

Three new species of mayflies (Ephemeroptera) from the mist oasis of Erkwit, Sudan*

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Taxonomy, *Baetis pseudogemellus* sp. n., *Baetis harasab* sp. n., *Thalerosphyrus ethiopicus* sp. n., keys, zoogeography

The mist oasis of Erkwit (18.47 N., 37.05 E.) lies at about 45 km to the south-west of Suakin near the coast of the Red Sea. Erkwit plateau is built of basement complex rocks (granites, basalt, etc.) and reaches about 1000 m high. Topography, geology and climatic history is described by KASSAS (1955). The plateau is dissected by several khors (seasonal water-ways). The bed of the khors is mostly stony but sporadically it is also formed by tuffaceous organic deposits which indicate a period of heavier rains during the pleistocene. Erkwit receives both the summer and winter rainfalls (218 mm). Permanently running water occurs only in Khor Harasab and Khor Amat but in dry periods they also become dry and only pools remain. At the locality of Khor Harasab three species of Baetidae (*Cloeon africanum*, *Baetis pseudogemellus* sp. n., *B. harasab* sp. n.) and one of Heptageniidae (*Thalerosphyrus ethiopicus* sp. n.) were collected by P. Štys:

Cloeon africanum ESBEN-PETERSEN, 1913

8 nearly mature larvae — Khor Harasab, 19. 9. 1966

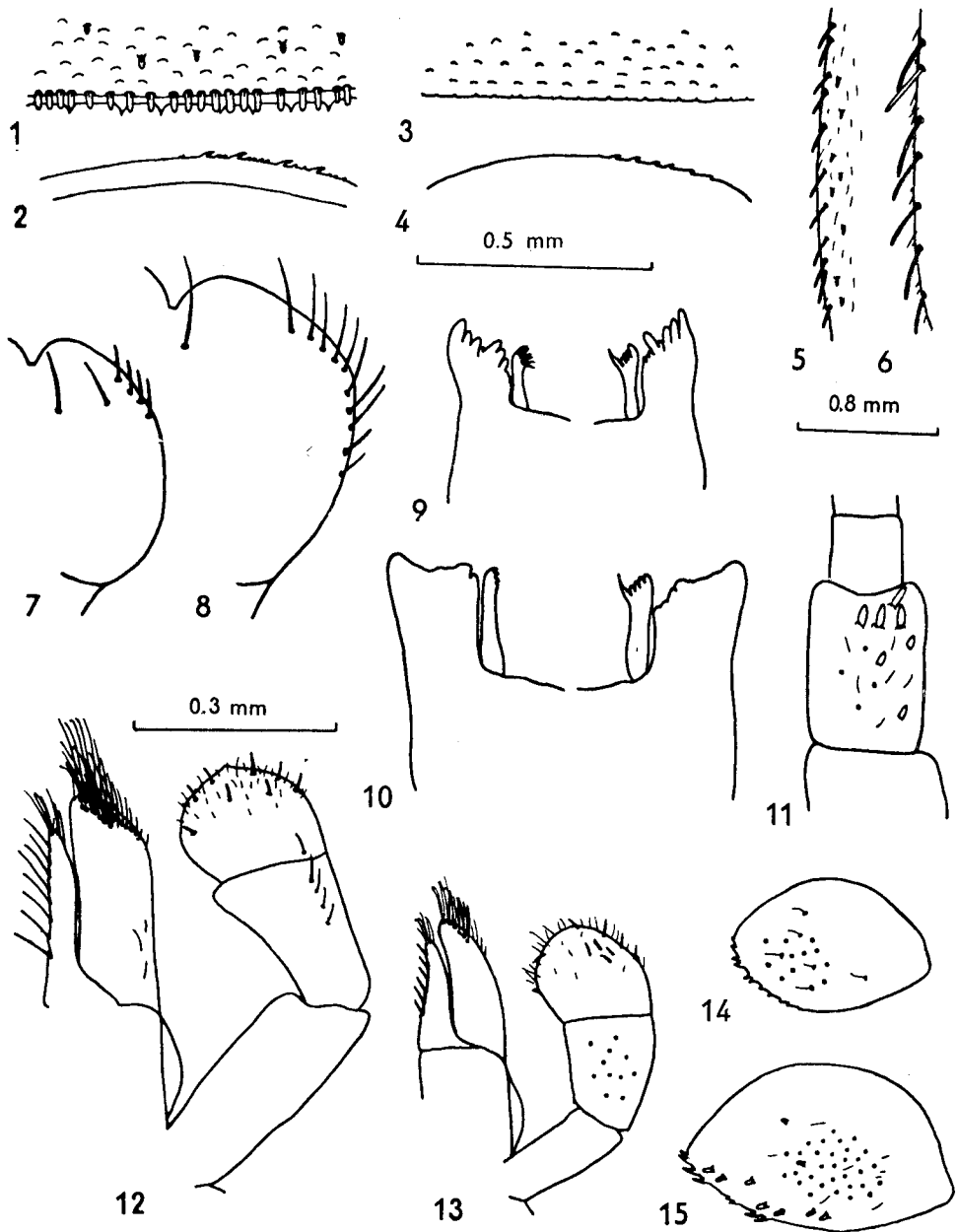
Distribution: Widespread in East Africa (Sudan, Ethiopia, Uganda) and Cape (DEMOULIN, 1970).

Baetis pseudogemellus sp. n.

(Figs. 1, 2, 5, 8, 10, 11, 12, 15)

Larva (holotype): Head brown, eyes dark grey; antennae lighter, with a group of about 7 slightly pointed spines on the surface of pedicellus. Pronotum light brown with a pair of darker spots. Mesothorax and metathorax brown, wing pads light brown with two pale circular spots near the basis. Abdominal terga light brown with a pair of diffuse pale spots; another pair of small pale spots and a pair of diverged strokes in the middle of each tergum; terga I, V, VIII, IX and X paler. Pointed teeth and a regular row of spatulate scales on the posterior margin of abdominal terga. On the surface of the terga scales and semilunar impressions. Labrum with 1 + 11 (10—12) pairs of setae. Outer incisors rounded without teeth. Segment 2 of maxillary palps slightly pointed. Segment 2 of labial palps enlarged towards segment 3; segment 3 rounded, bluntly pointed. Legs yellowish with brown smudges on femora; short, pointed setae on the posterior margin of femora,

* The sixth contribution of NE African fauna based on material collected by P. Štys in 1965 to 1968.



Figs. 1, 2, 5, 8, 10, 11, 12, 15: *Baetis pseudogemellus* sp. n., larva (holotype). Figs. 3, 4, 6, 7, 9, 13, 14. *Baetis harasab* sp. n., larva (holotype). Figs. 1, 3 — posterior margin of the third abdominal tergum. Figs. 2, 4 — margin of third gill. Figs. 5, 6 — posterior margin of femur. Figs. 7, 8 — labrum. Figs. 9, 10 — outer and inner mandibular incisors. Fig. 11 — pedicellus. Figs. 12, 13 — glossa, paraglossa and labial palpus. Figs. 14, 15 — paraproct plate.

Claws with 8 (8—10) teeth. Gill 1 triangular, rounded; gills 2—7 oval, asymmetrical; longer teeth alternate with shorter ones on the margin of gills. Irregular row of teeth on the margin of paraproct plate. Cerci yellowish with brown cilia.

Body length: 7 (6—7.5) mm; length of cerci: 3.8 (3.5—4.5) mm.

Subimago female (paratype No. 1): Body yellowish grey; eyes and ocelli blackish. Abdominal terga with a pair of pale spots and a pair of diverged strokes. Wings dark grey. Hindwing with a triangular process. Legs yellowish. Cerci unicoloured, whitish.

Adult unknown.

Holotype (mature larva), paratype No. 1 (subimago female), other paratype (12 larvae): Sudan, Kassala Province, Khor Harasab, Erkwit, 19. 9. 1966 leg. P. Štys, coll. Soldán, Institute of Entomology, Czechoslovak Academy of Sciences, Praha.

Differential diagnosis: *Baetis pseudogemellus* sp. n. is related to the *rhodani* species-group (MÜLLER-LIEBENAU, 1970, 1971). Critical larval characters are apparent from this key:

- 1 (2) Paracercus reduced; cerci 8 times as long as paracercus (Canary Islands) *B. pseudorhodani* MÜLLER-LIEBENAU, 1971
- 3 (1) Paracercus fully developed, not shorter than 1/2 of cerci.
- 3 (4) Two setae near the top of claws; blunt setae on the posterior margin of femora. Paracercus as long as 1/2 of cerci (Canary Islands) *B. canarensis* MÜLLER-LIEBENAU, 1971
- 4 (3) Claws without setae; pointed setae on the posterior margin of femora. Paracercus as long as 3/4 of cerci.
- 5 (6) On the posterior margin of abdominal sterna teeth and scales present. Longer teeth alternate with short ones on the margin of gills. Outer incisors without teeth (Sudan) *B. pseudogemellus* sp. n.
- 6 (5) On the posterior margin of abdominal sterna only scales present. Spines or teeth of the same length on the margin of gills. Outer incisors with blunt or pointed teeth.
- 7 (8) A group of bristles and hairs at apex of segment 2 of maxillary palps. Less than 5 teeth on the margin of paraproct plate (Central Caucasus) *B. baksan* SOLDÁN, 1978
- 8 (7) Apex of segment 2 of maxillary palps pointed, with only one bristle. More than 10 teeth on the margin of the paraproct plate.
- 9 (10) Gills with spines on the margin. Short and rounded scales on the surface of pedicellus (West Palaearctic) *B. rhodani* (PICTET, 1845)
- 10 (9) Gills without spines on the margin. Pointed scales on the surface of pedicellus (France, Italy, ČSSR, USSR) *B. gemellus* EATON, 1885

Bionomy: Taking into account the bionomy of related species probably two generations a year. Older larvae in August and September but with younger ones. Adults fly in September. Larvae live in small mountain streams with stony bottoms and can survive in pools during dry periods.

Baetis harasab sp. n.

(Figs. 3, 4, 6, 7, 9, 13, 14)

Named after the locality of the holotype.

Larva (holotype): Head yellowish, frons and vertex brown or greenish brown; eyes black; antennae yellowish. Pronotum light brown with a pair of kidney-shaped pale spots and two pairs of diffuse circular spots. Mesothorax with pale strips and smudges. Wing pads yellowish. Metathorax paler, without markings. Abdominal terga light brown with diffuse spots; Terga IV, VIII and IX paler, yellowish; tergum X dark brown. No scales or teeth on the posterior margin of abdominal terga. Semilunar impressions on the surface of terga. Labrum with 1 + 5 pairs of setae. Outer incisors with rounded teeth; inner incisors fully developed, 3/4 the length of the outer

ones. Segment 2 of labial palps cylindrical, not enlarged distally; segment 3 rounded, not pointed, three times as wide as segment 1, with spines and setae. Legs yellowish; distal part of femora darker, with a regular row of rounded setae on the posterior margin. Claws bent, with 9 teeth. Six pairs of oval gills; gills absent on the first abdominal segment. 10—14 teeth of the same length on the margin of gills. Paraproct plate with teeth on the margin and without scales on the surface. Cerci unicoloured, yellowish brown.

Body length: 4.0 mm; length of cerci: 2.5 mm. Subimago and imago unknown.

Holotype (larva): Sudan, Kassala Province, Khor Harasab, Erkwit, 19. 9. 1966 leg. P. Štys, coll. Soldán, Institute of Entomology, Czechoslovak Academy of Sciences, Praha.

Differential diagnosis: *Baetis harasab* sp. n. is in a comparatively independent position. Larval characters, particularly the arrangement of the gills (six pairs), approach those of the species of the *niger* species-group (MÜLLER-LIEBENAU, 1970). Larvae are distinguished mainly by the following characters:

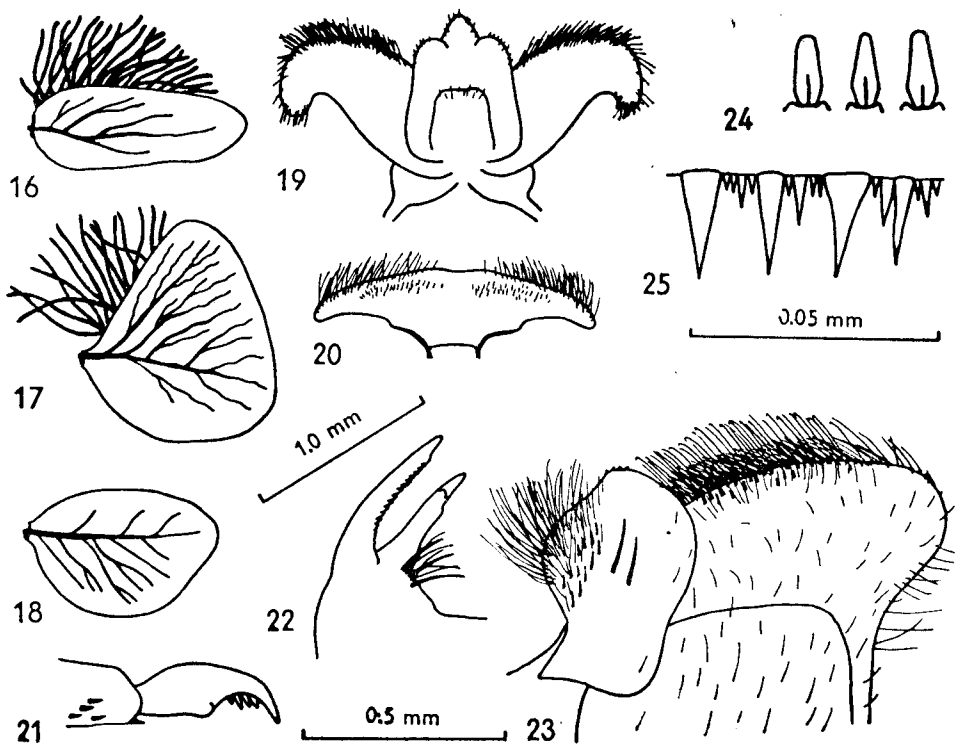
- 1 (2) A few (2—4) setae on the surface of the apical part of glossae. Last gill asymmetrical (Sweden, Great Britain, Austria) *B. digitatus* BENGTTSSON, 1912
- 2 (1) Many (more than 10) setae on the surface of the apical part of glossae. Last gill symmetrical.
- 3 (4) Cerci with transverse black strip. Dorsal part of body black with longitudinal light strip. On the labial palps a regular row of 4—6 setae. Teeth on the margin of abdominal terga (Norway, Sweden, Poland, USSR, Spain, France, Italy) *B. niger* (LINNÉ, 1761)
- 4 (3) Cerci yellowish brown, unicoloured. Dorsal part of body brown or greenish brown with pale spots. No setae on the labial palps. Posterior margin of abdominal terga without teeth (Sudan) *B. harasab* sp. n.

Bionomy unknown.

Thalerosphyrus ethiopicus sp. n.

(Figs. 16—20)

Larva (holotype): Body greenish brown. The apical part of antennae lighter. Four circular whitish spots between eyes. Thorax with pale spots and smudges. Two pairs of large triangular spots near the basis of the wing pads. On the surface of forewing pads two longitudinal pale stripes. Abdominal terga I—IV unicoloured; tergum V with two triangular usually fused spots; terga VI and VII with a pair of circular spots; terga VIII and IX paler; tergum X always dark brown. Ventral side of body yellowish, sterna VII—IX brown. Broad, sharp, long spines alternate with shorter ones and with small ones on the posterior margin of terga. Labrum narrow, its sides produced, and slightly produced backwards. 7 (7—8) branching setae on mandibles near incisors. Outer incisors blunt and medially notched; inner incisors distally rugged. Maxilla with 18 (17—19) bristles. Segment 3 of maxillary palps three times as long as wide at basis. Lateral lobes of hypopharynx produced and bent backwards. Labial paraglossae with distally rounded spines. Femora dark with transverse pale stripes. Claws with 3—5 teeth. Distally rounded spines on the surface of femora, and short and pointed setae on the posterior margin. Gill 1 tongue shaped, 2.5 times as long as wide; gills 2—6 triangular, not produced into a point, approximately as long as wide; gill 7 oval, asymmetrical. Gills 1—6 with tufts of filaments, gill 7 without any. The basis of cerci dark brown, the apical part of them yellowish.



Figs. 16—25: *Thalerosphyrus ethiopicus* sp. n., larva (holotype). Figs. 16, 17, 18 — gills 1, 3 and 7. Fig. 19 — hypopharynx. Fig. 20 — labrum. Fig. 21 — claw of fore leg. Fig. 22 — outer and inner incisors of mandible. Fig. 23 — glossa and paraglossa. Fig. 24 — scales on femur. Fig. 25 — spines on the margin of the third abdominal tergum.

Body length: 10 (9.5—11.0) mm, cerci as long as body.

Subimago female (paratype No. 1): Head yellowish brown, eyes and ocelli black. Scutum lighter with brownish black longitudinal bands. Abdomen dark brown with narrow longitudinal medial strip and with a pair of lobe-shaped light spots on each of terga. Terga VIII—X yellowish with brown smudges. Wings light brown, transparent; cross veins bordered with dark brown. Legs yellow, without markings. Cerci yellowish, not annulate. The basis of cerci reddish brown.

Adult unknown.

Holotype (mature larva), paratype No. 1 (subimago female), other paratypes (14 larvae): Sudan, Kassala Province, Khor Harasab, Erkwit, 19. 9. 1966 leg. P. Štys, coll. Soldán, Institute of Entomology, Czechoslovak Academy of Sciences, Praha.

Differential diagnosis: *Thalerosphyrus ethiopicus* sp. n. belongs in a species-group with *T. sinuosus* NAVÁS and *T. determinatus* (WALKER). Critical larval characters are apparent from this key:

- 1 (2) Two spindle-shaped dark spots on the surface of femora. Abdomen light with dark spots and smudges. Gill 7 narrow, 6 times longer than wide (Sunda Islands) *T. sinuosus* NAVÁS, 1933
- 1 (1) Transverse light stripes on the surface of femora. Abdomen dark with light spots. Gill 7 ova twice longer than wide.

- 3 (4) Gills 2—6 round, gill 7 asymmetrical. Lateral glossae of hypopharynx bent backwards. Spines on the surface of femora distally rounded (Sudan) *T. ethiopicus* sp. n.
 4 (3) Gills 2—6 produced into a point, gill 7 symmetrical. Lateral glossae of hypopharynx produced only. Spines on the surface of femora distally pointed (Sunda Islands)
 *T. determinatus* (WALKER, 1853)

Bionomy: Taking into consideration the bionomy of related species probably one generation a year. Older larvae in August and September. Adults flying in September. Larvae live in small mountains streams.

DISCUSSION

The locality is situated on the border of the Ethiopian and the Palaearctic regions and is at present completely isolated by ecological barriers of the Red Sea, mountain deserts (about 1.100 m a.s.l.) and semi-desert areas. The nearest permanently running water occurs in Khor Arba'at on the beach of the Red Sea. (19.48 N, 37.03 E; 40 m a.s.l.). Only *Caenis* sp. was collected at this locality.

Only one of the four species found, *Cloeon africanum* ESBEN-PETERSEN, is widespread in the Ethiopian area. The other species show affinities with the oriental mayfly fauna although they are probably all endemic. *Baetis pseudogemellus* sp. n. is related to the species of the *rhodani* group from Europe and from the Canary Islands. However, in morphological characters (arrangement of gills) it is even more closely related to undescribed species from Malaysia (MÜLLER-LIEBENAU, 1973). *B. harasab* sp. n. is analogously independent among the species of the *niger* group from Europe that do not occur in Africa. *Thalerosphyrus ethiopicus* sp. n. is closely related to the other species of *Thalerosphyrus* which live in the Sunda Islands (ULMER, 1943). This genus has not hitherto been found in Africa. Undescribed species were found in Turkey (DEMOULIN, 1965) and in Madagascar (Edmunds pers. comm.). Judging from the present distribution of *Thalerosphyrus* it seems that these species have spread to Africa through the Middle East.

Of the other insect orders only the Heteroptera have been studied at Erkwit. Endemic species of palaearctic genera prevail at this locality (Linnavuori, in prep.; Štys in prep.).

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