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*Leuctra delmastroi* sp. n., a new Alpine species, with comments on the micro-endemism in the *Leuctra* genus in the southwestern Alps (Plecoptera, Leuctridae)

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*Leuctra delmastroi* sp. n. is described and compared with the closest relative *L. concii* Consiglio, 1958. The distribution area of this micro-endemic species is restricted to the Ligurian Alps on both sides of the Franco-Italian border. The distribution area of *L. concii* extends from the central Apennines to the Cottian Italian Alps and a small part of the French Alpes-Maritimes. Micro-endemism in the Ligurian and Maritime Alps is discussed and compared with that of the neighbouring Cottian Alps.

Keywords: Stoneflies, new species, *Leuctra delmastroi* sp. n., *L. concii*, Ligurian and Maritime Alps.

INTRODUCTION

The first specimens of *L. delmastroi* sp. n. were discovered in 1988 on the southern slope of the Marguareis Massif in some tributaries of the Roya River (French Ligurian Alps). They were previously assigned to *L. concii* in the study of the French Alps stoneflies (Vinçon 1996) and in the revision of the Alpine Leuctridae (Ravizza & Vinçon 1998).

In 2007, additional specimens of *L. delmastroi* sp. n. were collected for the first time on the Italian slope of the Marguareis Massif in the high Tanaro Valley (Delmastro coll.).

To better understand the distribution area and the variability of *L. delmastroi* sp. n. and *L. concii*, two complementary collecting trips were undertaken in 2007 and 2009 in the French and Italian Ligurian Alps and in the Apennines, and the Ravizza collection was revised in 2010.

In the southwestern Alps *L. delmastroi* sp. n. is sympatric with two other micro-endemic species, *L. ligurica* Aubert, 1962 and *L. marinettae* Ravizza & Vinçon, 1989. The micro-endemism in this mountainous region and in the neighbouring Cottian Alps is discussed.

MATERIAL AND METHODS

The material is preserved in alcohol. Type specimens are deposited in the Zoological Museum of Lausanne, Switzerland. Other specimens are held by G. Vinçon, Grenoble, France.

Abbreviations: b.= brook, R.= River, spr.= spring, tor.= torrent, trib.= tributary, > = above, < = below, Rav.= Ravizza coll., Vin.= Vinçon coll.

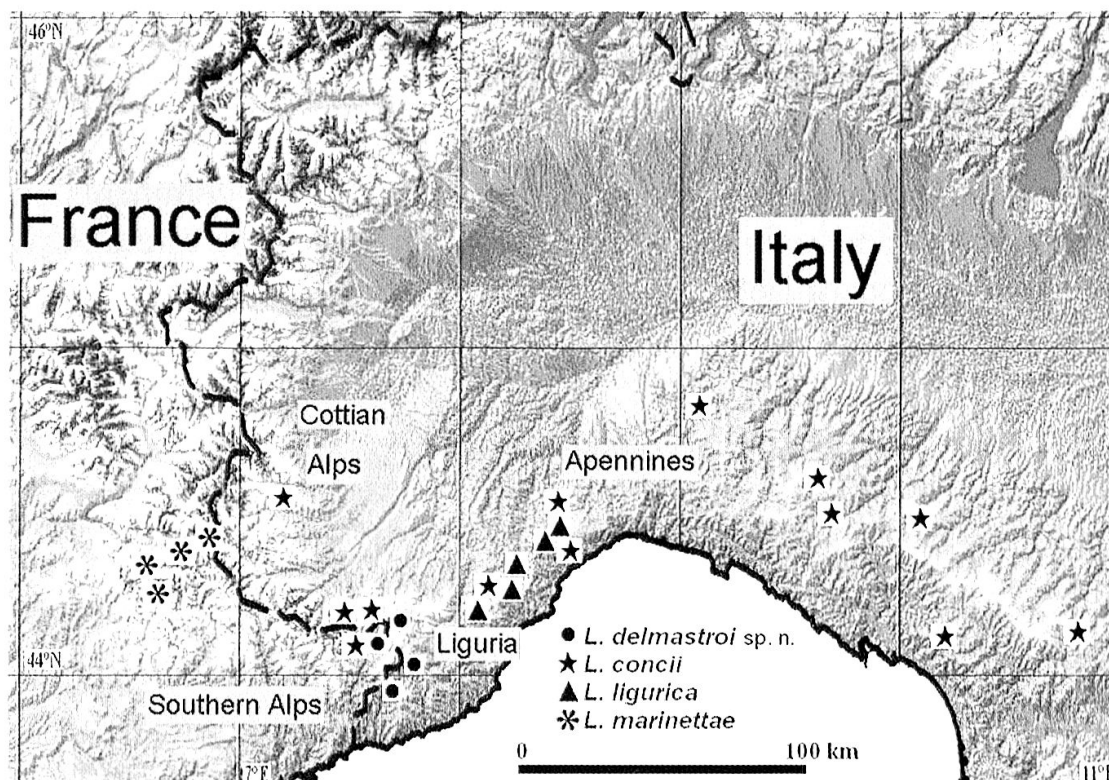


Fig. 1. Micro-endemism in the South Western Alps and Liguria. Distribution areas of *Leuctra delmastroi* sp. n., *L. concii*, *L. marinettae* and *L. ligurica*.

## RESULTS AND DISCUSSION

*L. delmastroi* sp. n. and *L. concii* occur in different springs and brooks around the Marguareis Mount on both the French and Italian slopes (Fig. 1), and they have stable distinctive characters in both sexes, justifying the species status given to *L. delmastroi* sp. n.

As a result of the revision of the Ravizza collection (Ligurian Alps and Apennines), the *L. concii* specimens from the Ligurian Alps, High Tanaro Valley (Ravizza & Ravizza Dematteis 1977) are now re-assigned to *L. delmastroi* sp. n.

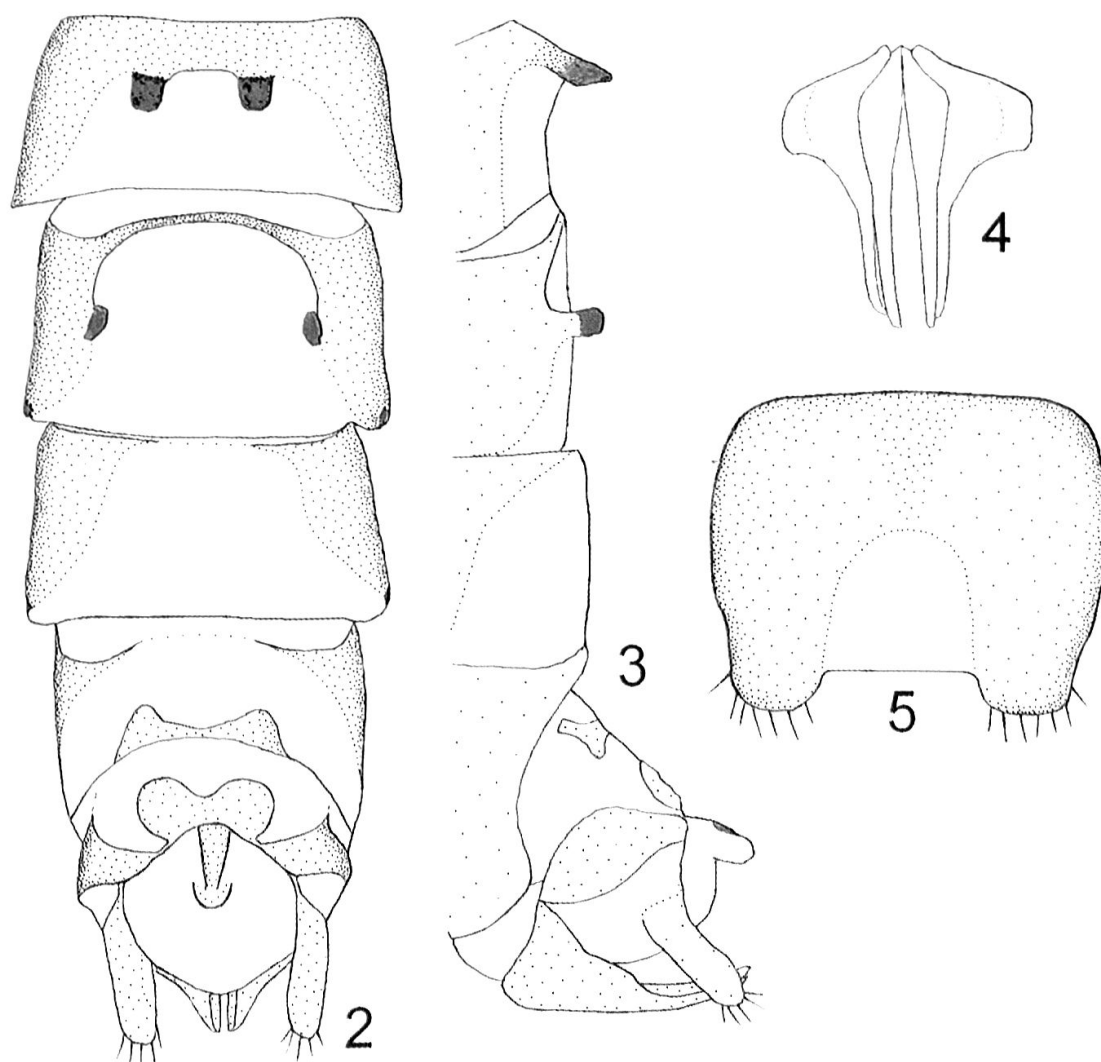
### *Leuctra delmastroi* Vinçon sp. n.

(Figs 2–5)

*Leuctra concii* Consiglio, 1958 — specimens from the Italian Ligurian Alps, high Tanaro Valley (Ravizza & Ravizza Dematteis 1977).

*Leuctra concii* Consiglio, 1958 — specimens from the French Ligurian Alps, high Roya Valley (Vinçon 1996 pro parte).

*Material examined.* Holotype ♂. **FRANCE:** Alpes-Maritimes, Ligurian Alps: Marguareis Massif, eastward the Tende Pass, < Perle Pass, > ‘Vacherie de Valmaurina’, spr. of Refrei R., Roya trib., 2050 m, 5.09.2007 (Vinçon coll.). Paratypes: same date and locality: 44 ♂♂, 40 ♀♀. Other material: other spr. of Refrei R., Roya trib., 1700 m, 2 ♂♂, 2.09.1988; 7 ♂♂, 10 ♀♀, 27.09.1988 (Vin.). **ITALY:** Ligurian Alps, Monesi, Tanarello, Tanaro trib., 1300–1900 m, 45 ♂♂, 59 ♀♀, 22.09.1975 (Rav.); Mendatica, Valcona sottana, Rio Valle di Pietra, Tanarello trib., 1240 m, 12 ♂♂, 8 ♀♀, 11.09.2007 (Delmastro coll.); > Melosa Pass, Vallon del



Figs 2–5. *Leuctra delmastroi* sp. n.: male abdominal tip in dorsal view (2) and lateral view (3), male genitalia in ventral view (4), female subgenital plate in ventral view (5).

Tane, Nervia trib., 1550 m, 2 ♂♂, 8.08.2009; west of the Langan pass, > the dam, Nervia trib., 1350 m, 5 ♀♀, 8.08.2009 (Vin.);

*Description:* Medium sized species: body length: male 6.1–7.1 mm, female 6.2–7.7 mm. Macropterous, sometime slightly brachypterous, wing length: male 4.9–5.5 mm, female 6.3–7.1 mm. General colour brown. Head brown with dark granulation on occiput. Antennae brown with few short bristles at tip of each antennal segment. Pronotum brown with dark pattern. Legs light brown, femora slightly darker on distal third. Body covered with short thin setae.

Male (Figs 2–4). Tergite V with a narrow rounded median membranous field on nearly a third of segment's length. Tergite VI with a wide rounded median membranous field; strong anterior margin with two median teeth, widely separated often more than three times width of one of them, and rising upward and rearward (Figs 2–3); median membranous field covered with thin hairs except several long hairs between teeth and lateral edges. Tergite VII with a median bell-shaped membranous field; narrow anterior margin strongly arched, not interrupted in middle; two rounded widely separated teeth project near mid-length on lateral edges; teeth often

almost same size of those of tergite VI (Fig. 2); median membranous field carrying several long hairs posteriorly between teeth and lateral edges. Tergite VIII with a bell-shaped median membranous field; anterior margin interrupted on about one third of segment's width; several long hairs clearly visible on lateral parts of membranous field. Tergite IX carrying two sub-triangular sclerites connected by a narrow pigmented strip. Tergite X: anterior margin bilobed as usual in the genus, posterior margin with wide and deep median notch, where epiproct rises. Epiproct racket-shaped with long narrow stalk. Cerci rather long and slim. Sternite IX: vesicle short and rounded, without stalk. Specilla nearly straight, progressively getting thinner toward apex; hardly longer than paraprocts. Paraprocts: rounded base flanked by a lateral sub-rectangular lobe; styles getting thinner progressively in first half and ending in a long and thin blade (Fig. 4). Paraprocts and specilla gently curved ending in a sharp point, in side view (Fig. 3).

Female (Fig. 5). Subgenital plate wide, sinuous on its edges, with a median membranous field posteriorly. Two posterior lobes rounded, widely separated by a notch wider than width of one lobe; carrying long hairs at tip. Spermatheca sclerite with a median rounded arch supporting two short anterior teeth and two longitudinal arms gently curved and connected at their tip (V-shaped).

*Affinities.* *L. delmastroi* sp. n. is closely related to *L. concii*. In the *L. delmastroi* sp. n. male, the teeth on tergite VII are about twice as large as in *L. concii* (Figs 6–7), and the expansions of the paraprocts (styles) narrow more abruptly near mid-length (Fig. 3) while they get progressively thinner in *L. concii* (Fig. 8). In *L. concii* females, the subgenital plate lobes have an acute angle on their inner edge (Fig. 9), while in *L. delmastroi* sp. n. the lobes are rounded, without an acute angle on their inner edge (Fig. 5).

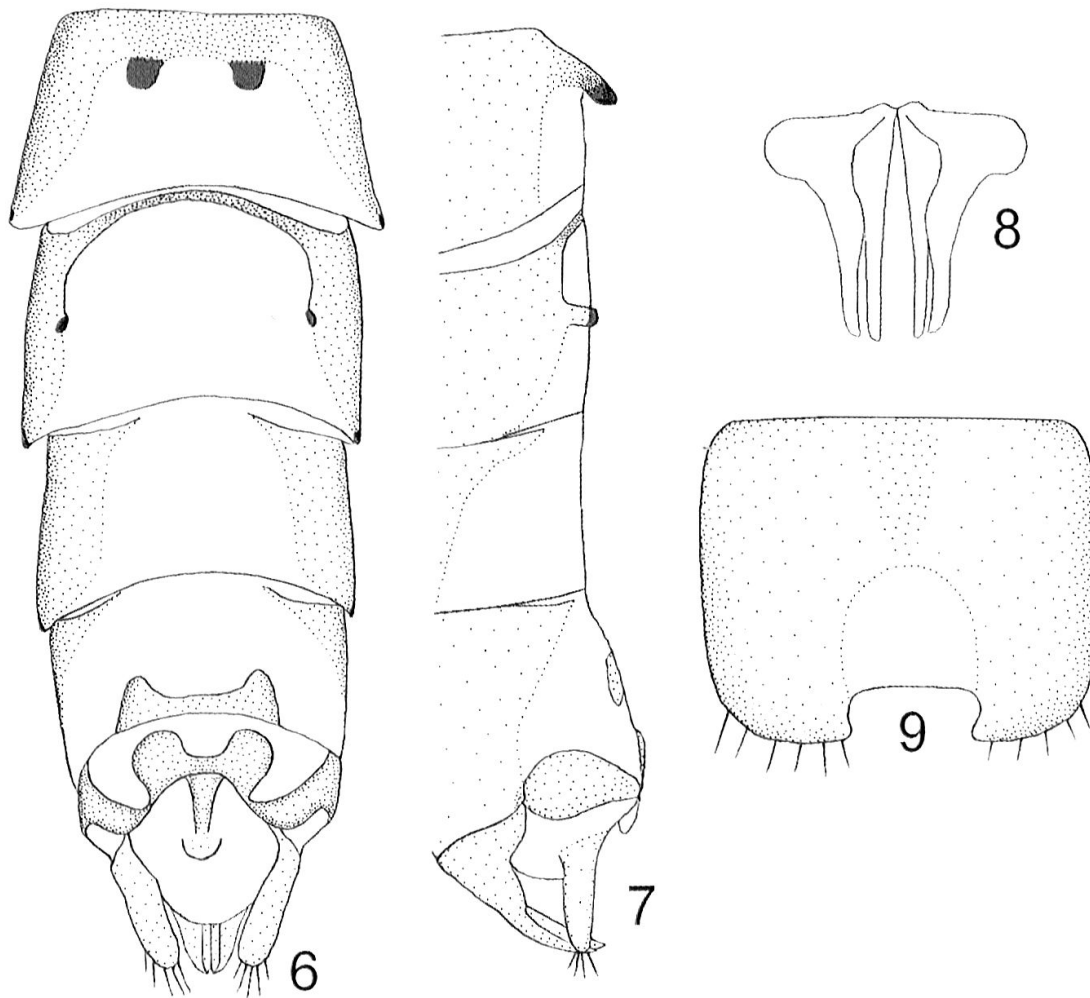
*Distribution and ecology.* *L. delmastroi* sp. n. occurs in the Ligurian Alps, in the surroundings of the Marguareis Mount (2650 m a.s.l.), Saccarel Mount (2200 m) and Peïrevielle Mount (2038 m) that rise from north to south along the Franco-Italian border, and eastward in the surroundings of the Italian Mongioie Mount (2630 m) (Fig. 1). It is an orophilic and crenophilic species occurring in springs and brooklets that are tributaries of the Roya and Nervia Rivers that flow directly into the Mediterranean Sea, or tributaries of the Tanaro River flowing in the Po valley. The specimens were collected at moderate and high altitudes (1240–2050 m a.s.l.). The flight period is in autumn (VIII–X).

*Etymology.* This species is dedicated to the Italian entomologist Giovanni Delmastro (Museo Civico di Storia Naturale, Carmagnola, Italy) who worked with the author on the Alpine stonefly fauna for many years (Malicky et al. 2007).

### *Leuctra concii* Consiglio

(Figs. 6–9)

*Material examined.* **ITALY:** Apennines: Emily, Balze, Fumaiolo Mount, Verghereto Pass, Tevere trib., 1300 m, 4 ♂♂, 1 ♀, 7.08.2001 (Vin.); Croce Arcana Pass, > Fanano, Leo torrent trib., Panaro R. trib., 1 ♀, 19.09.2009; northern slope of the Croce Arcana Pass, brooklet, 1550 m, 42 ♂♂, 28 ♀♀, 19.09.2009; southern slope of the Croce Arcana Pass, brooklet, 1600 m, 10 ♂♂, 5 ♀♀, 19.09.2009; 1300 m, 1 ♂, 1 ♀, 19.09.2009 (Vin.). Alpi Apuane, Gramolazzo, Rifugio Alpino Val Seranaia, 1600 m, spr., 30 ♂♂, 13 ♀♀, 19.09.2009 (Vin.). Ligurian Apennines:



Figs. 6–9. *Leuctra concii*: male abdominal tip in dorsal view (6) and lateral view (7), male genitalia in ventral view (8), female subgenital plate in ventral view (9).

Pontinvrea, Erro R., 400 m, 1 ♂, September 1974 (Rav.); Montenotte, Erro R., 700m, 24 ♂♂, 13 ♀♀, 23.09.1974 (Rav.); Montenotte, Porassino b., 700–750 m, 182 ♂♂, 185 ♀♀, collected over several years (Rav.); Repiano di Pontinvrea, Tortone b., 700 m, 1 ♂, 1 ♀, 23.09.1974 (Rav.). Ligurian Alps: Calizzano, Melogno Pass, Frassinio-Piemonte, < Tende Pass on the northern slope, Cabanaira tor., Vermagnana trib., 1600 m, 18 ♂♂, 21 ♀♀, 5.09.2007; 1700 m, 41 ♂♂, 32 ♀♀, 5.09.2007 (Vin.). Maritime Alps: > Limonetto, Prati della Chiesa tor., 1600 m, 14 ♂♂, 14 ♀♀, 2.09.1988; 2000 m, 15 ♂♂, 17 ♀♀, 2.09.1988 (Vin.). Cottian Alps: Sampeyre, Colle del Prete, Cumbal Cialancia, 1630 m, 5 ♂♂, 5 ♀♀, 16.10.2007 (Delmastro coll.). **FRANCE**: Ligurian Alps: Roya R., > Tende Tunnel and Franco-Italian border, 1400 m, 1 ♀, 27.09.1988 (Vin.). East of the Tende Pass, Begin spr., Roya trib., 1900 m, 27 ♂♂, 30 ♀♀, 6.09.2007 (Vin.).

*Complementary description*: Male (Figs 6–8). Tergite VI with two median teeth on anterior margin; widely separated and rising upward and rearward (Figs 6–7). Tergite VII with two small teeth rising near mid length on lateral edges; about twice smaller than those of tergite VI (Fig. 6). Epiproct racket-shaped with long narrow stalk. Specilla nearly straight and hardly longer than paraprocts. Paraprocts with

wide base flanked by a rounded lateral lobe; blade-shaped styles getting thinner progressively in distal half (Fig. 8).

Female (Fig. 9). Subgenital plate wide, with two posterior lobes having an acute angle on inner edge. Spermatheca with V-shaped longitudinal arms (Ravizza & Vinçon 1998, Fig. 11d).

*Affinities.* *L. concii* belongs to the *fusca* group, and is closely related to *L. delmastroi* sp. n. (see previous description).

*Distribution and ecology.* *L. concii* mainly occurs in the northern half of the Apennines from Lazio to Liguria (Consiglio 1958, 1976). It was mentioned from several catchments in the northern Apennines: Staffora Valley (Ravizza 1974), Erro torrent (Ravizza 1976), Lecca, Taro and Porassino Rivers (Ravizza & Ravizza Dematteis 1978, 1983), brooklet tributary of the Moo Lake in the high Nure Valley (Ravizza 2011), Parma stream (Ravizza Dematteis & Ravizza 1994). It also extends to the Italian Maritime Alps (Ravizza 2002). It is now recorded for the first time from the Cottian Alps where it seems very scarce since it is known only from a single locality (Sampeyre Pass) even after several years of intensive collecting in this region (Malicky et al. 2007) and since the species was not found in the Grana and High Po valleys (Ravizza & Ravizza Dematteis 1986, Ravizza Dematteis & Ravizza 1988). It is also confirmed from the French Alps though the previous records mainly refer to *L. delmastroi* sp. n. (Vinçon 1996).

#### MICRO-ENDEMISM IN THE SOUTHWESTERN ALPS

The Ligurian Alps are the eastern spurs of the southwestern Alps, before the Cadi-bona Pass that separates the Alps from the Apennines (Fig. 1). They constitute the eastern extension of the Maritime Alps from which they are barely separated by the fluvial Roya Valley at the Tende Pass (1870 m). Both the Ligurian and Maritime Alps constitute a wide transversal mountain range rising along the Mediterranean Sea (Mercantour and Argentera massifs). Northward they are widely separated from the Cottian Alps by the Italian Stura di Demonte and the French Ubaye-Durance valleys.

Three micro-endemic Plecoptera species all belonging to the *Leuctra* genus inhabit this mountainous region of exceptional faunistic richness, from east to west: — *L. ligurica* Aubert, 1962, springs and brooklets of the foothills, mainly under 1000 m a.s.l., present in both the Ligurian Alps (Aubert 1962) and the Ligurian Apennines (Ravizza Dematteis & Ravizza 1984), — *L. delmastroi* sp. n., restricted to the Ligurian Alps at higher altitude biotopes (1200–2050 m), — *L. marinettae* Ravizza & Vinçon, 1989, extending westward in the Mercantour Massif in high altitude biotopes (1700–2000 m) (Ravizza & Vinçon 1989) (Fig. 1).

This faunistic richness is similar to that of the neighbouring Cottian Alps where four other micro-endemic species or subspecies occur (*Leuctra queyrassiana queyressiana* Ravizza & Vinçon, 1991, *L. vesulensis* Ravizza & Ravizza Dematteis, 1992, *L. queyrassiana orsiera* Ravizza & Vinçon, 2003 and *L. gardinii* Ravizza, 2005).

The inner spurs of the Cottian Alps, because of their moderate altitude and position deep within the Po Plain, and the southern slopes of the Maritime and Ligurian Alps influenced by the Mediterranean Sea, were not glaciated in the Quater-

nary, and were therefore attractive refuges during the Ice Ages (Jeannel 1942, Ravizza Dematteis & Ravizza 1988). Moreover, the main separating valleys, Stura di Demonte, Ubaye and Durance, occupied by huge glaciers for a long time, were effective faunistic barriers for aquatic insects, explaining the exceptional richness in steno-endemic species in these two neighbouring mountain ranges.

We can also remark that among the seven micro-endemic *Leuctra* occurring in the Cottian, Maritime or Ligurian Alps, two are strictly apterous (*L. ligurica* and *L. gardinii*) and one is brachypterous (*L. vesulensis*). The wing reduction, linked to crenophilic tendency, is favoured by a high level of precipitation in these humid regions submitted to the Mediterranean influence (Liguria and southern spurs of the Alps). The influence of humidity on apterism or wing reduction was also observed in the western Pyrenees and Cantabrian Cordillera exposed to the Atlantic precipitations (Vinçon & Sánchez-Ortega 2002). Wing reduction in Plecoptera is also believed to be favoured by high altitude and low temperatures: — *Leuctra hippopus* may be short-winged or not, according to the altitude (Hynes 1941), — *Capnia bifrons* may be brachypterous at lower altitudes, but micropterous at higher altitudes; a feature that seems to be related to the number of moults induced by temperature (Westermann 1993) (Reding in lit.).

Moreover, apterous or micropterous species such as *L. ligurica* and *L. gardinii* emerge in the cold season, mainly in winter (Ravizza Dematteis & Ravizza 1984, Ravizza 2005). This feature is shared with apterous *Capnioneura* species (Berthélemy 1969, Vinçon & Sánchez-Ortega 2002) as well as other micropterous and apterous *Leuctra* species (Vinçon & Pardo 1994, Vinçon & Ravizza 2000).

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