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HISTORICAL RECORDS: *POLYGONIA EGEA* (CRAMER, 1775), AN EXTINCT MEMBER, NOW A SCARCE VISITOR OF THE CARPATHIAN BASIN FAUNA (LEPIDOPTERA: NYMPHALIDAE)

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ABSTRACT: The Carpathian Basin literature records and voucher specimens of the Mediterranean migratory anglewing species *Polygonia egea* (Cramer, [1775]) are reviewed. Eight specimens deposited in the Hungarian Natural History Museum collection are catalogued: from Budapest, Hungary (n=2), from the Cazan Gorge, Romania (n=4), from Jósvafő, Hungary (n=1) and from Orsova, Romania (n=1). The literature porvided altogether 11 locality records from the Banat region (n=6), from the Carpathian region (n=1), and from the Pannonian region (n=4). The species was most probably native in the region Banat until the turn of the 19-20th centuries. It is concluded that the species is a sporadic visitor of the Carpathian Basin, and at present it is not indigenous, because of climate change.

Keywords: Carpathians, Banat, climate change, collection, literature, Pannonia, voucher specimen.

INTRODUCTION:

As we have already demonstrated in two previous studies, the Lepidoptera collections of the Hungarian Natural History Museum hide interesting information on the fauna of the Carpathian Basin (Bálint & Katona 2016, 2017). There are specimens which serve as vouchers of historical data published in various journals, but the data of many specimens have never been published or critically consulted. The subject of the present paper is the nymphalid anglewing *Polygonia egea* (Cramer, [1775]) (Nymphalini: Nymphalinae), a characteristic Mediterranean-Pontic species (Thsikolovets 2012).

Although the species is widely distributed in the Adriatic coast, in the Balkans and in the adjacent mountain regions (Tshikolovets 2011, Kudrna *et al.* 2015), its occurrence has been sparsely recorded in the Carpathian Basin. Imre Frivaldszky was the first who recorded the species in the Banat region (south-western Romania) under the name „*Vanessa triangulum*" (Frivaldszky 1865). Horváth & Pável (1875) practically repeat Frivaldszky's records, but subsequently more precise data were given (Frivaldszky 1873; cf. Pável 1886). Later Rebel (1912) considered all these data from the region Banat to be erroneous based on misidentifications of *P. c-album* (Linnaeus, 1758) summer phenotype f. *hutchinsoni*. Frederic König (1910-2002), arguably the most active lepidopterist of the Banat region in the 20th century, has never seen the species in this area (pers. comm.; König 1998). Therefore it is not surprising that Rákosy *et al.* (2003) and Székely (2008) considered the species to be extinct in Romania.

Along Croatian and Banat occurrences, Abafi-Aigner *et al.* (1896) list the species also from the Pannonian region of the Carpathian Basin: „Nagyvárad" (Oradea). In 1903 the species was also recorded in the present day territory of Slovakia (Englisch 1903), but subsequently the record was considered to be erroneous (Hrubý 1964). Besides the occurrence of Nagyvárad, *P. egea* has never been recorded in the Pannonian region or in the Northern Carpathians.

The aim of the present paper is to document the specimens of *P. egea* collected in the Carpathian Basin and housed in the collections of the Hungarian Natural History Museum. Potentially these can serve as vouchers for historical data regarding the occurence of the species in the region. Besides various aspects regarding historical specimens we also discuss the phenomena of population fluctuation, climate change and lepidopterists' activity.

MATERIALS AND METHODS:

Specimens are stored in the Carpatho-Pannonian (Carpathian Basin) Lepidoptera collection of the Hungarian Natural History Museum (HNHM) (cabinet 63A, drawer 19). Specimens of the Frivaldszky collection were also examined (cabinet 75P, drawer 8).

Under the entry „Results" first we document the specimens in the following way: sex, external appearance, measurement, label data and remark. The specimens are listed according to the date of capture. The given measurement indicates the length of forewing costa from the base of the vein to the wing apex; the sign „[//]" indicates a line break in the label script and „[%]" indicates the script of the label verso; handwritten characters and numbers are indicated in italics; under remark we indicate the way the specimen was acquired by the HNHM.

The geographic references (with the present-day allocations) collected from the literature are grouped in the faunistic regions Banat, Carpathian and Pannonian and are listed alphabetically within the groups. Full references for the data (author, year of publication,

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page reference and the name as the species is recorded) are given. The location is always given in quotation marks (with the present-day official name). When it turned out to be evident, HNHM specimen was rendered to the published record as voucher.

For climatic correlations we used only records where the year could be identified more or less precisely; these were the following: 1830 (Füle), 1864 (Frivaldszky I.), 1873 (Frivaldszky J.), 1891 (Pável), 1937 (Zukowsky) and 1980 (Fedor).

RESULTS:

Specimens

No. 1. Male, set dorsally, in perfect condition, forewing length 26 mm, labelled as (1) „FRIV. [//] *305*." (quadrant shaped white label with black frame; letters printed, numbers handwritten) and (2) „Hungaria [//] coll. E. Friv." (oblong shaped white paper; letters printed). Remark: Frivaldszky collection specimen. (Fig. 1a)

No. 2. Female, set dorsally, in moderate condition (wings slightly worn, missing antennae), forewing length 27 mm, labelled as (1) „FRIV. [//] *305*." (quadrant shaped white label with black frame; letters printed, numbers handwritten), (2) „*1*." (quadrant shaped white label, number handwritten), and (3) „Hungaria [//] coll. E. Friv." (oblong shaped white paper; letters printed). Remark: Frivaldszky collection specimen. (Fig. 1b)

No. 3. Male, set dorsally, in perfect condition, forewing length 24 mm, labelled as (1) „FRIV. [//] *305*." (quadrant shaped white label woth black frame; letters printed, numbers handwritten) and (2) „Hungaria [//] coll. E. Friv." (oblong shaped white paper; letters printed). Remark: Frivaldszky collection specimen. (Fig. 1c)

No. 4. Female, set dorsally, in moderate condition (right wings were broken, subsequently fixed to body), forewing length 25mm, labelled as (1) „FRIV. [//] *305*." (quadrant shaped white label with black frame; letters printed, numbers handwritten) and (2) „Hungaria [//] coll. E. Friv." (oblong shaped white paper; letters printed). Remark: Frivaldszky collection specimen. (Fig. 1d)

No. 5. Female [based on wing shape], set dorsally, in bad condition (body entirely missing, wings glued to paper, left side wings heavily broken), forewing length 28 mm, labelled as „*1891* [//] *2/7* ♀; [%] Orsova" (quadrant shaped white paper with black frame, numbers and locality name handwritten in red). Remark: no sign for any acquisition, most probably collected by J. Pável, official collector of the HNHM. (Fig. 2a)

No. 6. Male, set dorsally, in perfect condition, forewing length 23,5 mm, labelled as (1) „*Budapest* [//] *Dr. Németh E*." (oblong shaped white label with black fram, script handwritten in black ink) and (2) „coll. Pazsiczky" (oblong shaped label with printed letters in black). Remark: specimen from the Pazsiczky collection. (Fig. 2b)

No. 7. Female, set dorsally, in moderate condition (wing surfaces slightly worn, right hind wing broken, missing left antenna, forewing length 24 mm, labelled as (1) „*Budapest* [//] *Dr. Németh E*." (oblong shaped white label with black fram, script handwritten in black ink) and (2) „coll. Pazsiczky" (oblong shaped label with printed letters in black). Remark: specimen from the Pazsiczky collection. (Fig. 2c)

No. 8. Male, set dorsally, in moderate condition (wing surfaces slightly worn, right hindwing broken, missing right antenna, abdomen broken and fixed back to thorax), forewing length 23 mm, labelled as „*Jósvafő 1980. VIII.15* [//] Leg: Fedor J." (oblong shaped white label with black frame script handwritten and in blue ink and printed in black). Remark: specimen from the Török collection. (Fig. 2d)

Localities with references and voucher specimens

(Figs 3-5)

Banat region (n = 6)

1. Cserna folyó (Valea Rîul Cerna, Romania) – Frivaldszky 1873: 201, *Vanessa triangulum*, „a Cserna-patak szélein" (= along the edges of the rivulet Cserna); Pável 1886: 150, *Vanessa Egea*, „a Csernavölgyben" (= in the Cserna valley); no voucher.
2. Herkulesfürdő (Băile Herculane, Romania) – Frivaldszky 1873: 201, *Vanessa triangulum*, „a Domogled alatti réteken" (= in the fields at the feet of the Domogled); Zukowsky 1937: 567, *Polygonia Egea*, „Herkulesbad"; no voucher.
3. Kazán-szoros (Cheile Cazan, Romania) – Frivaldszky 1865: 41, *Vanessa triangulum*, „az Al-Duna szoros völgyében sziklás helyeken repdes" (= it flies in rocky places of the Cazan Gorge valley); Frivaldszky 1873: 236, *Vanessa triangulum*, „a Kazánnál" (= at Cazan); Horváth & Pável 1875: 32, *Vanessa egea*, „aldunai szorosok" (= gorges at Cazan); Pável 1886: 150, *Vanessa Egea*, „a Kazánszorosban" (= in the Cazan Gorge); Hormuzaki 1893: 243, *Vanessa Egea*, „Eisernen Thor" (=Porţile de Fier, Cazan Gorge); vouchers: nos 1-4.
4. Mehádia (Mehadia, Romania) – Horváth & Pável 1875: 32, *Vanessa Egea*, „Mehádia"; Abafi-Aigner *et al.* 1896: 17, *Vanessa Egea*, „Mehádia"; Aigner-Abafi 1901: 10, *Vanessa Egea*, „Mehadia"; A. Aigner 1906: 148, „Vanessa Egea", „Mehádia"; no voucher.
5. Orsova (Orşova, Romania) – Hormuzaki 1893: 243, *Vanessa Egea*, „Orsova"; Aigner-Abafi 1901: 10, *Vanessa Egea*, „Orsova"; voucher: no. 5.
6. Stájerlakanina (Anina, Romania) – Mayer 1904: 57, *Vanessa Egea, „*Fuchseck… Stájerlak" (= in the valley Fuchseck, vicinity of Anina); no voucher.

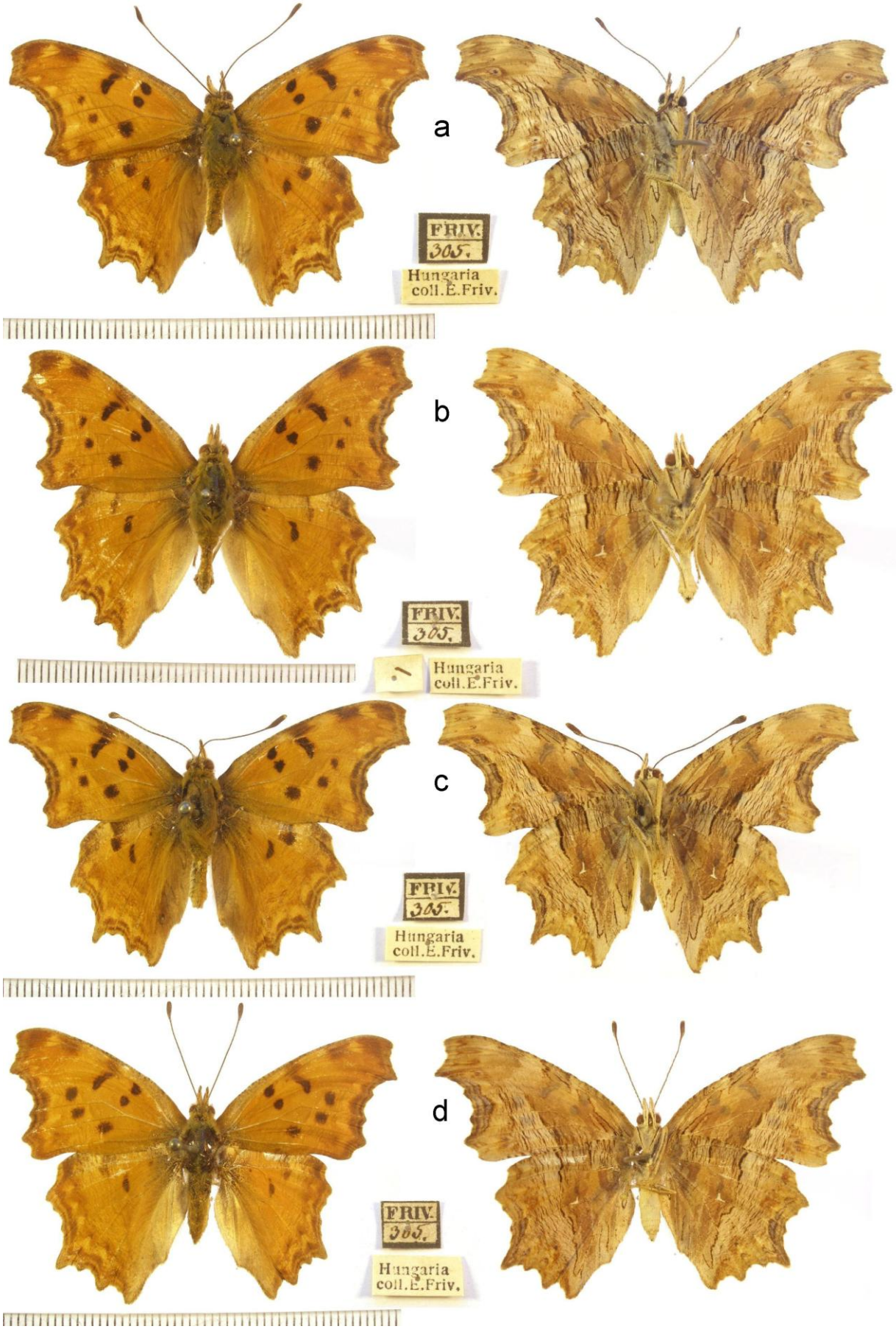

Fig. 1: *Polygonia egea* (Cramer, [1775]) specimens from the Frivaldszky collection, Hungarian Natural History Museum, collected in the Cazan Gorge area, in dorsal (left), and ventral (right) views, with labels (in center); a = male (no. 1), b = male (no. 2), c = male (no. 3), d = female (no. 4); (scale in mm). (Photos: Gergely Katona, HNHM)

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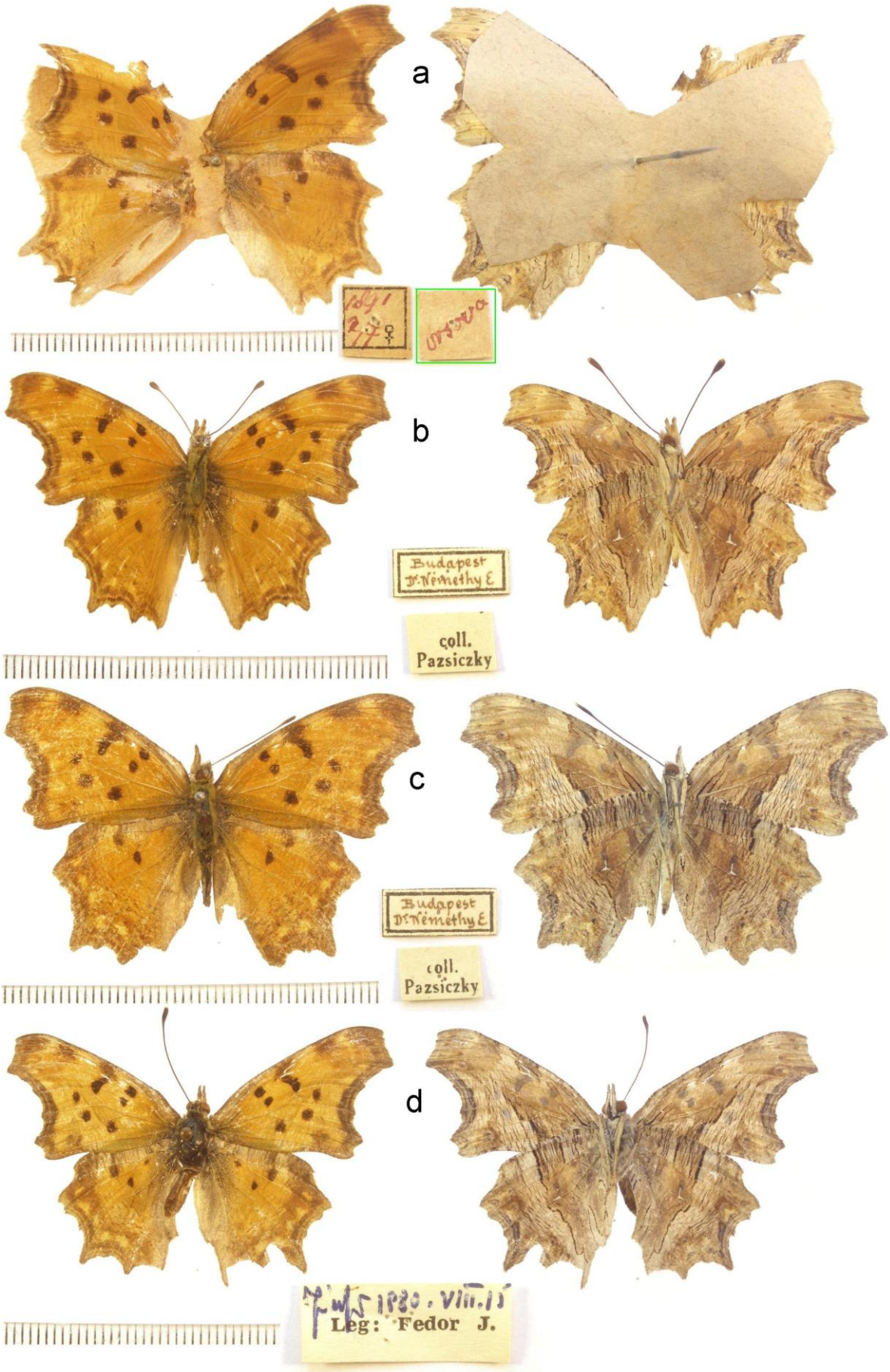

Fig. 2: *Polygonia egea* (Cramer, [1775]) specimens from the Hungarian Natural History Museum, collected in various Carpathian Basin localities, in dorsal (left), and ventral (right) views, with labels (in center); a = male, Orsova (Romania) (label verso in green frame) (no. 5), b = male, Budapest (Hungary) (no. 6), c = female, Budapest (Hungary) (no. 7), d = male, Jósvafő (Hungary) (no. 8); (scale in mm). (Photos: Gergely Katona, HNHM)

Carpathian region (n = 1)

1. Tátrafüred (Smokovec, Slovakia) – Englisch 1903: 81, *Polygonia Egea*, „Tátra-Füred táján" (= around Smokovec); no voucher.

Pannonian region (n = 4)

1. Bát (Batovce, Slovakia) – Ružička 1931: 73, *Polygonia egea*, „Bátovce"; no voucher.
2. Budapest (Hungary) – no reference; vouchers: nos 6-7.
3. Jósvafő (Hungary) – no reference, voucher: no. 8.
4. Nagyvárad (Oradea, Romania) – Mocsáry 1874: 145, *Vanessa egea*, „A szőlőhegyek alatt igen ritka" (= at the feet of the vineyards very rare); Abafi-Aigner *et al*. 1896: 17, *Vanessa Egea* „Nagyvárad" (= Oradea), A. Aigner 1906: 148, *Polygonia Egea*, „Nagyvárad"; no voucher.

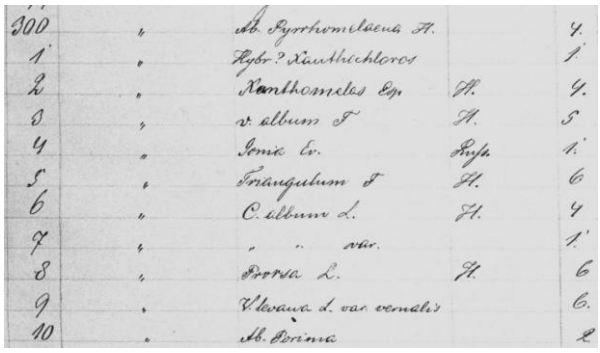

Fig. 3. Extract from the Frivaldszky collection catalogue, rubrics nos 300-310 listing *Vanessa* species; rubric no. 305 gives the data „Triangulum F. / H / 6" indicating that in the collection originally there were six specimens captured in Hungary. (Composed by Gergely Katona, HNHM)

DISCUSSION:

Voucher specimens (Figs 1-2): The specimens nos 1-4 originate from Imre Frivaldszky (1799-1870). In the handwritten catalogue of the collection (Frivaldszky 1864) six specimens are indicated from „Hungaria" under the rubric „305" (Fig. 3). The specimens nos 1-4 in the HNHM represent these specimens. We know that there are other Frivaldszky specimens, most probably exchanged or presented by the HNHM staff (König 1975: 257). The second Frivaldszky specimen label was produced and fixed to the specimen by the HNHM staff in the 1950s, to provide direct locality data. The specimen no. 5 was captured most probably by János Pável (1842-1901), who collected intensively for the HNHM in the Cazan gorge region (A. Aigner 1901). However, the manner of labelling most probably comes from Lajos Abafi-Aigner (1840-1909), as specimens handled by him have been similarly labelled (Aigner-Abafi 1906). Specimens nos 6-7 are problematic. We were unable to detect who „Dr. Németh E." was. However we suspect that the person is a relative, or the same as „Dr. Németh Nándor" who collected butterflies and moths for Jenő Pazsiczky (see Pazsiczky 1917). The last voucher has been collected by József Fedor (1940-2011), a well known Hungarian collector. He was in good relationship with Ferenc Török (1913-1999) and often they collected together (Szabóky 2007: 144). The Török collection was donated by his heirs to the HNHM. The specimen was amongst uncurated specimens collected in Hungary, mainly in Jósvafő.

Misidentification, mislabelling: The specimens of *P. egea* are easy to identify, and the confusion with the summer form *P. c-album* is highly improbable as the wing shape, pattern and colouration of these phenotypes characteristically differ (see Bozano and Floriani 2012). This is confirmed by even the most questionable data, where along *egea*, the ocurrence of *c-album* has been recorded (Englisch 1903, Mayer 1904, Ružička 1931). Amongst the exsisting eight specimens with Carpathian Basin locality, the authenticity of specimens nos 6-7 can be questioned. Although there was a hint in the Pazsiczky paper published in 1917 that in the Németh collection there were some remarkable *Vanessa* collected in Hungary, there was no exact species name given. Therefore it cannot be excluded that the inscription „Budapest" indicates the residence of the owner, and not the actual place of specimens' capture. Similarly, the authenticity of the specimen no. 8 collected in Jósvafő can be also questioned. However, evidence based on the fact that the specimen is worn and has been curated amongst other specimens collected in Jósvafő the same year, supports that the record is not based on a mislabelled individual, but on a specimen indeed captured in the Pannonian region.

Records of the Banat region (cf. Fig. 5): The data of the Banat occurrences suggest that the species was native until the turn of the 19-20th centuries as it was repeatedly observed or collected there. Caradja (1895) recorded the species from Turnu Severin, southwestern Oltenia. The earliest unpublished reference we found is from year 1830. Accordingly, András Füle worked in the Banat region for Imre Frivaldszky and collected „Triangulum" in the vicinity of Mehadia (see Fig. 4). Frivaldszky (1865) considered the species to be characteristic for the fauna of the Banat region. Hence the statement of Rebel (1912: 289), who mentioned that the „*Vanessa triangulum*" data of Frivaldszky (1873) and Pável (1886) represent the summer phenotype of *P. c-album* (f. *hutchinsoni*), was

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erroneous. It is interesting to note that apparently Rebel was neither aware of the records of Frivaldszky, nor of his faunistic monograph (Frivaldszky 1865) as it was not referred to by him. Subsequent to the publication of Rebel the species has been recorded in the region only once (Zukowsky 1937). Since the second half of the 20th century there was no record for the occurrence of *P. egea* in the Banat region (König 1998), thus at this moment it can be considered to be extinct. Nevertheless, it can be presumed that the species will appear again displaying a northward expansion, as other butterfly species have already shown (for example *Melanargia larissa*, *Melitaea arduinna*, *Zerynthia cerysi*); or „rare" species have been rediscovered in the region (for example: *Iolana iolas*, *Satyrus ferula*) (Groza *et al.* 2015a, 2015b, Groza & Dincă 2016).

Records for the Carpathian region (cf. Fig. 5)*:* Hrubý (1964) considered the specimen from „Tátrafüred" as „impossibile, certe falsum" (= impossible, certainly erroneous). This is the only record for the region. However, we know that all anglewing nymphaline species are subject to seasonal or annual migration (cf. Shapiro 2007), therefore it cannot be excluded with certainty that *P. egea* imagines from the Mediterranean region occasionaly reach the Carpathian Basin, or even territories in more northern regions. This is supported by the specimen from the Czech Republic taken in 1965 (Slamka 2004: 143).

Records of the Pannonian region (cf. Fig. 5)*:* There are no voucher specimens in the HNHM for the published records „Nagyvárad". Similarly, the „Bátovce" specimen is also without voucher, but probably it is still present in the Barsi Múzeum in Levice (Tekovské Múzeum v Leviciach). It was collected by J. Kosztka, who was an insect dealer according to the advertisements he published in the pages of the journal Entomologischer Anzeiger (cf. Volume 6 (1926), number 23). The record was considered by Hrubý (1964: 834) as „improbable et non confirmatum, fortasse error in determinatione" (= impossible and not confirmed, probably an error in identification). The „Budapest" specimens did not appear in the literature as Dr. Némethy was not active in publishing. This is exactly the case for the „Jósvafő" specimen, as the collector József Fedor did not publish anything. The Pannonian records of *P. egea* are very scattered in time and space, and it could be easily considered indeed that they are based on mislabelled or misidentified specimens (see above), but knowing the migratory nature of the anglewing nymphalines it cannot be excluded that, like other Mediterranean species, *P. egea* also reaches the Carpathian region sporadically (see Katona *et al.* 2018). Consequently the Pannonian records or specimens cannot be plainly considered erroneous or false.

Climate and fluctuations (Fig. 6)*:* If we take into consideration the years when *P. egea* has been recorded in the Carpathian Basin and inspect them in relation to diagrams showing European average air temperature anomalies, one pattern becomes notable: The period between 1850 to 1910, when the species was native in the Banat region, experienced in average colder winters than the following period. After 1910 the species was recorded only sporadically, suggesting that *P. egea* individuals arrived into the region as strays, but the species was not native anymore, even in the Banat region. Therefore we hypothesise that *P. egea* permanently inhabits only areas where the winter is cold enough for a successful hibernation, and after hibernation the populations are able to fluctuate in or migrate towards adjacent warmer regions, where two or three annual generations can develop.

We summarize that, although the anglewing nymphalid butterfly *P. egea* is a rare visitor, ocurrence of vagrant specimens can be expected in the Carpathian Basion any time and anywhere arriving from the Adriatic regions or from the Balkans where it seems to be native (for example Serbia: Zečević & Radovanović 1974, Van Swaay *et al.* 2007.). Because of the warming climate the species most probably will hardly recolonize again the region, in spite of the fact that the main larval host *Parietaria officinalis* (Urticaceae) is very abudant everywhere, especially in areas with strong anthropogenic influence. However, where microclimatic factors create suitable habitats, for example by forest covers (cf. Slancarova *et al*. 2016), the short term existence of local populations cannot be excluded.

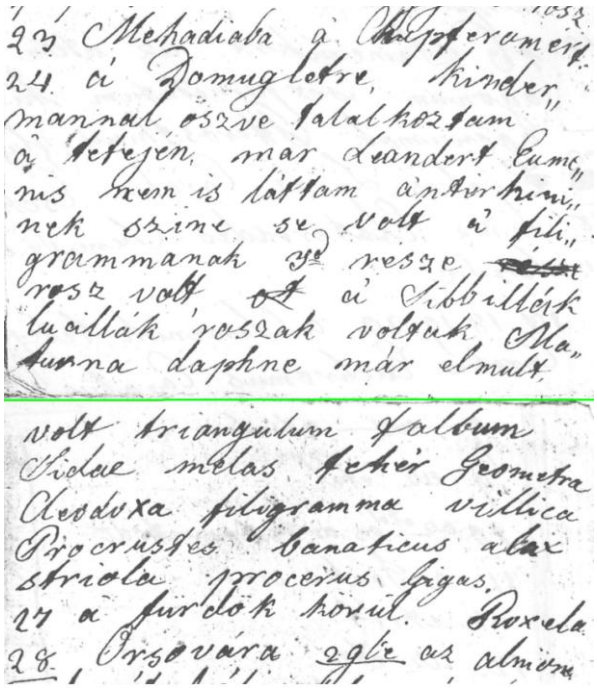

Fig. 4. Extracts from the diary of András Füle carried on the journey from Buda to Mehádia in 1830, dedicated to collecting insects (the green line indicates page turn): „[Június] 23 Mehádiába a kopferemért. 24 a Domugletre, Kindermannal öszve talalkoztam a tetején, már Leandert Eumenis nem is láttam antirhininek szine se volt a filigrammának 3ad része rosz volt a sibillák lucillák roszak voltak Maturna daphne már elmult [//] volt triangulum falbum sidae melas fehér Geometra Cleodoxa filigramma villica Procrustes banaticus alax striola procerus gigas 27 a fürdök körül. Roxela. 28 Orsovára 29be az Alnion” (= [June] 23: for my suitcase
to Mehadia. 24: to the Domogled, I met Kindermann on the top, I did not see Leander Eumenis, for Anthirrini any sign, 3rd of Filigramma was worn, Sibillas Lucillas were all damaged Maturna Daphne were gone [//] there were Triangulum F-album Sidae Melas white Geometrid Cleodoxa Filigramma Villica Procrustes Banaticus Alax Striola Procerus Gigas 27: around the baths. Roxelana. 28: to Orsova. 29: On the Allion.”) (Translated by Zsolt Bálint; image composed by Gergely Katona, HNHM)

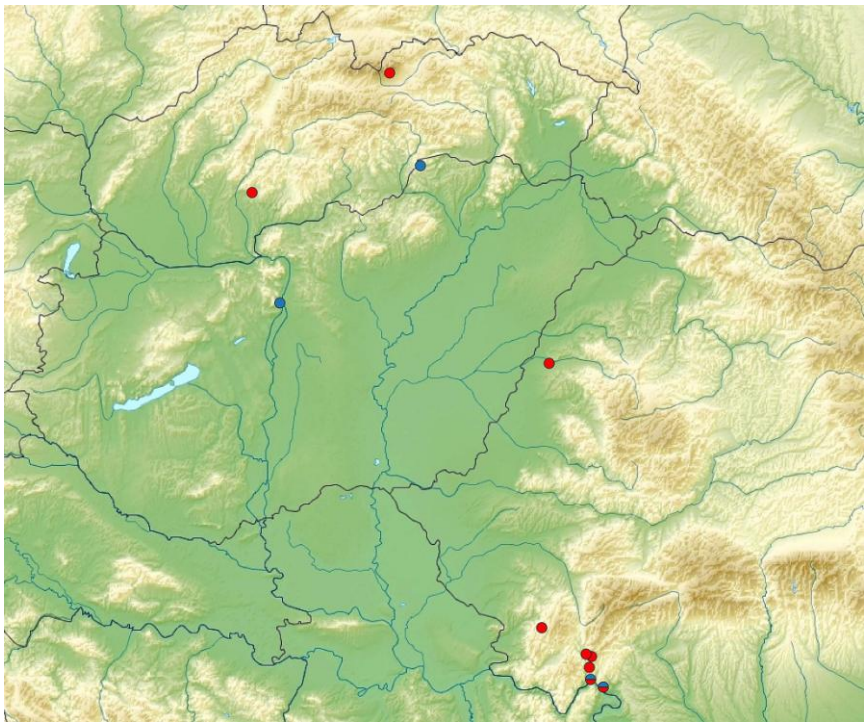

Fig. 5. Carpathian Basin geographic records for *Polygonia egea* (Cramer, [1775]) based on literature (red), museum specimens (blue) and both (red/blue). (Composed by: Judit Fekete)

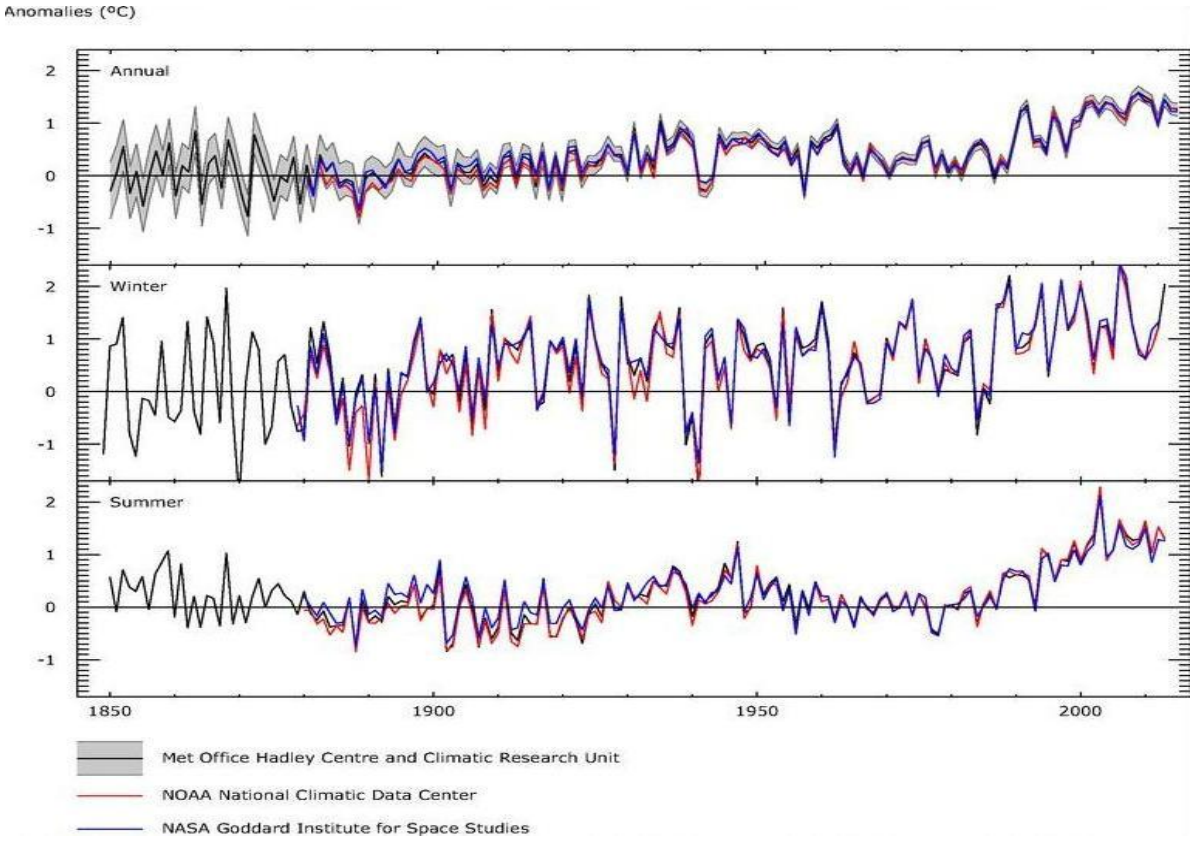

Fig. 6. European average air temperature anomalies (1850 to 2013) in °C over land areas only, for annual (upper), winter (middle) and summer (lower) periods. (source: www.eea.europe.eu)

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