



## Central Asian mountain Rhithrogenini (Ephemeroptera: Heptageniidae) with pointed and ephemeropteroid claws in the winged stages

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### Table of contents

Abstract .....	301
Introduction .....	302
Material and methods .....	303
Part I. Revision of <i>Cinygmula</i> in Central Asian mountains .....	304
I.1. <i>Cinygmula hutchinsoni</i> (Traver 1939) .....	304
I.2. <i>Cinygmula joosti</i> Braasch 1977 .....	309
Part II. Revision of <i>Himalogena</i> .....	314
<i>Himalogena</i> Kluge 2004 .....	316
II.1. <i>Rhithrogena (Himalogena) tianshanica</i> Brodsky 1930 .....	321
II.2. <i>Rhithrogena (Himalogena) pamirica</i> sp. n. ....	324
II.3. <i>Rhithrogena (Himalogena) carnivora</i> sp. n. ....	326
II.4. <i>Rhithrogena (Himalogena) semicarnivora</i> sp. n. ....	329
II.5. <i>Rhithrogena (Himalogena) stackelbergi</i> Sinitshenkova 1973 .....	331
II.6. <i>Rhithrogena (Himalogena) gunti</i> sp. n. ....	334
II.7. <i>Rhithrogena (Himalogena) nepalensis</i> Braasch 1984 .....	337
Key to larvae of <i>Himalogena</i> .....	338
Key to imagoes of <i>Himalogena</i> .....	339
Part III. Revision of <i>Ironopsis/g1</i> (inc. <i>Caucasiron</i> ) in Central Asian mountains .....	340
III.1. <i>Epeorus (Caucasiron) guttatus</i> (Braasch & Soldán 1979) .....	340
III.2. <i>Epeorus (Ironopsis) rheophilus</i> Brodsky 1930 .....	343
Part IV. Notes about <i>montanus</i> species group of <i>Iron</i> .....	347
Part V. Possible explanation of occurrence of pointed claws among Heptageniidae .....	347
Acknowledgements .....	351
References .....	351

### Abstract

Among mountain species of Heptageniidae from Central Asia, six species belonging to the taxa *Cinygmula* McDunnough 1933, *Himalogena* Kluge 2004 and *Caucasiron* Kluge 1997 have all claws of the winged stages (subimago and imago) pointed. In this area *Cinygmula* is represented by two species: *C. hutchinsoni* (Traver 1939) (with pointed claws) and *C. joosti* Braasch 1977 (with the more typical ephemeropteroid claws); for both species all stages of both sexes associated by rearing are redescribed. The Central Asian mountain taxon *Himalogena* includes seven species: *Rhithrogena (Himalogena) tianshanica* Brodsky 1930, *Rh. (H.) pamirica* sp. n., *Rh. (H.) carnivora* sp. n., *Rh. (H.) semicarnivora* sp. n., *Rh. (H.) stackelbergi* Sinitshenkova 1973, *Rh. (H.) gunti* sp. n. and *Rh. (H.) nepalensis* Braasch 1984; for five of them, all stages of both sexes associated by rearing are redescribed; *Rh. (H.) semicarnivora* is known as male imagoes reared from larvae; *Rh. (H.) nepalensis* formerly known only as larvae, is redescribed based on an anomalous female imago (with gynandromorphism caused by helminth in abdomen) reared from the larval stage. Among these species, *Rh. (H.) tianshanica*, *Rh. (H.) pamirica*, *Rh. (H.) carnivora* and *Rh. (H.) semicarnivora* have mandibles and the labrum modified for carnivorism, while the other three species have the usual *Rhithrogena* mouth apparatus. Imagoes and subimagoes of *Rh. (H.) pamirica*, *Rh. (H.) carnivora*, *Rh. (H.) gunti* and *Rh. (H.) nepalensis*, have both claws of each leg pointed, while the

other species have ephemeropteroid claws. Corrections to the description of *Rh. minima* Sinitshenkova 1973 claw denticulation and to original figure references are given. The taxon *Ironopsis*/g1 is represented by two species in the Central Asian mountains: *Epeorus (Caucasiron) guttatus* (Braasch & Soldán 1979) (with pointed claws) and *Epeorus (Ironopsis) rheophilus* (Brodsky 1930) (with ephemeropteroid claws); for both species all stages of both sexes associated by rearing are redescribed. The character distribution patterns of pointed and ephemeropteroid claws within mayfly phylogeny leads one to assume that both types of claws repeatedly change back and forth within Ephemeroptera. However, within Heptageniidae, those species whose winged stages have pointed claws have overlapping ranges of distribution limited to high mountain systems of Central Asia; their larvae inhabit the same biotopes (stones in rapid streams), have the same habitat and can come into contact with one another when they aggregate on a stone. These observations allow for a hypothesis that explains the repeated change to pointed claws from ephemeropteroid claws among various Heptageniidae species via horizontal transfer of some hereditary factor during the evolutionary history of each of those species with the peculiar claw morphology.

**Key words:** Central Asia, mayflies, Ephemeroptera, Heptageniidae, *Cinygmula*, *Rhithrogena*, *Himalogena*, *Epeorus*, *Ironopsis*, *Caucasiron*, systematics, new species, horizontal gene transfer

## Introduction

Traver (1939) described from the Himalayas a new heptageniid species which in winged stages (both subimago and imago) has both claws of each leg similar, sclerotized, hooked and pointed; on the basis of this character, this species was placed in a new genus as *Ororotsia hutchinsoni* Traver 1939. Now the name *Ororotsia* is regarded to be a subjective synonym of *Cinygmula* McDunnough 1933 (Kluge 1988). *Cinygmula* is a holophyletic taxon, with all other species having ephemeropteroid claws. The term "ephemeropteroid claws" means that the structure of the pretarsus is such that its two claws are dissimilar, the anterior one being blunt and oval, and the posterior one being pointed and hooked (Kluge 2004).

Recently, besides *Cinygmula hutchinsoni*, other heptageniid species with similar pointed claws in winged stages (both subimago and imago) have been discovered—these are *Epeorus (Caucasiron) guttatus* (Braasch & Soldán 1979) and four species of *Himalogena* described in this paper. All heptageniid species with pointed claws in winged stages belong to the taxon *Rhithrogena*/fg1, which in various classifications is treated either as the subfamily Rithrogeninae, or the tribe Rhithrogenini.

The taxon *Rhithrogena*/fg1 [f: *Rhithrogeninae* Lestage 1917; g: *Rhithrogena* Eaton 1881] is divided into three subordinated taxa: (1) *Paegniodes* Eaton 1881, (2) *Rhithrogena*/fg2 and (3) *Epeorus*/fg1 [f: *Epeorini* Kluge 2004; g: *Epeorus* Eaton 1881]. The taxon *Rhithrogena*/fg2 is divided into *Cinygmula* McDunnough 1933 and *Rhithrogena*/fg3. The taxon *Rhithrogena*/fg3 is divided into *Rhithrogena*/fg4, *Sibirigena* Kluge 2004, *Epeiron* Demoulin 1964 and *Himalogena* Kluge 2004. The taxon *Epeorus*/fg1 is divided into *Bleptus* Eaton 1885 and *Epeorus*/fg2. The taxon *Epeorus*/fg2 is divided into *Ironodes* Traver 1935 and *Epeorus*/fg3. The taxon *Epeorus*/fg3 is divided into *Proepeorus* Kluge 2004, *Epeorus*/fg4, *Belovius* Tshernova 1982 and *Iron*/g1 [g: *Iron* Eaton 1883]. The taxon *Iron*/g1 is divided into *Iron*/g2 and *Ironopsis*/g1 [g: *Ironopsis* Traver 1935]. The taxon *Ironopsis*/g1 is divided into *Ironopsis*/g2 and *Caucasiron* Kluge 1997. Diagnoses of all these taxa are given in the monograph on mayfly systematics (Kluge 2004).

In the classification below, taxa containing species with pointed claws are marked by asterisks (\*).

1. *Rhithrogena*/fg1 (subfamily or tribe)
  - 1.1. *Paegniodes* (genus)
  - 1.2. *Rhithrogena*/fg2 (tribe or genus)
    - 1.2.1. *Cinygmula* (genus or subgenus) \*
    - 1.2.2. *Rhithrogena*/fg3 (genus or subgenus)
      - 1.2.2.1. *Rhithrogena*/fg4 (subgenus)
      - 1.2.2.2. *Sibirigena* (subgenus)
      - 1.2.2.3. *Epeiron* (subgenus)
      - 1.2.2.4. *Himalogena* (subgenus) \*
    - 1.3. *Epeorus*/fg1 (tribe or genus)
      - 1.3.1. *Bleptus* (genus)