

Mayflies of the Northern Levant (Insecta: Ephemeroptera)

by Stefan Koch

Abstract: For 31 species of mayflies, new records on their distribution are presented. Most of them are new to the Middle East or to the northern Levant (Turkey, Syria, Lebanon). The fauna is composed for the most part of species widespread in Europe (63%), a relatively high number (26%) of endemic species, and a few Caucasian (8%) and South European (3%) species. Using the genus *Prosoptoma* as an example, it is shown that the mayfly fauna of the northern Levant has been isolated from the faunas of Africa and Asia for a very long period.

Kurzfassung: Zu 31 Arten von Eintagsfliegen werden Verbreitungangaben vorgestellt. Die Mehrzahl der Arten ist für den Mittleren Osten bzw. für die nördliche Levante neu. Die Ephemeropteren-Fauna der nördlichen Levante besteht überwiegend aus in Europa weit verbreiteten Arten (63%), einem relativ hohen Anteil an Endemismen (26%) sowie einigen südeuropäischen (3%) und kaukasischen (8%) Arten. Am Beispiel der Gattung *Prosoptoma* wird gezeigt, daß die Fauna der nördlichen Levante lange Zeit von der Afrikas und Asiens getrennt war.

Key words: Ephemeroptera - Lebanon - Syria - Turkey - zoogeography - Prosoptoma

1. Introduction

Until now little was known about the mayfly fauna of the Near East. Earlier publications mention only a very few species, often solely at the generic level. For instance, BODENHEIMER (1935, 1937) listed only three species: *Palingenia jordanica* (a synonym of *P. orientalis*), *Cloeon dipierus* and *Polysiphonia* sp. (probably *Ephoron virgo*). VERRER (1955) reported some further species in addition to *Cloeon dipierus*: *Baetis bioculatus* (a synonym of *B. fuscatus*), *Caenis macrura*, and some undetermined species of the genera *Baetis*, *Ecdyonurus* (two species, one resembling *Ecdyonurus lateralis*, the other *Heptagenia fuscogrisea*), *Ephemera*, *Leptophlebia*, and *Paraleptophlebia*. DEMOULIN (1963, 1965) mentioned three *Baetis* sp., two *Afromurus*? sp. and a *Thalerosphyrus*? sp. PUTHZ (1972, 1973) was able to increase the known fauna further by listing the following species: *Baetis rhodani*, *B. alpinus*, *B. cf. melanonyx*, *Baetis* sp., *Cloeon* sp., two species of *Heptagenia* (lateralis-group), *Habrophlebia fusca*, *Ephemerella ignita*, *Caenis robusta*, and *C. macrura*. Adding *Siphonurus lacustris*, *Baetis muticus*, *B. vernus*, *Centropilum luteolum*, *Cloeon simile*, *Iron caucasicus*, *Epeorus sylvicola*, *Rhithrogena znojtkoi*, *Ecdyonurus insignis*, *Neoephemera nazima*, *Choroterpes picteti*, *Habrophlebia lauta*, *Ephemera danica*, *E. vulgata*, and *Potamanthus luteus*, PUTHZ (1978) was able to list 24 species from the Near East. Additional species were recorded by DEMOULIN (1973: *Ecdyonurus asiaticus*, *E. galileae*, *Afromurus lugleri*, *Signonura samochai*), ALOUF (1977: *Prosoptoma oroni*, *P. phoenicum*), JACOB (1977: *Palingenia anatolica*, *P. orientalis*), SOUDAN (1978: *Palingenia fuliginosa*) and BRASCH (1981: *Ametropus fragilis*, *Iron znojtkoi*, *Rhithrogena thalassini*, *Ecdyonurus ornaticornis*, *E. raschi*, *Paraleptophlebia submarginata*).

Since our knowledge of the mayfly fauna of the Near East was obviously incomplete, it was a great pleasure to study a rich collection from the area, which was generously provided by Prof. Dr. R. KINZELBACH, Darmstadt. The mayflies were collected mainly from the river Orontes and its tributaries during expeditions to Syria, Lebanon and Turkey in 1978 to 1982. This collection, containing 36 species, adds 22 species to the known mayfly fauna of the Middle East, which now has a total of 62 species. 31 of them are discussed in detail in this paper, some others having already been published elsewhere (KOCH 1980, 1981, 1985).

2. Collecting Sites

The collecting sites lie mainly in Syria, with some others in the adjacent countries of Turkey and Lebanon. They mainly cover the catchment area of the river Orontes (Asi Nehri, Nahr al-'Asi) and adjoining river basins. For presentation of the results, they are arranged in areas (Fig. 1). For precise denomination and location of the sites compare the appendix and KINZELBACH, KRUPP, ROTH & SCHNEIDER (1989).

In the species chapter, only the year and site numbers are given instead of the full data, as set out in appendix 1.

Abbreviations: L = larva(e), LB = Lebanon, SY = Syria, TR = Turkey, E = east of, N = north of, S = south of, W = west of.

3. Species

The occurrence of the species contained in the material is compared with their known distribution, which is cited from MÜLLER-LIEBENAU (1969), PUTZ (1978) and original descriptions. Data concerning the preferred habitats are taken from the same authors and from KIMMINS (1972), MACAN (1970), PLESKOT (1954) and SCHOENEMUND (1930). The determination of the species follows the works of GRANDI (1960), KIMMINS (1972), LANDA (1969), MACAN (1970), SCHOENEMUND (1930), ULMER (1929), and others (mentioned in the text).

In addition to the material listed below, there are other specimens collected by KINZELBACH in Turkey which have already been published (KOCH 1985). Since these findings enrich the mayfly fauna of the Near East, the additional species (*Baetis macrospinosus*, *B. vernus*, *Centroptilium luteolum*, *Prospatoma foliaceum*, *Choroterpes picteti*) are discussed in section 4.

Family Baetidae

The species of *Baetis* were determined with MÜLLER-LIEBENAU (1969). In addition, MÜLLER-LIEBENAU kindly checked my identifications in some cases. She found some differences when compared with Central European specimens, which still lie, however, within the range of variation. I have tried to associate the unnamed species from Israel (SAMOCHA 1972) with known ones. This is discussed under the individual species.

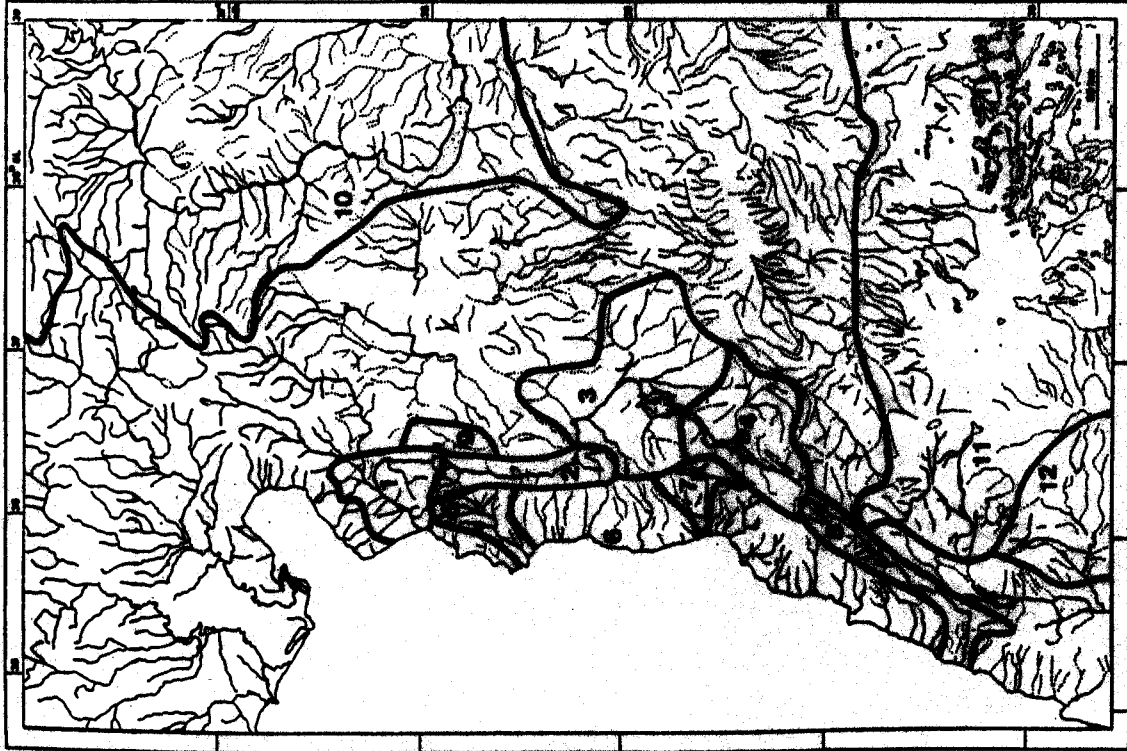


Fig. 1. Areas of the studied region, after KINZELBACH (1980) and POR (1975). 1- Lower course of Orontes. 2- Area of the Gab. 3- Middle course of Orontes and tributaries. 4- District of Homs. 5- Nahr al-Kabir (north). 6- Mediterranean rivers of the coast. 7- Nahr al-Kabir (south) and plain of Buqai'a. 8- Libani and plain of Baq'a. 9- Area of al-Bahra. 10- System of the Euphrates. 11- Nahr Barada and Nahr al-'Awaj. 12- System of the Yarmouk.

Tab. 1. Species of mayflies contained in the material. For areas cf. Fig. 1.

Area	1	2	3	4	5	6	7	8	9	10	11	12	total
number of collecting sites	11	27	8	11	6	12	7	1	1	14	5	2	105
<i>Baetis buceratus</i>	2	10	5	2	3	6	4	1	4	2			39
<i>B. digitatus</i>	1												1
<i>B. tutheri</i>	3	4	2	6	2	3	1	1	3				25
<i>B. melanonyx</i>	1												1
<i>B. niger</i>											1		1
<i>B. rhodani</i>	2	5	1	1	2	2	1				1		15
<i>B. samochai</i>	6	2	1	1	1	1							13
<i>B. tricolor</i>	1												1
<i>Centroptilum pennulatum</i>	1	2			3	4	3						13
<i>C. pulchrum?</i>											1		1
<i>Cloeon dipterum</i>	2	3	1	2	3	1	1	5	1	2			19
<i>C. simile</i>	1										1		2
<i>Oligoneuricella orontensis</i>	1												2
<i>Epeorus zaiceni</i>	2				1								4
<i>Iron caucasicus</i>													1
<i>Rhithrogena znojtkoi</i>	1				1						1		2
<i>R. sp.</i>	1	1			1			3					6
<i>Ecdyonurus galileae</i>	2				2								4
<i>E. sp.</i>	2	1	2	2				1					8
<i>Heptagenia coerulans</i>										1	1		2
<i>Afromurus kugleri</i>	1	1			1								3
<i>Ephemerella ignita</i>	2									1			3
<i>E. ikononovi</i>	1	1											2
<i>E. mesoleuca</i>													1
<i>E. macronata</i>												2	2
<i>Caenis luctuosa</i>	2	1								2			5
<i>C. macrura</i>	2	5	3	1	5	5	1	7					27
<i>Prosopistoma oronti</i>													1
<i>Choroterpes balcanica</i>													1
<i>Habroleptoides modesta</i>											1		1
<i>Potamanthus luteus</i>													1
Species / area	13	16	11	10	7	9	7	1	3	13	8	1	31

Baetis buceratus Eaton, 1870

Distribution: Many localities in Europe; new to Lebanon, Syria and Turkey.

Habitats: Larvae among water plants and stones near banks.

Material: 78/17: 3 I, 78/20: 1 I, 78/23: 5 I, 79/13: 1 I, 79/15: 1 I, 79/18: 15 I, 79/22: 5 I, 79/24: 1 male, 79/35: 1 I, 79/58: 1 I, 79/70: 14 I, 1 male, 79/73: 3 I, 79/76: 5 I, 79/77: 1 I, 79/78: 1 I, 79/79: 3 I, 79/80: 4 I, 79/81: 3 males, 79/84: 7 I, 79/85: 2 males, 79/88: 1 male, 79/94: 5 I, 4 males, 79/95: 3 I, 79/102: 2 I, 79/122: 3 I, 80/20: 5 I, 80/36: 4 I, 80/39: 1 I, 80/42: 3 I, 80/43: 20 I, 2 males, 80/44: 2 I, 80/45: 6 I, 80/53: 15 I, 80/64: 1 male, 80/71: 4 I, 80/73: 7 I, 21 males, 82/42: 3 I, 82/47: 1 I, 82/49: 1 I.

In the material this species is the most abundant mayfly. It appears to be present in Israel (SAMOCHA 1972: as *Baetis* sp. A7, male).

Baetis digitatus Bengtsson, 1912

Distribution: Only a few widespread localities in Europe; new to Syria.

Habitats: Larvae seem to prefer slow-flowing water; among water plants near banks.

Material: 79/12: 1 I.

This species appears to be present in Israel (SAMOCHA 1972: as *Baetis* sp. L 57 larva).

Baetis tutheri Müller-Liebena, 1967

Distribution: Southern parts of Europe, reaching the Caucasus. New to Lebanon, Syria and Turkey. Not present in England, Ireland, Iceland or the Scandinavian countries.

Habitats: Larvae in summer-warm fast-flowing rivers with stony beds.

Material: 78/8: 1 I, 78/9: 1 I, 78/12: 3 I, 78/13: 1 I, 78/34: 2 I, 79/13: 7 I, 79/15: 2 I, 79/18: 2 I, 79/37: 8 I, 79/62: 1 I, 79/63: 1 I, 79/72: 7 I, 79/94: 1 I, 79/95: 2 I, 79/102: 4 I, 79/106: 2 I, 79/120: 1 I, 79/128: 10 I, 79/129: 3 I, 80/6: 2 I, 80/20: 1 I, 80/35: 2 I, 80/42: 2 I, 80/44: 1 I, 80/47: 1 I.

This species is abundant. It appears to be present in Israel (SAMOCHA 1972: as *Baetis* sp. A 12, male).

Baetis melanonyx Pictet, 1843-1845

Distribution: Southern part of Europe; new to Turkey.

Habitats: Larvae in small and medium-sized brooks.

Material: 82/269: 3 I.

Baetis niger Linnaeus, 1761

Distribution: Whole of Europe; new to Syria.

Habitats: Larvae often together with the related *B. digitatus*, in rivers rich in plants.

Material: 79/129: 3 I.

Baetis rhodani Pictet, 1843-1845

Distribution: Western Palearctic region.

Habitats: Larvae in slow and fast-flowing rivers among stones or plants. Larvae do not

require high water quality.

Material: 78/34: 4 1, 78/45: 1 1, 79/12: 2 1, 79/13: 1 1, 79/25: 2 1, 79/33: 4 1, 79/63: 3 1, 79/72: 6 1, 79/76: 3 1, 79/106: 6 1, 80/39: 12 1, 80/43: 2 1, 80/47: 12 1, 80/70: 3 1, 82/26: 2 1.

This species appears to be present in Israel (SAMOCHA 1972: as *Beatis* sp. A 3, male).

Beatis samochoi Koch, 1981

Distribution: Israel, Lebanon, Syria.

Habitats: Larvae in flowing and stagnant water. They seem to prefer slow-flowing water rich in plants.

Material: 79/12: 1 1, 79/22: 3 1, 79/77: 8 1, 79/80: 3 1, 79/95: 1 1, 79/97: 1 1, 79/101: 1 1, 79/104: 4 1, 79/107: 2 1, 80/36: 3 1, 80/40: 3 1, 80/42: 1 1, 80/70: 2 1.

This recently described species, which appears to be endemic in the Near East, was also found by SAMOCHA (1972: figured as *Beatis* sp. L 34). Comparison between the original material (in coll. MÖLLER-LIEBENAU) and my material proved that it is conspecific.

Beatis tricolor Tshernova, 1928

Distribution: Some localities in the eastern part of Europe; new to Turkey.

Habitats: Larvae in brooks and rivers.

Material: 82/31: 6 1.

This species appears to be present in Israel (SAMOCHA 1972: *Beatis* sp. larva).

Genus *Centropitium*

Many species of this genus are very difficult to determine, because some of them cannot be distinguished in the larval stage while others are only known from the male imago. I compared the features of the larvae with the descriptions and figures given in several publications: GRANDI (1964), IKONOMOV (1962b), JACOB (1973), KAZLAUSKAS (1964), and KEFFERMÜLLER & SOWA (1975).

Centropitium pennulatum Eaton, 1870

Distribution: Widespread in Europe, especially in the Mediterranean region. New to Lebanon, Syria and Turkey.

Material: 78/23: 3 1, 78/18: 1 1, 79/20: 2 1, 79/30: 5 1, 79/33: 3 1, 79/35: 1 1, 79/86: 12 1, 79/120: 6 1, 80/45: 2 1, 80/71: 9 1, 82/47: 9 1, 82/49: 1 1, 82/51: 1 1.

aff. *Centropitium pulchrum* Eaton, 1885

Distribution: Italy and the plains of Central Europe; new to Turkey.

Habitats: Larvae in rivers and streams.

Material: 82/50: 4 1.

These larvae are closely related to *C. pulchrum*. However, larvae of this species resemble those of *C. parapulchrum* Keffermüller & Sowa (KEFFERMÜLLER & SOWA 1975). A similar species is present in Israel (SAMOCHA 1972).

Cloeon dipterum Linnaeus, 1761

Distribution: Holarctic region, except Iceland.

Habitats: Larvae in ponds, lakes and in slow-flowing parts of rivers, among plants.

Material: 78/36: 10 1, 78/40: 8 1, 78/42: 14 1, 78/47: 14 1, 79/17: 12 1, 79/22: 2 1, 79/34: 3 1, 79/48: 1 1, 79/70: 2 1, 79/79: 4 1, 79/116: 15 1, 79/117: 3 1, 80/29: 4 1, 80/36: 1 1, 80/48: 10 1, 80/54: 5 1, 80/73: 6 1, 82/26: 3 1, 82/38: 1 1, 82/46: 1 1.

Cloeon simile Eaton, 1870

Distribution: Whole of Europe, Caucasus; new to Syria. Not present in Iceland.

Habitats: Larvae often together with *C. dipterum*.

Material: 79/58: 3 1, 80/54: 1 1.

SAMOCHA (1972) figures several *Cloeon* sp.

Family Oligoneuridae

Oligoneuriella orontensis Koch, 1980

Distribution: Israel, Lebanon, Syria, Turkey.

Habitats: Larvae in rivers with stony beds.

Material: 78/49: 1 1, 79/108: 1 1.

This recently-described species seems to be endemic in the Levant region. SAMOCHA (1972) figured the larva as *Oligoneuriella* sp. SOLDAN generously sent me larvae for study, which were found near El Hermel (Lebanon), Orontes on 7.3.1952.

Family Heptageniidae

Epeorus zaicevi Tshernova, 1981

Distribution: Turkey, Armenian SSR; new to Syria.

Material: 78/34: 3 1, 79/13: 1 1, 79/106: 1 1, 82/47: 3 1.

These larvae are similar to those described and figured by BRAASCH (1978, as *Epeorus znojtkoi*), DEMOULIN (1973, as *Epeorus* sp.) and SAMOCHA (1972, as *Epeorus* sp.). Since *Epeorus znojtkoi* is now considered to be a *Rhithrogena* (THOMAS 1982; see below), these larvae which are clearly of the *Epeorus*-type must therefore belong to another species. BRAASCH kindly checked some specimens. In his opinion, the larvae may belong to *Epeorus zaicevi* Tshernova, 1981.

Iron caucasicus Tshernova, 1938

Distribution: Restricted to the Caucasus and Asia Minor.

Habitats: Larvae in brooks and small rivers.

Material: 82/53: 1 1.

The species was originally described as *Cinygma caucasia* (TSHERNOVA 1938). Subsequently, *Iron fuscus* Sinitshenkova 1976 was found to be a synonym (BRAASCH 1979c).

Rhithrogena znojkoï Tshernova, 1938

Distribution: Asia Minor, Caucasus.

Material: 79/62: 1 male, 79/108: 1 male.

The imagines agree with the description and illustration *Epeorus znojkoï* (TSHERNOVA 1938, as *Echyonurus ? znojkoï*). THOMAS (1982) established that *Epeorus znojkoï* is a species of the genus *Rhithrogena*: He was able to study an imago and the larva from which it derived. This larva showed the typical features of the *Rhithrogena* larvae. Consequently, at least some of the larvae recorded as *Rhithrogena* sp. could belong to this species. However, this cannot be confirmed, because THOMAS did not describe the larva of *Rhithrogena znojkoï*. I sent BRAASCH a specimen to study. He regards it as *Epeiron anseli* Demoulin 1964, which is known from Afghanistan (DEMOULIN 1964).

Rhithrogena sp.

Material: 79/14: 1 I, 79/72: 1 I, 79/102: 3 I, 80/20: 4 I, 82/45: 2 I, 82/46: 1 I.

The material contains only a few larvae of *Rhithrogena*, which cannot be determined with present knowledge. Reared material is necessary for the determination of these species. Many Caucasian species are known (BRAASCH 1979a, 1979b), and some of them are probably present in Syria and Turkey.

Echyonurus galileae Demoulin, 1973

Distribution: Israel (DEMOULIN 1973; SAMOCHA 1972, as *Afromurus* sp. 1, SAMOCHA in litt.). New to Syria.

Material: 78/34: 1 I, 79/30: 1 I, 79/73: 8 I, 80/6: 1 I.

This species seems to be endemic in the Near East.

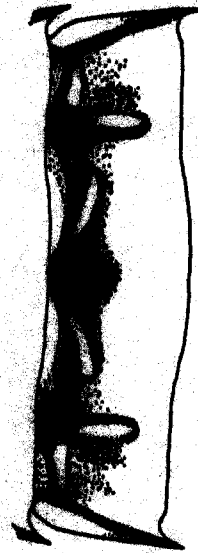


Fig. 2. *Echyonurus* sp., 5th sternite.

Echyonurus sp.

Material: 78/15: 2 I, 78/23: 3 I, 79/62: 10 I, 79/71: 5 I, 79/95: 12 I, 79/108: 6 I, 79/119: 18 I, 80/45: 8 L.

This species cannot be determined because the larvae of Near East Heptageniidae are not sufficiently known.

Description: The larva has seven pairs of gills; the last pair without a bunch of filaments. Spines of the femora in general shovel-shaped. Sternites with a characteristic pattern (Fig. 2).

Heptagenia coeruleans Rostock, 1877

Distribution: Many localities in Europe, except England, Ireland and Iceland.

Habitats: Larvae in rivers and streams.

Material: 82/47: 2 I.

The larvae look very similar to those of *H. coeruleans*, but I cannot exclude the possibility that they belong to *H. perflava* Brodsky, 1930. This species, which is known only in the adult stage, lives in the Caucasus (BRODSKY 1930).

Afromurus lugleri Demoulin, 1973

Distribution: Israel (DEMOULIN 1973, SAMOCHA 1972). New to Syria and Turkey.

Material: 79/63: 6 I, 79/72: 2 I, 80/43: 6 I.

This species seems to be endemic in the Near East.

Family Ephemerellidae

The species of *Ephemerella* were determined using mainly the publications of BENTGSSON (1930), IKONOMOV (1962a), KAZLAUSKAS (1959), KEFFERMÜLLER (1960) and KEFFERMÜLLER & DATERRA (1978).

Ephemerella ignita Poda, 1761

Distribution: Palaearctic region.

Habitats: Larvae in slow and fast-flowing rivers. They prefer localities rich in plants. In mountain rivers they also live among stones.

Material: 79/99: 4 I, 79/102: 3 I, 82/51: 1 I.

Ephemerella ikononovi Puthz, 1971

Distribution: Southern part of Yugoslavia (IKONOMOV 1962a, as *E. spinosa*; TANASJEVIC 1979). New to Syria.

Material: 79/86: 11 I, 79/106: 4 I.

Ephemerella mesoleuca Brauer, 1857

Distribution: Bulgaria, Carpathians, uplands of Central Europe. New to Syria. Not present in Iceland, Ireland or England.

Material: 79/108: 2 I.

This species appears to be present in Israel (SAMOCHA 1972: as *Ephemerella* sp. larva).

Ephemerella mucronata Bengtsson, 1909

Distribution: Europe except Spain, Pyrenees, Italy, Iceland, Ireland and England. New to Syria.

Habitats: Larvae prefer mossy stones.

Material: 79/128: 3 I, 79/129: 1 I.

Family Caenidae

The larvae of the two species in the material show some differences from Central European specimens (MALZACHER in litt.), which are probably due to variability.

Caenis luctuosa Burmeister, 1839

Distribution: Europe, except Iceland and the northern part of Sweden. New to Syria.

Habitats: Larvae in the same habitats as the related *C. macrura*.

Material: 78/18: 23 I, 78/42: 3 I, 79/57: 3 I, 79/77: 4 I, 79/97: 2 males.

Caenis macrura Stephens, 1835

Distribution: Europe, Asia Minor, Caucasus. Not present in Iceland.

Habitats: Larvae in slow-flowing parts of rivers with stony beds; also in lakes.

Material: 78/21: 3 I, 78/42: 10 I, 78/18: 7 I, 79/20: 8 I, 79/21: 1 female, 79/29: 14 I, 79/33: 7 I, 79/34: 9 I, 79/57: 6 I, 79/70: 16 I, 79/71: 23 males, 79/86: 5 I, 79/88: 21 I, 79/98: 27 males, 11 females, 12 I, 79/102: 3 I, 79/121: 1 I, 80/7: 11 males, 8 females, 80/13: 1 I, 80/43: 1 I, 80/44: 7 I, 80/45: 12 I, 80/55: 23 males, 18 females, 80/71: 2 females, 82/42: 15 I, 82/46: 12 I, 82/47: 2 I, 82/49: 1 I, 82/50: 12 I, 82/51: 1 I.

This species is one of the most abundant mayflies in the material.

Family Prosoptomatidae

Prosoptoma oronti Akouf, 1977

Distribution: Israel (SAMOCHA 1972, as *P. yigali*), Lebanon (ALOUF 1977). New to Syria.

Habitats: Larvae allegedly carnivorous, probably living among the stones of rivers.

Material: 79/108: 6 I.

This species was never formally described as *P. yigali* (DEMOULIN in litt.), and so the name *P. oronti* is valid. The pattern on the larval 'carapace', which is a characteristic of several species, is relatively variable in this species (Fig. 3). *P. oronti*, like its relative *P. phoenicianum* Akouf, 1977, seems to be endemic in the Near East.

Family Leptophlebiidae

Choroterpes (= *Euthraulus*) *balcanica* Ikonomov, 1961

Distribution: Southern part of Yugoslavia (IKONOMOV 1961), Israel (SAMOCHA 1972, as *Euthraulus* sp.). New to Syria.

Material: 79/20: 1 I.

Until 1961 the subgenus *Euthraulus* was only known from the Oriental, Ethiopian and the eastern part of the Palearctic regions (Japanese Islands). In Europe *E. balcanicus* seems to be the only representative of this subgenus.

Habroleptoides modesta Hagen, 1864

Distribution: Southern part of Europe. New to Syria. Not present in Iceland, Ireland,

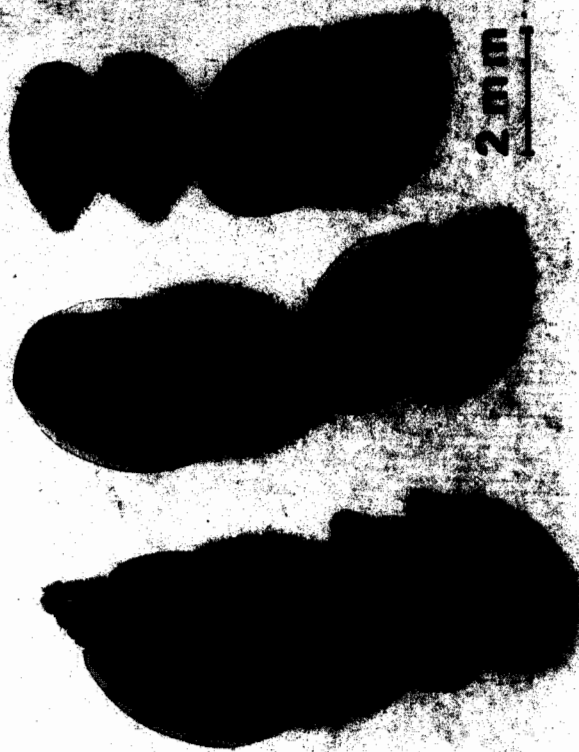


Fig. 3. Larvae of *Prosoptoma oronti*.

England, northern part of Germany, Scandinavia or the northern European U.S.S.R.

Habitats: Larvae in the interstitial of fast-flowing brooks.

Material: 79/128: 1 I.

Another species of this genus, *H. caucasica* Tshernova, 1930 (TSHERNOVA 1930, 1964), is known only in the adult stage from the Caucasus. It is thus possible that this larva may belong to the Caucasian species.

Family Potamanthidae

Potamanthus luteus Linnaeus, 1767

Distribution: Palearctic region, except Iceland, Ireland, Norway and northern Sweden.

Habitats: Larvae mainly in large moderately flowing rivers, among stones.

Material: 79/95: 15 I.

4. Zoogeographical Remarks

Tab. 1 summarizes the species contained in the studied material. The last column (total) reflects the abundance of the species. *Pteris buceratus* is the most abundant species. The data in the last line (species/area) indicates that most species seem to live in

the river Orontes, especially since more than the half of the collecting sites lie on the Orontes. There appears to be no distinct preference by individual species for particular areas: The abundant species occur in nearly all areas, and the rare ones are found too seldom to draw any conclusion. Since mayflies are able to colonize large territories, the areas studied are too small and lie too close together to show differences in the species representation.

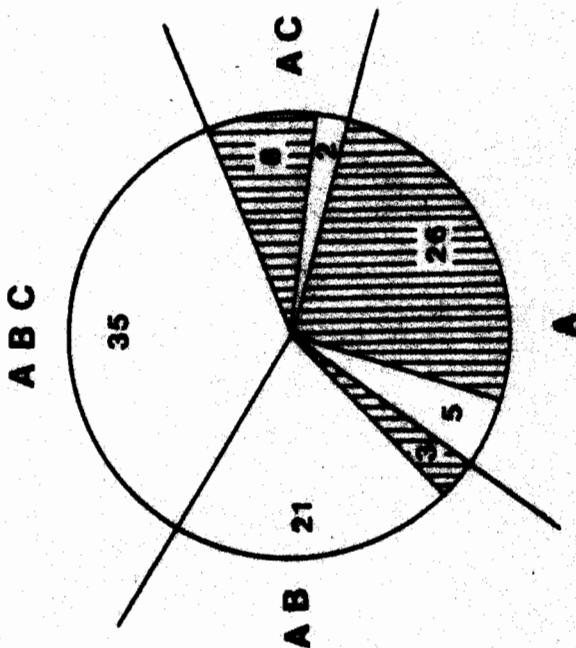


Fig. 4. Composition of the mayfly fauna of the Near East. The figures give the percentage (%) of species in a certain region out of 62 species. The shaded area shows the endemic species. A = Asia Minor, B = Balkan, C = Caucasus.

Fig. 4 shows the connections of the mayfly fauna of the Near East with the neighbouring faunas of the Balkans and of the Caucasus. For these comparisons zoogeographical data are considered, which are given by the publications mentioned in section 1 and which are presented in detail in this paper. Additional data concerning the Caucasus were taken from BRAASCH (1980) and ZIMMERMANN (1981). BRAASCH (in lit.) reported some further Caucasian species: *Heptagenia coeruleans*, *Habrodeptoides modesta*, and *Ephemera danica*, whereas *Epeorus sylvicola* was attributed to this area by mistake (PUTTZ, in lit.). The fauna of the Asia Minor area is composed mainly of species which are widespread in Europe (63%). However, there are strong connections with the South European fauna (*Ephemerella ikononovi*, *Cheroterpes balcanica*) and with the Caucasian fauna (*Ison znojtkoi*, *Ison caucasicus*, *Epeorus zaitzevi*, *Ecdyonurus ornaticornis*, *Rhytrogenia znojtkoi*). Although Asia Minor and the Balkans have more species in common than Asia Minor and the Caucasus, the latter areas have more

endemic species. There is also a strikingly high number of species which are endemic to the Asia Minor area: *Baetis macrospinus*, *B. samochai*, *Oligoneurietta orientalis*, *Rhytrogena theischingeri*, *Ecdyonurus asiaeminoris*, *E. galleiae*, *E. ressi*, *Afromurus kugleri*, *Thalerosphyrus* sp., *Sigmoneuria samochai*, *Prosopistoma oronti*, *P. phoenicium*, *Palingenia anatolica*, and *P. orientalis*. This high number of endemic species in the Near East indicates the rather isolated character of this region.

What connection does the mayfly fauna of this region have with the adjacent faunas of Africa and Asia? So far as Asia is concerned, the high mountains in Iran should allow the dispersal of some species which are adapted to biotopes at these altitudes. A candidate for this type of distribution is *Epeiron anseii*. BRAASCH believes that the specimen mentioned as *Rhytrogena znojtkoi* may possibly belong to this species. Since *Epeiron anseii* is known from Afghanistan (DEMOULIN 1964), it is conceivable that it is present in the highlands of Turkey, Iran, Afghanistan and perhaps reaches the Himalayas.

Large areas of Iran and especially of Saudi-Arabia and North Africa consist of deserts which are hostile to water-dependent insects such as mayflies. Therefore, strong connections between the fauna of the Near East and those beyond the deserts are not to be expected, but nevertheless this does need to be demonstrated. It is possible that there are some species which are present on both sides of the desert or even in suitable sites in the desert. However, since the African and Asian mayfly faunas are insufficiently known, it is impossible to compare them directly. Indirectly this can be done at the level of genera and families. A large number of families - 9 out of 19 - are present in Europe, Africa and Asia (ILLIES 1966). This picture changes dramatically when the worldwide distribution of the genera composing these families is studied (HUMARD 1979). These three continents have only 15 out of 127 genera in common and two of these genera are restricted to Africa and Europe only.

These figures suggest that there are indeed some faunal connections between these continents. The question is how strong these connections really are. To investigate this in detail it is necessary to compare the species of these genera, but this kind of study is hampered by at least two facts. Firstly, the number of species in several of the genera - for example *Ecdyonurus*, *Rhytrogena* and *Baetis* - is very high. Secondly, the species usually differ in many features. It is difficult to determine which of these is a greater weight and therefore has a higher value for estimating relationships. For these reasons, I looked for a genus which has few species that differ only in a few characters. I selected the genus *Prosopistoma* which is distributed with a few species in the Palearctic, Palaeo-tropical and parts of the Australian regions (Tab. 2). The adult life of *Prosopistoma* is very short (GILLIES 1954) and thus passive drift of the adults with the wind cannot lead to the colonization of distant regions. Generally, mayflies are regarded as ideal subjects for biogeographic analyses, because their powers of dispersal appear to be rather sharply limited (EDMUNDS 1972).

The larvae of *Prosopistoma* differ from all other mayflies by the 'carapace' which covers almost the entire body (Fig. 3). Among themselves they look similar. I have dealt only with the larvae, because the imagines of nearly all species are

Tab. 2. The species of *Prosopistoma*.

Species	distribution	references
<i>africanum</i> Gillies, 1954	East-Africa, Tanzania	Gillies (1954, 1956)
<i>boreus</i> Peters, 1967	Philippines, Minanao	Peters (1967)
<i>crassi</i> Gillies, 1954	South Africa, Natal	Gillies (1954, 1956)
<i>deguernei</i> Vayssière, 1893	West-Africa, Senegal	Vayssière (1893), Gillies (1954)
<i>foliaceum</i> Fourcroy, 1785	Europe	Trägårdh (1911), Lafon (1952), Gillies (1956)
<i>indicum</i> Peters, 1967	India, Kerala State	Peters (1967)
<i>lieftincki</i> Peters, 1967	Ceylon	Peters (1967), (Henry 1929: as <i>P. sp.</i>)
<i>oronti</i> Alouf, 1977	Near East	Alouf (1977)
<i>palawana</i> Peters, 1967	Philippines, Palawan	Peters (1967)
<i>phoenicium</i> Alouf, 1977	Near East	Alouf (1977)
<i>scellaceki</i> Peters, 1967	New Guinea, Solomon Islands	Peters (1967)
<i>sp. Paulian</i> , 1947	West Africa, Zaire (Belgian Congo)	Paulian (1947), Gillies (1954)
<i>sp. Vayssière</i> , 1936	East Africa, Kenya	Vayssière (1936, as <i>P. deguernei</i>), Gillies (1954)
<i>variegatum</i> Latreille, 1833	Madagascar	Latreille (1833), Westwood (1877), Vayssière (1890), Gillies (1954, 1956)
<i>wouterae</i> Lieftinck, 1932	Java, Sumatra	Lieftinck (1932), Ulmer (1939, as <i>P. sp.</i>), Lafon (1952), Gillies (1954, 1956), Peters (1967)

unknown. Comparing the characteristics and especially the mandibles, I divided the species into two groups. In group 1 the mandible has a short and thick "neck" which bears strong teeth. The prosthema is relatively short and does not reach the distal end of the mandible. Furthermore, the mandibles have five to twelve bristles (Fig. 5a - f). In group 2 a long and slender "neck" bearing three small bristles is present. The long prosthema nearly reaches the distal end of the mandible which always bears three bristles (Fig. 5g - m). Comparing the composition and distribution of each group, there is one striking feature: the European species are clearly distinct from the African ones.

To explain the distribution of the eastern species, it is necessary to consider geological and biogeographical data. The ancient Gondwanaland continent, which includes the Southern Hemisphere and India, broke up during the Jurassic to late Cretaceous and gave rise to the recent continents. During this process, India and Madagascar drifted away together from Africa and subsequently became separated; India continued drifting north and eventually reached Asia. Evidence for this is

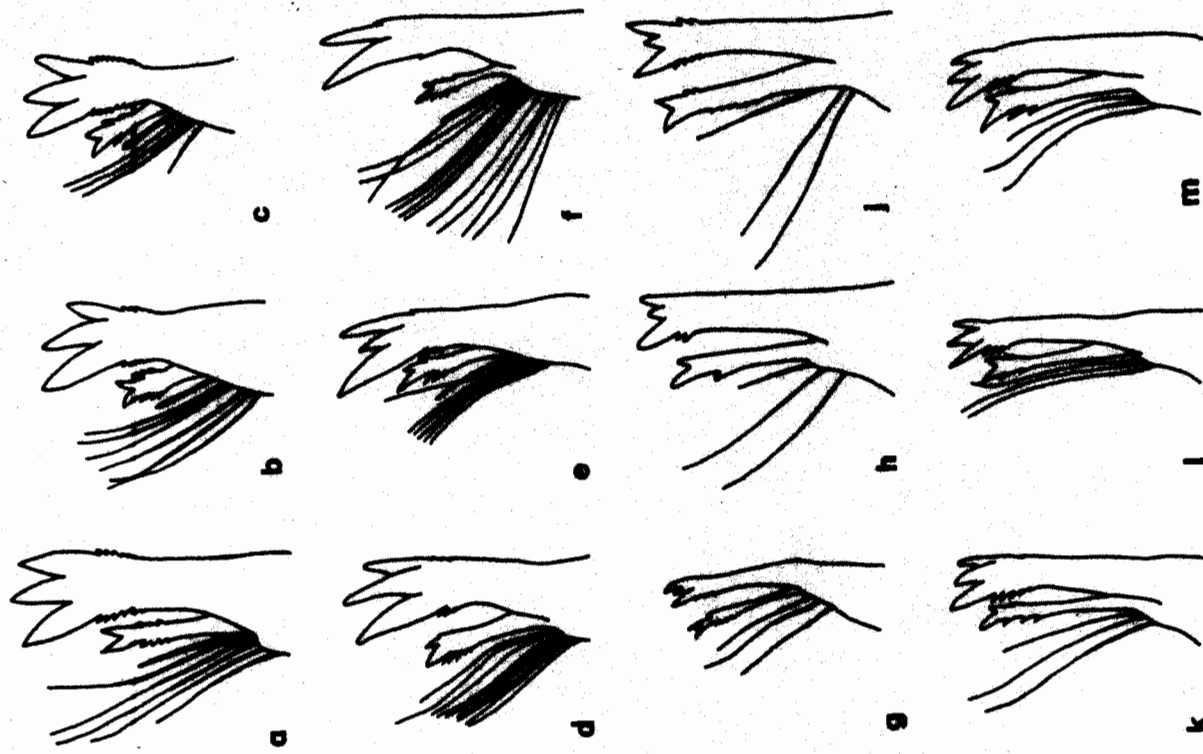


Fig. 5. *Prosopistoma*, mandible. From the original drawings (cited in Tab. 1) except *P. foliaceum* (from TRÄGÅRDH 1911) and *P. wouterae* (from PETERS 1967). a) *foliaceum*, b) *oronti*, c) *phoenicium*, d) *boreus*, e) *scellaceki*, f) *lieftincki*, g) *Paulian*, h) *crassi*, i) *africanum*, k) *indicum*, l) *wouterae*, m) *palawana*.



Fig. 6. Distribution of the genus *Prosopistoma* in the world. Shaded parts show the region covered by the Tethys in the Upper Cretaceous (according to WAGNER 1960). Arrows indicate the hypothetical migrations of the groups.

a) *foliaceum*, b) *aronii* and *phoenicium*, c) *deguernei*, d) sp. Paulian, e) *africanum* and sp. Vayssiere, f) *crassi*, g) *variegatum*, h) *indicum*, i) *lieftincki*, k) *wouterae*, l) *palawana*, m) *boreus*, n) *sedlaceki*.

provided by studies on mayflies (TSUI & PETERS 1975). According to EDMUNDS (1972, 1975), *Prosopistoma* is basically Ethiopian. In his opinion the Oriental species of *Prosopistoma* probably represent the descendants of a single original species which entered with the Indian landmass. ILLIES (1968) suggested that in the Tertiary this thermophilous genus was distributed throughout the Old World and only survived in a few localities as a relict.

The proposed hypothesis is as follows: It is not clear when the two groups of *Prosopistoma* diverged, but by the Upper Cretaceous they must already have been separated into a northern and a southern group by the ancient sea Tethys. The uplift of the

Himalayas separated Central Asia from the oceanic climate and brought it into the regime of a cold dry continental climate.

The northern group became extinct in this region, but colonized the warmer regions in the west (Fig. 6a, b) and in the east (Fig. 6i, m, n). This pattern of distribution is also found in the carnivorous Baetidae *Raptobaetopus tenellus* Albarda (Europe) and *R. orientalis* Müller-Liebenau (Malaysia, Kuala Lumpur) (MÜLLER-LIEBENAU 1978a, 1978b, 1980). During the Cretaceous, the southern group, which had already colonized the areas now known as Africa, Madagascar and India (Fig. 6c, d, e, f, g, h), reached Asia by drifting with the Indian landmass. In this way the southern group was able to enter the eastern part of its territory (Fig. 6k, l).

The sea receded relatively late from Northern Africa and Saudi Arabia. By that time, immigration into the Near East had already taken place from the north. Later the deserts of the Sahara, Saudi Arabia and Iran prevented any colonization from the south and the east. The example of *Prosopistoma* explains why the mayfly fauna of the Near East has almost no connections with Africa and Asia, except for species of the high mountains in South-West Asia.

Postscriptum: When the manuscript had been finished, some further species new to Turkey have been published by KAZANCI (1986).

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References

- ALOUF, N. J. (1977): Sur la présence du genre *Prosopistoma* au Liban. Description de *P. aronii* n. sp. et de *P. phoenicium* n. sp. (Eph.). - Annales de la Limnologie, 13: 133 - 139, Paris.
- BENGTSSON, S. (1930): Kritische Bemerkungen über einige nordische Ephemeropteren, nebst Beschreibung neuer Larven. - Lunds Universitets Årsskrift, N.F. 2, 26 (3): 1 - 27, Lund.
- BODENHEIMER, F. S. (1935): Animal Life of Palestine. - Jerusalem, 507 pp.
- BODENHEIMER, F. S. (1937): Prodrromus Faunae Palaestinae. - Mémoires de l'Institut d'Égypte, 33: 1 - 286, Cairo.
- BRAASCH, D. (1978): *Epeorus znojtkoi* Tabern. und *Ison magnus* n. sp. (Heptageniidae, Eph.) aus dem Kaukasus. - Entomologische Nachrichten, 22: 65 - 70.

- Dresden.
- BRAASCH, D. (1979a, 1979b): Neue *Rhithrogena*-Arten (Heptageniidae, Eph.) aus dem Kaukasus und Transkaukasien (Sowjetunion). 1, 2. - Entomologische Nachrichten, 23: 129 - 139, 154 - 159, Dresden.
- BRAASCH, D. (1979c): Beitrag zur Kenntnis der Gattung *Iron* Eaton im Kaukasus (UdSSR). 3. (Eph., Heptageniidae). - Reichenbachia, 17, 33: 283 - 294, Dresden.
- BRAASCH, D. (1980): Beitrag zur Kenntnis der Gattung *Iron* Eaton (Heptageniidae, Eph.) im Kaukasus (UdSSR). 2. - Entomologische Nachrichten, 24: 166 - 173, Dresden.
- BRAASCH, D. (1981): Eintagsfliegen aus Anatolien und Iran. - Faunistische Abhandlungen. Staatliches Museum für Tierkunde in Dresden, 8(6): 75 - 79, Dresden.
- BRODSKY, K. (1930): Zur Kenntnis der mittelasiatischen Ephemeropteren. I. Imagines. - Zoologisches Jahrbuch, Abteilung für Systematik, 59: 681 - 720.
- DEMOULIN, G. (1963): Mission E. Janssens en Anatolie (Aout - Septembre 1962), Ephemeroptera. - Bulletin de l'institut royal des sciences naturelles de Belgique, 39 (37): 1 - 6, Bruxelles.
- DEMOULIN, G. (1964): Mission H. G. Amsel en Afghanistan (1956). Eph. - Bulletin annuel de la société royale entomologique de Belgique, 100(28): 351 - 363.
- DEMOULIN, G. (1965): Résultats de l'expédition belge au Moyen-Orient (Avril - Aout 1963), Ephemeroptera. - Bulletin de l'institut royal des sciences naturelles de Belgique, 41 (28): 1 - 8, Bruxelles.
- DEMOULIN, G. (1973): Contribution à l'étude des Éphéméroptères d'Israël: Introduction et I. Heptageniidae. - Bulletin de l'institut royal des sciences naturelles de Belgique, Entomologie, 49 (8): 1 - 19, Bruxelles.
- EDMUNDS, G. F., Jr. (1972): Biogeography and evolution of Ephemeroptera. - Annals et revue entomologique, 17: 21 - 42, Paris.
- EDMUNDS, G. F., Jr. (1975): Phylogenetic biogeography of mayflies. - Annals of the Missouri Botanical Garden, 62: 231 - 263.
- GILLIES, M. T. (1954): The adult stages of *Prospistoma* Latreille (Eph.), with descriptions of two new species from Africa. - Transactions of the royal entomological Society 105: 355 - 372, London.
- GILLIES, M. T. (1956): A supplementary note on *Prospistoma* Latreille. - Proceedings of the royal entomological Society of London, 31: 165 - 166, London.
- GRANDI, M. (1960): Fauna d'Italia. 3. Ephemeroidea. - Bologna.
- GRANDI, M. (1964): Contributi allo studio degli Efemeroteri Italiani XXVI. - Repertorio sulle ninfe del genere *Centropilum* Etn. - Bollettino de l'istituto entomologico de l'università de Bologna 27: 119 - 125, Bologna.
- HENRY, M. G. (1929): II. Report of assistant in systematic entomology. In: J. PEARSON (Ed.), Part IV. Administration report of the director of the Colombo Museum for 1928. p. 9 - 12, Colombo.
- HUBBARD, M. D. (1979): Genera and subgenera of recent Ephemeroptera. - Entomologia, Supplements 2, 1 - 8.
- IKONOMOV, P. (1961): Eintagsfliegen Jugoslawiens, *Euthraulus balcanicus* sp. n. - Fragmenta balcanica, Mus. macedon. sci. nat., 4 (1): 1 - 10, Skopje.
- IKONOMOV, P. (1962a): Eintagsfliegen Mazedoniens, Fam. Ephemerellidae. - Acta musei maced. sci. nat., 8 (3): 52 - 74, Skopje.
- IKONOMOV, P. (1962b): Baetidae (Eph.) Mazedoniens. - Fac. sci. universit., Biologie, 83 - 140, Skopje.
- ILLIES, J. (1968): Handbuch der Zoologie, IV, 2. Insecta, 2. Spezielles, 5. Ephemeroptera. - Berlin.
- JACOB, U. (1973): Ein *Centropilum* des *stenopteryx*-Komplexes aus dem mitteleuropäischen Festland. - Reichenbachia, 14 (10): 163 - 170, Dresden.
- JACOB, U. (1977): *Palingenia anatolica* n. sp. (Eph., Palingeniidae) aus der Türkei. - Entomologische Nachrichten, 21: 177 - 182, Dresden.
- KAZANCI, N. (1986): New Ephemeroptera records from Turkey. - Zoology in the Middle East, 1: 141 - 143, Heidelberg.
- KAZLAUSKAS, R. (1959): Material about the Mayflies (Eph.) in Lithuanian SSR with description of a new species *Eurylophella lithuanica* Kazlauskas and imago *Neopphemera maxima* (Joly). - Vilniaus Valstybino V. Kapstuko Vardo Univ. Mokslo Darbai, 23 Biol., Geogr. ir Geol., 6: 157 - 174, Wilna.
- KAZLAUSKAS, R. (1964): Materialy k poznaniu podenaju podenok reki Oki. - Trudy zool. Inst. ANSSSR, 32: 163 - 176, Moscow.
- KEFFERMÜLLER, M. (1960): Investigations on the fauna of Ephemeroptera in Great Poland. - Poznan society friends of science. Dept. mathem. and nat. sci., sect. biol., 19 (8): 1 - 57, Poznan.
- KEFFERMÜLLER, M. & R. SOWA (1975): Les espèces du groupe *Centropilum pulchrum* Eaton (Eph., Baetidae) en Pologne. - Bulletin entomologique Polonais, 45: 479 - 486, Warszawa.
- KEFFERMÜLLER, M. & L. S. W. DA TERRA (1978): The second European species of the subgenus *Eurylophella* Tienasu (Eph., Ephemerellidae, Ephemerella). - Bulletin de l'Académie polonaise des Sciences, Série Biologie, 26: 29 - 33, Warszawa.
- KIMMINS, D. E. (1972): A revised key to the adults of the British species of Ephemeroptera with notes on their ecology. - Freshwater biology association, Scientific publications, 7 (2nd revised edition), London.
- KINZELBACH, R. (1980): Hydrobiologie am Orontes. - Natur und Museum, 110(1): 9 - 18, Frankfurt a.M.
- KINZELBACH, R., F. KRUPP, G. ROTH & W. SCHNEIDER (1989): Zoological travels in the Middle East 1975 - 1985. Catalogue of the collecting stations (in press).
- KOCH, S. (1980): Beschreibung der Larve von *Oligoneuriella orontensis* n. sp. aus dem Vorderen Orient und Vergleich mit den paläarktischen Arten von *Oligoneuriella* Ulmer (Eph.). - Entomologische Zeitschrift, 90: 153 - 160, Stuttgart.
- KOCH, S. (1981): *Baetis samochai* n. sp. aus dem Vorderen Orient (Eph., Baetidae). - Entomologische Zeitschrift, 91: 121 - 125, Stuttgart.
- KOCH, S. (1985): Eintagsfliegen aus der Türkei und Beschreibung einer neuen

- Baetis*-Art: *B. macrospinus* n. sp. (Eph., Baetidae). - Senckenbergiana biologica, 66 (1/3): 105 - 110, Frankfurt a. M.
- LAFON, J. (1952): Note sur *Prosopistoma foliaceum*. - Bulletin de la société zoologique de la France, 77: 425 - 436.
- LANDA, V. (1969): Fauna CSSR 18. Jepice - Ephemeroptera. - Praha, 347 pp.
- LATREILLE, P. A. (1833): Description d'un nouveau genre de Crustacés. - Nouvelles annales du muséum d'histoire naturelle, 2: 23 - 34, Paris.
- LIEFTINCK, M. A. (1932): A new species of *Prosopistoma* from the Malay Archipelago (Eph.). - Tijdschrift voor Entomologie (Suppl.), 75: 44 - 45.
- MACAN, T. T. (1970): A key to the nymphs of British species of Ephemeroptera with notes on their ecology. - Freshwater biology association, Scientific publications, 20 (second revised edition), London.
- MÜLLER-LIEBENAU, I. (1969): Revision der europäischen Arten der Gattung *Baetis* Leach, 1815 (Insecta, Eph.). - Gewässer und Abwasser, 48/49: 1 - 214, Göttingen.
- MÜLLER-LIEBENAU, I. (1978a): *Raptobaeetopus*, eine neue carnivore Ephemeropteren-Gattung aus Malaysia (Insecta, Eph.: Baetidae). - Archiv für Hydrobiologie, 82 (1/4): 465 - 481, Stuttgart.
- MÜLLER-LIEBENAU, I. (1978b): *Raptobaeetopus*, a new genus of the family Baetidae. - Verhandlungen des internationalen Vereins für Limnologie, 20: 2599, Stuttgart.
- MÜLLER-LIEBENAU, I. (1980): Ergänzungen zur Beschreibung von *Raptobaeetopus orientalis* M.-L. 1978 (Insecta, Eph.). - Archiv für Hydrobiologie, 88 (3): 388 - 390, Stuttgart.
- PAULIAN, R. (1947): Un *Prosopistoma* (Eph.) du Congo belge. - Revue Zool. Bot. afr., 40: 12 - 124.
- PETERS, W. L. (1967): New species of *Prosopistoma* from the Oriental Region (Prosopistomidae, Eph.). - Tijdschrift voor Entomologie, 110(9): 207 - 222.
- PLESKOT, G. (1954): Ephemeroptera. - In: H. FRANZ (ed.): Die Nordostalpen im Spiegel ihrer Landschaft. - Innsbruck.
- POR, F. D. (1975): An outline of the zoogeography of the Levant. - Zoologica Scripta, 4(1): 5 - 20, Stockholm.
- PUTHZ, V. (1972): Einige Ephemeropteren aus der Türkei. - Mitteilungen der schweizerischen entomologischen Gesellschaft, 45: 35 - 36, Lausanne.
- PUTHZ, V. (1973): Ephemeropteren aus östlichen Mittelmeerlandern. - Fragmenta entomologica, 9 (1): 15 - 19, Roma.
- PUTHZ, V. (1978): Ephemeroptera. - In: ILLIES, J. (ed.): Limnofauna Europaea. - Stuttgart, 256 - 263.
- SAMOCHA, M. (1972): Ephemeroptera of Israel. - Thesis submitted towards the M.Sc. degree of Tel-Aviv University, Tel Aviv.
- SCHOENEMUND, E. (1930): Eintagsfliegen oder Ephemeroptera. - In: DAHL, F. (ed.): Die Tierwelt Deutschlands, 19: 1 - 103, Jena.
- SOLDAN, T. (1978): Revision of the genus *Palingenia* in Europe (Eph., Palingeniidae). - Acta entomologica bohemoslovaca, 75: 272 - 284, Praha.
- TANASIEVIC, M. (1979): Beitrag zur Kenntnis der Art *Ephemella ikonovi* Puthz (Insecta, Eph.). - Godis. biolog. institut. univ. Sarajewo, 32: 163 - 169.
- THOMAS, A. (1982): *Ecdyonurus* (?) *znajki* Tshernova 1938: Redescription et appari-tenance générale réelle (Eph., Heptageniidae). - Bulletin de la société d'histoire naturelle, 118: 297 - 303, Toulouse.
- TRÄGARDH, J. (1911): Om *Prosopistoma foliaceum* Fourc., en för Sverige ny Ephemeroptera. - Entomologisk Tidskrift, 1911: 91 - 104, Uppsala.
- TSHERNOVA, O. A. (1930): Beiträge zur Kenntnis der paläarktischen Ephemeropteren. 1. - Zoologischer Anzeiger, 92: 214 - 218, Leipzig.
- TSHERNOVA, O. A. (1938): K poznaniyu podenok vostochnovo Zakavkasa. - Trudy Azerb. Fil. ANSSR, 8: 55 - 64, Baku.
- TSHERNOVA, O. A. (1964): Ephemeroptera - Podenki. - In: BEL-BIENKO, G. Y. (ed.): Opređelitel' nasekomykh cyropejskoy casti SSSR, 1: 110 - 136, Moscow.
- TsUI, P. T. P. & W. L. PETERS (1975): The comparative morphology and phylogeny of certain Gondwanian Leptophlebiidae based on the thorax, tentorium and abdominal terga (Eph.). - Transactions of the American entomological society, 101: 505 - 595, Philadelphia, PA.
- ULMER, G. (1929): 6. Ordnung: Eintagsfliegen, Ephemeroptera (Agnatha). - In: P. BROHMER, P. EHRMANN & G. ULMER (Ed.), Die Tierwelt Mitteleuropas, 4: 1 - 43, Leipzig.
- ULMER, G. (1939): Eintagsfliegen (Eph.) von den Sunda-Inseln. - Archiv für Hydrobiologie, Supplementum, 16: 443 - 692, Stuttgart.
- VAYSSIÈRE, A. (1890): Sur le *Prosopistoma variegatum* de Madagascar. - Comptes rendus des séances de l'Académie des sciences, 110: 95 - 96, Paris.
- VAYSSIÈRE, A. (1893): Note sur l'existence au Sénégal d'une espèce nouvelle de *Prosopistoma*. - Ann. Sci. nat. Zool., 7(15): 337 - 342, Paris.
- VAYSSIÈRE, A. (1936): Mission scientifique de l'Onno. Ephemeroptera. II. Formes larvaires. - Mém. Mus. Hist. nat. Paris, 4: 129 - 132, Paris.
- VERRIER, M.-L. (1955): Ephemeroptères capturés par M. K. Lindberg en Turquie. - Bulletin de la société entomologique de France, 60: 98, Paris.
- WAGNER, G. (1960): Einführung in die Erd- und Landschaftsgeschichte. - Öhringen, 694 pp.
- WESTWOOD, J. O. (1877): Notes on the genus *Prosopistoma* of Latreille. - Transactions of the royal entomological society of London, 1877: 189 - 194, London.
- ZIMMERMANN, W. (1981): Beitrag zur Kenntnis der Gattung *Baetis* Leach, 1815 (Insecta, Eph.) im Kaukasus und in Transkaukasien (UdSSR). - Entomologische Nachrichten, 25: 97 - 112, Dresden.

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Appendix

List of the collecting stations. For linguistic correct versions and geographic co-ordinates compare KINZELBACH, KRUPP, ROTH & SCHNEIDER (1989).

date/site number	collecting site	area fig. 1
02-03.08.1978/8-9	SY, Homs, Lake of Homs, channel	4
03.08.1978/12	SY, Homs, Orontes	4
03/05.08.1978/13	SY, Homs, Qasatina, channel	4
03.08.1978/15	SY, S Homs, al-Qusair, Orontes	4
04.08.1978/17	SY, N Homs, ar-Rastan, Orontes	3
05.08.1978/18	SY, Homs, Lake of Homs	4
05.08.1978/20	SY, Homs, Orontes	4
06.08.1978/21	SY, N Hamah, Saizar, Orontes	3
09.08.1978/23	SY, Hamah, Orontes	3
11.08.1978/34	SY, al-Ghab, Abu Qubayis, spring and brook	2
11.08.1978/36	SY, W Hamah, Masyaf, al-Ba'isa, brook	3
15.08.1978/40	SY, Dair az-Zur, tributary of the Euphrates	10
17.08.1978/42	SY, E Raqqa, M'adant, tributary of the Euphrates	10
19.08.1978/45	SY, Gisir as-Sugur, Orontes, brook	2
20.08.1978/47	SY, Latakia, Nahr al-Kabir N	5
23.08.1978/49	TR, Samandagh, Orontes	1
05.03.1979/12-13	SY, NE Latakia, Nahr al-Kabir N	5
05.03.1979/14	SY, E Latakia, tributary of Nahr al-Kabir N	5
05.03.1979/15	SY, E Latakia, Nahr al-Kabir N	5
06.03.1979/17	SY, E Latakia, Nahr al-Kabir N summer-dry creek	5
06.03.1979/18	SY, E Latakia, Nahr al-Kabir N	6
06.03.1979/20	SY, SE Latakia, Salharin (summer-dry)	6
06.03.1979/21	SY, SE Latakia, Larrasir, river	6
06.03.1979/22	SY, SE Latakia, Harra'atun, karst spring	6
06.03.1979/24	SY, SE Latakia, Nahr as-Sana	6
06.03.1979/25	SY, S Latakia, Banyas, Nahr al-Harra'atun	7
07.03.1979/29	SY, Tartus, Marqiyah, Nahr Marqiyah	7
07.03.1979/30	SY, Tartus, Nahr al-Husain	7
03.08.1979/33	SY, W Homs, Buqai'a-plains, creek and spring	4
08.03.1979/34	SY, W Homs, Buqai'a-plains, irrigation canals	10
08.03.1979/35	LB, W Homs, Tall Kalah, Nahr al-Kabir S	10
09.03.1979/37	SY, Homs, Lake of Homs, Orontes	11
13.03.1979/48	SY, N Abu Kamal, Mari, backwater of the Euphrates	11
16.03.1979/57	SY, N ar-Raqqa, Gisir as-Sannin, Nahr al-Bal'ih	11
16.03.1979/58	SY, ar-Raqqa, Euphrates	11
17.03.1979/62	TR, Samandagh, Orontes	11
17.03.1979/63	TR, N Samandagh, Biyyuk Kara Cayi	11
20.03.1979/70	SY, E Gisir as-Sugur, tributary of the Nahr al-Kabir S	7
21.03.1979/71	SY, Gisir as-Sugur, Orontes	2
21.03.1979/72-73	SY, Gisir as-Sugur, Nahr al-Abyad	2
22.03.1979/76	SY, Gisir as-Sugur, karst spring	2
22.03.1979/77	SY, S Gisir as-Sugur, ditches	2
22.03.1979/78	SY, S Gisir as-Sugur, karst spring	2
22.03.1979/79	SY, S Gisir as-Sugur, fish ponds	2
22.03.1979/80	SY, S Gisir as-Sugur, 'Ain Salimu drainage ditch	2
22, 23, 25.03.1979/81	SY, S Gisir as-Sugur 'Ain Salimu, Orontes	2
23.03.1979/84	SY, Hamah, Orontes	3
25.03.1979/85	SY, S Gisir as-Sugur, Qafat al-Mudiq, karst spring	2
25.03.1979/86	SY, W Hamah, Nahr as-Sarut (summer-dry)	3
27.03.1979/88	SY, NW Hamah, Saizar, Orontes	2
29.03.1979/94	SY, E Hamah, Kafat, Wadi Salamya	3
29.03.1979/95	SY, S Hamah, Kafat, Orontes	3
30.03.1979/97	SY, W Hamah, al-Hansa, ditches	2
30.03.1979/98	SY, W Hamah, Masyaf Nahr al-Fuar, ditches	2
30.03.1979/99	SY, W Hamah, Masyaf Nahr al-Fuar, brook	2
30.03.1979/101	SY, NW Hamah, al-'Asarna, rainpool	2
30.03.1979/102	SY, NW Hamah, al-'Asarna, tributary of Orontes	2
30.03.1979/104	SY, NW Hamah, al-'Asarna, Orontes	2
31.03.1979/106	SY, W Hamah, Nahr Abu Qubayis	2
31.03.1979/107	SY, W Hamah, Tall Sahab, karst spring and small lake	2
01.04.1979/108	SY, SW Homs, al-Qusair, Orontes	4
06.04.1979/116	SY, SE Damascus, as-Sawad, brook	12
06.04.1979/117	SY, SE Damascus, as-Suweid, reservoir of Sa'ad Rumi	12
09.04.1979/119	TR, Antakya, Orontes	1
09.04.1979/120	TR, N Antakya, Amk Gölü, drainage ditch	1
09.04.1979/121	TR, N Antakya, brook	1
09.04.1979/122	TR, N Antakya, springs and small ponds	1
09.11.1979/124	SY, Damascus	11
12.11.1979/129	SY, SW Damascus, Qasira, S'ass'a, river	11
06.03.1980/6	SY, N Tartus, Nahr Marqiyah	6
06.03.1980/7	SY, S Latakia, Banyas, Harra'atun, spring	6
07.03.1980/13	SY, Gisir as-Sugur, tributary of Nahr al-Abyad	2
09.03.1980/20	SY, N Ma'nabig, Euphrates, Nahr as-Sugar	10
13.03.1980/29	SY, Dair az-Zur, Palomyra, tributary of the Euphrates	10
20.03.1980/35	SY, SW Damascus, S'ass'a, Nahr al-'A'awag	11
20.03.1980/36	SY, SW Damascus, S'ass'a, pond	11
20.03.1980/39	SY, SW Damascus, S'ass'a, tributary of Nahr al-'A'awag	11
21.03.1980/40	LB, S Zable, Chthaura, tributary of the Litani	8
21.03.1980/42	LB, N Baalbek, al-Laba'a, Orontes	4
22.03.1980/43	SY, W Homs, tributary of Nahr al-Kabir S	4
22.03.1980/44-45	SY, W Homs, Tall Kalah, tributary of the Nahr al-Kabir S	7

23.03.1980/47	SY, Tartus, Nahr al-Tartus	6
23.03.1980/48	SY, E Tartus, Duraiakis, small spring	6
24.03.1980/53	SY, NW Hamah, Saizar, ditch	2
24.03.1980/54	SY, NW Hamah, Saqalbiya, ditch	2
25.03.1980/55	SY, NW Hamah, Saqalbiya, irrigation canal	2
26.03.1980/64	SY, NW Hamah, 'Ain al-Kurum, karst spring and pond	2
28.03.1980/70	SY, NW Homs, Aqrab, tributary of the Orontes	3
29.03.1980/71	SY, S Tartus, Safafa, Nahr Abras	7
29.03.1980/73	SY, S Tartus, river	7
18.09.1982/26	TR, Antakya, Topraksu	1
20.09.1982/31	TR, Antakya, Orontes	1
21.09.1982/38	TR, Antakya, Karasu canal	1
22.09.1982/42	TR, Antakya, tributary of Karasu	1
23.24.09.1982/42	TR, Urfa, Birecik	10
24.09.1982/46-47	TR, Urfa, tributary of the Euphrates	10
27.09.1982/49	TR, Urfa, brook	10
27.09.1982/50	TR, Urfa, tributary of the Euphrates	10
27.09.1982/51	TR, Urfa, Adyaman, Euphrates	10
28.09.1982/53	TR, Adyaman, brook	10