-307.
- FERRIS C.D., BROWN F.M. (eds.) 1981. *Butterflies of the Rocky Mountain States*. Univ. of Oklahoma Press, Norman, Oklahoma, USA, 442 pp.
- FISCHER K. 1998. Population structure, mobility and habitat selection of the butterfly *Lecaena hippothoe* (*Lycaenidae: Lycaenini*) in western Germany. *Nota Lepidopterologica* **21**(1): 14-30.
- GERASIMOV R.P., PLJUSHTCH I.G. 2005. Second capture of *Oeneis jutta* (*Lepidoptera, Satyridae*) in Ukraine. *Vestnik zoologii*, Volume 39, No. 4, 28.
- GŁOWACIŃSKI Z. (ed.) 2002. Czerwona lista zwierząt ginących i zagrożonych w Polsce. Instytut Ochrony Przyrody PAN, Kraków, 155. [In Polish].
- GŁOWACIŃSKI Z., NOWACKI J. (red.) 2004. Polska czerwona księga zwierząt. Bezkregowce. Instytut Ochrony Przyrody PAN, Kraków, 448. [In Polish].
- HENRIKSEN H.J., KREUTZER I. 1982. Skandinaviens Dagsommerfugle i Naturen, Skandinavisk Bogforlag, Odense, 215.
- HOOPER R.R. 1973. *The Butterflies of Saskatchewan*. 216.
- KATWIJK D. VAN. 1978. On the flight of *Oeneis jutta* (HÜBNER 1806) (*Satyridae*). *Nota Lepidopterologica* **3**(1):137-138.
- KRZYSZTOFIAK L., KRZYSZTOFIAK A., FRĄCKIEL K., BIAŁA A., KULIKOWSKA A., SELL J. 2009. Genetic and morphological differentiation between isolated Polish populations of "glacial relict", the endangered butterfly *Oeneis jutta* (HÜBNER, 1806). Work under preparations.
- KRZYWICKI M. 1966. Motyle – *Lepidoptera*. Ocennice – *Satyridae*. Cz. 27, zesz. 63, PWN Warszawa, 41.
- KUDRNA O. 2002. The distribution atlas of European butterflies. *Oedippus*. **20**: 1-343.

- LAYBERRYR.A., HALL P.W., LAFONTAINE J.D. 1998. The butterflies of Canada. University of Toronto Press, Toronto, 280.
- LUKHTANOV V.A., EITSCHBERGER U. 2000. Butterflies of the World: *Nymphalidae* V, *Oeneis*. **11**: 2, pl. 3/4, f. 1-4.
- MASTERS J.H., SORENSEN J.T. 1969. Field observations on forest *Oeneis* (*Satyridae*). *J. Lepid. Soc.*, **23**, **3**: 155-161.
- OPLER P.A., WRIGHT A.B. 1999. A Field Guide to the Western Butterflies. Second Edition. Peterson Field Guide Series. Houghton Mifflin Company, New York, USA, 540.
- PYLE R.M. 1981. National Audubon Society Field Guide to North American Butterflies. Alfred A. Knopf, Inc., New York, USA, 924.
- ROMANISZYN J., SCHILLE F. 1929. Fauna motyli Polski. I. Pr. Monogr. Kom. Fizjogr. **6**: 1-552.
- ROZPORZĄDZENIE MINISTRA ŚRODOWISKA z dnia 26 września 2001 r. w sprawie określenia listy gatunków zwierząt rodzimych dziko występujących objętych ochroną gatunkową ścisłą i częściową oraz zakazów dla danych gatunków i odstępstw od tych zakazów. Dz. U. Nr 130, poz. 1456.
- ROZPORZĄDZENIE MINISTRA ŚRODOWISKA z dnia 28 września 2004 r. w sprawie gatunków dziko występujących zwierząt objętych ochroną. Dz. U. Nr 220, poz. 2237.
- SCHMIDT-NIELSEN K. 1997. Animal Physiology: Adaptation and Environment. Cambridge University Press. 607.
- SCOTT J.A. 1986. The Butterflies of North America. Stanford University Press, Stanford, California, USA, 583.

Received: March 30, 2009

Accepted: September 04, 2009