

**Egg structure morphology gives evidence for a cryptic subspecies of *Electrogena lateralis* (Curtis, 1834) in Southern Europe: *E. lateralis concii* (Grandi, 1953) nov. stat. [Ephemeroptera, Heptageniidae]**

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Keywords: eggs (chorion, KCT's), subspecies, status novus, allopatric distribution.

*Electrogena lateralis* (Curtis, 1834) from Central Europe, at least North of the Alps forelands in Germany and in the UK (Ireland, terra typical s. l.) differs significantly in egg structure from species from Italy and the alpine region (Switzerland, Austria). While the southern European population bears numerous adhesive elements (KCT's) on egg-surface, specimens from the UK and central Germany have eggs which almost completely lack these KCT's. Larvae from both regions show only minor differences, if at all, and males seem to be morphologically inseparable. However, due to the high taxonomic significance of chorion patterns in this genus, as well as the allopatric distribution of the populations, it is proposed that the southern population is given subspecific rank by removing *Heptagenia concii* Grandi, 1953 partly from its synonymy with *E. lateralis*, reinstating it as a subspecies: *Electrogena lateralis concii* (Grandi, 1953) **status novus**.

**La structure morphologique de l'oeuf met en évidence l'existence d'une sous-espèce cryptique d'*Electrogena lateralis* (Curtis, 1834) en Europe du Sud : *E. lateralis concii* (Grandi, 1953) nov. stat. [Ephemeroptera, Heptageniidae]**

Mots-clés : oeufs (chorion, KCT's), sous-espèce, status novus, répartition allopatrique.

Les populations d'*Electrogena lateralis* (Curtis, 1834) d'Europe Centrale, du moins celles situées au Nord des Préalpes d'Allemagne, et celles de Grande-Bretagne (Irlande, terra typica s. l.), diffèrent significativement, par la structure des œufs, des populations d'Italie et de la région alpine (Suisse, Autriche). Alors que la population Sud Européenne montre de nombreux éléments adhésifs (KCT's) à la surface de l'oeuf, les spécimens de Grande-Bretagne et d'Allemagne Centrale possèdent des œufs presque complètement dépourvus de KCT's. En revanche, les larves des deux populations ne montrent que des différences mineures, si elles existent réellement, et les mâles apparaissent morphologiquement identiques. Cependant, en raison d'abord de la haute signification taxonomique de l'ornementation du chorion chez ce genre, et ensuite de la répartition allopatrique des populations, il est proposé de donner un rang sous spécifique à la population du Sud en retirant *Heptagenia concii* Grandi, 1953 partiellement de sa synonymie d'avec *E. lateralis*, et en la réinstaurant comme sous-espèce : *Electrogena lateralis concii* (Grandi, 1953) **status novus**.

## Introduction

*Electrogena* species from different localities in Germany were investigated during the last decade. Some of this work formed part of a revision of *Electrogena affinis* (Eaton) by BELFIORE et al. (1999), some was part of a revision of the three German species and led to a larval key (HAYBACH & BELFIORE 2003) and a key to the female stages (HAYBACH 2006). In this context, egg structure (chorion) was also considered and was frequently shown to possess high taxonomic value even at species level (e.g. SOWA 1981, GAINO et al. 1987, LANDOLT et al. 1991, BELFIORE et al. 1999, and others). While eggs of *E. affinis* (Eaton, 1883) and *E. ujhelyii* (Sowa, 1981) in the investigated material from Germany showed no significant differences with published descriptions, the study of *Electrogena lateralis* (Curtis, 1834) led to unexpected results.

## Material

UK ("Ireland"): 01.06.1994, 1 ♀-Nymph, leg. R. Illek, ex coll. Bauernfeind; Austria: NÖ, „Kl. Erlauf at Brunning“, 09.05.1992, 1 ♀-Nymph, ex. coll. Bauernfeind; Switzerland: Guederes, Kanton Vaud, near Lac Lemane, 14.07.2005, 1 ♀-Nymph, ex coll. Wagner; Germany: Sammetbach bei Hasborn, 24.05.1994, 2 ♀ (reared), Eifel Dombach, 10.05.1994, 1 ♀ (reared), Pfalz Bollenbach 04.07-15.08.1992, 1 ♂, 1 ♀, 2 ♀-Si. from an emergence trap, Westerwald, Kleine Nister, 29.05.1994, 2 ♀-Si, Baden-Württemberg, Black Forest, Gauchach, 30.05.1992, leg. R. Kuettnner, 1 ♀-N. From Bollenbach, Dombach and Sammetbach several males and fullgrown larvae were used to confirm the determination.

## Methods

Mayfly specimens were preserved in a 70-75% ethanol solution. Eggs were dissected from all female stages (mature larva, subimago, imago) from the middle of the abdomen. Eggs were investigated by light microscopy up to a magnification of 1000 X. A phase-contrast microscope is useful but not necessarily needed. Although it is possible to investigate the eggs "as they are" in alcohol-solution, it is useful to clear the surface, remove proteins, etc. and to lighten the object using lactic acid. (Semi-) permanent slides are therefore best made using polyvinyl-lactophenol after HEINZE (1952). However storage of eggs directly in 90% lactic acid solution for some 3-5 minutes is very helpful (see Figs 2 and 3).

## Results

As can be seen from Fig. 1, specimens from Italy possess eggs with a chorion structure including many adhesive elements (KCT's : Knob-terminated Coiled Threads, see KOSS & EDMUNDS 1974 and GAINO & MAZZINI 1987), which are larger and concentrated at one of the poles. This structure was also present in material from Switzerland (Fig. 2) and Austria.

Specimens of *E. lateralis* from Germany and Ireland show a totally different egg structure (Fig. 3). The chorion surface lacks KCT's completely, only in very rare cases are there single small KCT's in the region of the pole cap. Such "naked" eggs without attachment structures are known in *Electrogena gridellii* (Grandi) and *E. fallax* (Hagen), as well as in *E. antalyensis* (Kazanci & Braasch) (GAINO et al. 1987, BELFIORE et al. 2000).

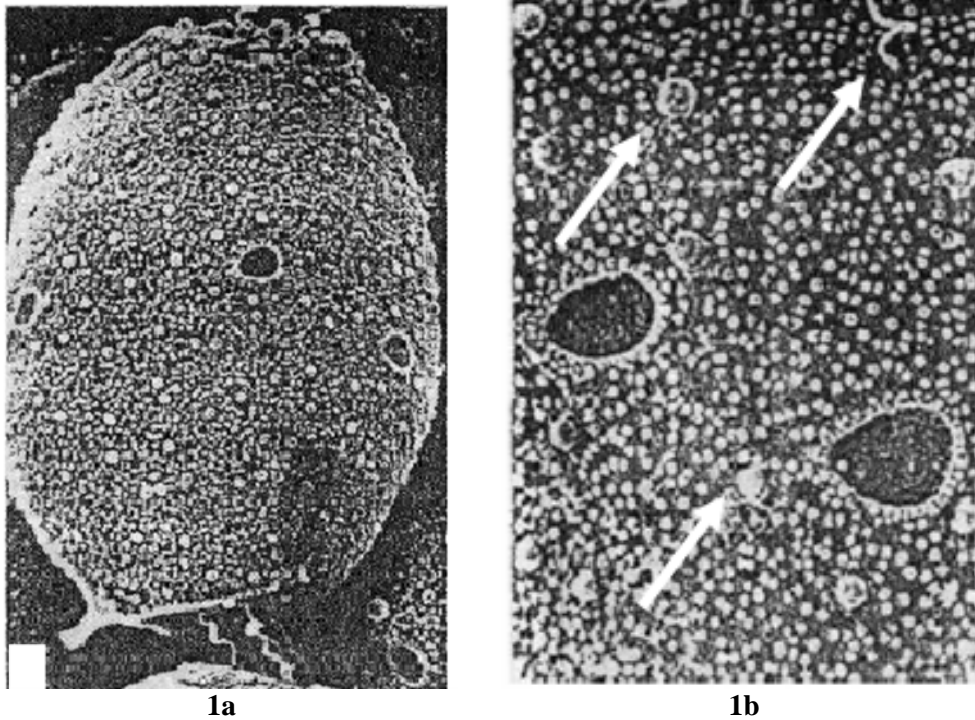


Figure 1a. Egg of *Electrogena lateralis concii* (Grandi, 1953) stat. nov. from Italy. Note the regularly distributed KCT's (Knob-terminated Coiled Threads) concentrated in the pole region.

Figure 1b. Detail of Fig. 1a. Fine structure in the equatorial area. Note the KCTs (some marked by arrows). Figures 1a and 1b reproduced from GAINO et al. (1987).

Figure 1a. Oeuf d'*Electrogena lateralis concii* (Grandi, 1953) stat. nov. d'Italie. Remarquer la distribution régulière des KCT's (Knob-terminated Coiled Threads) concentrés en région polaire.

Figure 1b. Détail de la Fig. 1a. Structure fine de l'aire équatoriale. Remarquer les KCTs (quelques-uns marqués par des flèches). Figures 1a et 1b reproduites de GAINO et al. (1987).

## Naming the new subspecies

Four younger subjective synonyms are known for *E. lateralis*: *Baetis obscura* used by PICTET (1843) is the oldest name but a nomen abusum, a misidentification of STEPHENS (1836). *Baetis obscura* Stephens = *Ephemerella ignita*, as communicated by EATON (1871). *Cloe brunnea* Rambur, 1842 is also an available name, taken into synonymy by EATON (1871). This latter name is rejected for probably being based on Central-European material from France (= *E. lateralis* s. str.). *Ecdyonurus rivulorum* Navás, 1928 from Spain was taken into synonymy by THOMAS (1968). Unfortunately recent egg material from Spain was unavailable for comparison, and the egg structure of Spanish specimens therefore remains unclear.



Figure 2. Egg of *Electrogena lateralis concii* (Grandi, 1953) stat. nov. from Switzerland, near the Lac Léman (coll. A. Wagner: fullgrown nymph). Numerous KCT's are visible, several of them are uncoiled. Photo B. Eiseler.

Figure 2. Oeuf d'*Electrogena lateralis concii* (Grandi, 1953) stat. nov. de Suisse, près du Lac Léman (coll. A. Wagner : larve en fin de croissance). De nombreux KCT's sont visibles, plusieurs d'entre eux sont déroulés. Photo B. Eiseler.

Only one younger subjective synonym of *E. lateralis* was described from Italy, *Heptagenia concii* Grandi, 1953.

The synonymy is held at the species level, as proposed by the Italian genus expert Carlo Belfiore (BELFIORE 1981) based on imaginal and larval studies, but *Heptagenia concii* Grandi is reinstated as a subspecies of *Baetis lateralis* Curtis: *Electrogena lateralis concii* (Grandi, 1953) status novus, known distribution Italy, Switzerland and Austria and *E. lateralis lateralis* (Curtis, 1834), known distribution Europe (certainly Germany and the UK) but not Italy, the Alpine region and Fennoscandia where this genus is in general missing. This subspecific name is used tentatively while its distribution in Southwest Europe, especially in Spain, remains unclear.

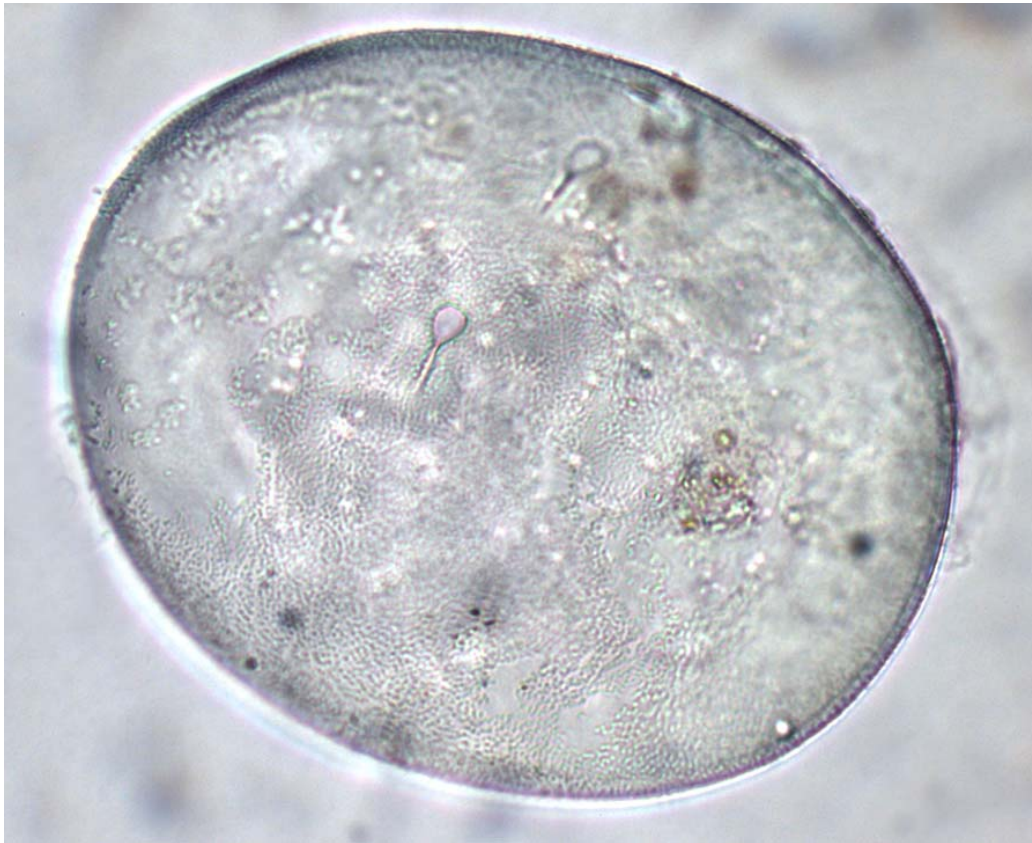


Figure 3. Egg of *Electrogena lateralis lateralis* (Grandi, 1953) stat. nov. from Germany (Eifel-mountains: fullgrown nymph). No KCT's are visible. The surface is totally smooth.  
Photo B. Eiseler.

Figure 3. Oeuf d'*Electrogena lateralis lateralis* (Grandi, 1953) stat. nov. d'Allemagne (montagnes de l'Eifel : larve en fin de croissance). Aucun KCT' n'est visible. La surface est totalement lisse.  
Photo B. Eiseler.

## Discussion

Larvae and male imagoes from Germany are identical with descriptions and specimens from Great Britain (Terra typica s. l.: MACAN 1958, KIMMINS 1972, ELLIOTT & HUMPESCH 1983, own material: 2 larvae from Ireland ex Coll. Bauernfeind, 3 ♂ from Scotland ex Coll. Harker).

The descriptions of BELFIORE (1981, 1982) also fit well and there are only very minor differences in larvae. First, as mentioned by MACAN (1958), in the Central European specimens the first tarsal claw typically possesses one larger tooth, rarely two (the second tooth was absent in a large series of Italian species studied by Belfiore. In rare cases teeth were completely absent).

Second, the shape of the labrum in Central European species seems to be not as broad as in Italian species where the side-lobes are wider. However, males of both regions are more or less identical, as has been shown by BELFIORE (1981) who also compared specimens from Central Europe (Poland), and therefore larvae and male imagines are most probably not separable, and BELFIORE (1981) was completely right to regard *Heptagenia concii* as conspecific with *E. lateralis* when focusing on imaginal and larval structures.

The subspecies concept is not popular among mayfly entomologists and few European species have been supplied with a subspecific rank. Nevertheless it should be stressed that biogeographic workers such as DE LATTIN (1967) suggest a subspecific level should be chosen when there are two representatives of a species group with only minor but quite constant features which occur in different, often neighbouring areas, showing an allopatric distribution.

Separation of Mediterranean regions from each other and from Central European regions at least during the ice-ages could easily lead to a sub-speciation, and in this context the sympatric occurrence of another very similar species, *Electrogena lunaris* Belfiore & Scillitani, 1997 in central Italian Appenine, is noteworthy.

In practice, a subspecific treatment will probably have some advantages. Future investigations of egg structure will clarify the exact ranges of both subspecies and may be an interesting object of biogeographic analyses.

A specific treatment on the other hand would overestimate the importance of the egg stage in this genus, while larval and male records would not be determinable to species level and this could easily lead to great confusion among mayfly workers.

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