

Zeitschrift: Mitteilungen der Schweizerischen Entomologischen Gesellschaft =
Bulletin de la Société Entomologique Suisse = Journal of the Swiss
Entomological Society

Herausgeber: Schweizerische Entomologische Gesellschaft

Band: 75 (2002)

Heft: 3-4

Artikel: The status of *Perlodes jurassicus* Aubert, 1946 (Insecta : Plecoptera :
Perlodidae)

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DOI: <https://doi.org/10.5169/seals-402826>

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The status of *Perlodes jurassicus* AUBERT, 1946 (Insecta :
Plecoptera : Perlodidae)

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The present status of *Perlodes jurassicus* appears to be totally confused due for one part to the partly unreliable morphological criteria of the original description by AUBERT in 1946, for the other part to an error of BERTHÉLEMY in 1964 who mistook the egg structure of *P. intricatus* (PICTET) for the one of *P. jurassicus*. This confusion has led by and by to a total misunderstanding of the status and the distribution of *P. jurassicus* and to several erroneous records from different European countries. In this article, we provide a redescription of *P. jurassicus* (male paraproct and egg structure) along with a comparative description of *P. intricatus*. *P. jurassicus* appears to be a species that is strictly endemic of the Jura massif.

Keywords : Plecoptera, *Perlodes jurassicus*, *P. intricatus*, Europe, taxonomy, distribution

INTRODUCTION

The status of *Perlodes jurassicus* AUBERT, 1946 has long been confused and needs clarification and complementary description. *P. jurassicus* was first described from material collected in the Swiss Jura massif (holotype from the Venoge valley). The adults of both sexes were described on the basis of morphological characters: shape of the female genital plate, shape of the pronotum, colour and width of the head, as well as the shape of the head patterns. At that time, no specific sexual characters in the *Perlodes* genus in Europe were recognized to identify either males or females. The morphological characters showed a wide range of individual variation, leading to misidentification and a completely erroneous distribution area. Already in the sixties of the last century *P. jurassicus* was supposed to have a wide distribution area in France (Alpes-de-Haute-Provence, MOULINS 1962; Massif-Central, AUBERT 1963), Italy (CONSIGLIO 1967) and throughout Central Europe (AUBERT 1959; ILLIES 1966).

As the non-sexual morphological characters used for the identification of European *Perlodes* appeared to be unsuitable for correct identification, BERTHÉLEMY (1964) undertook a study of the egg structure which proved to be the best character for identification of European *Perlodes*. Unfortunately, the eggs assigned to *P. jurassicus* by BERTHÉLEMY came from specimens from the Cantal (France), which in fact belonged to *P. intricatus*. Following this work, *P. jurassicus* was erroneously recorded in the French Alps (AUBERT 1986; VINÇON 1996), the Swiss and Italian Alps (RAVIZZA 1975; RAVIZZA & RAVIZZA DEMATTEIS 1990, 1991, 1993; AUBERT et al. 1996), Germany (REUSCH & WEINZIERL 1999), and Bosnia (SIVEC 1980).

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Finally, the eggs of the correct *P. jurassicus* from the Jura massif were described for the first time by BERTHÉLEMY & LAUR in 1975 (p. 275, Fig. 5 J). The confusion was nevertheless maintained because the egg of a specimen of a supposed *P. jurassicus* from the French Massif Central was presumed to belong to a subspecies of *P. jurassicus*, though it in fact belonged to *P. intricatus*.

The re-examination of different *Perlodes* material enabled clarification of the status of *P. jurassicus* and to determine its real distribution area. The examination of the egg structure was completed by the study of the male eversible paraproct lobes (EPLs) which are known to be a good character to separate closely related species in the Perlodidae (MARTEN 1991; ZWICK 1997). This character turned out to be very reliable for the identification of *P. jurassicus*.

MATERIAL

The examined *Perlodes* material came from the following collections: RIS and AUBERT (Switzerland), BERTHÉLEMY, VINÇON and DESPAX (France), REUSCH and ZWICK (Germany), KIMMINS, HYNES and ELLIOTT (England), RAVIZZA and DELMASTRO (Italy), JENSEN (Denmark), SIVEC (Slovenia), GRAF (Austria), RAUSER (Poland).

RESULTS

Redescription of Perlodes jurassicus AUBERT, 1946

The sclerite of the male EPLs is very characteristic; the base is wide and narrows very rapidly towards the apex, forming a thin rod that terminates in a thin sickle-shaped extremity turning around the tip of the paraproct (Fig. 1).

Egg-capsule (0.58 x 0.47 – 0.64 x 0.50 mm), yellow or brownish; the attachment structure (anchor) is an equisided triangular plate with its margins slightly raised and its interior part uniformly depressed (Figs 2, 8); its outer surface covered with numerous mushroom-like structures (Fig. 9). The collar is triangular, having its free margins aligned with the anchor margins. The outer surface of the collar is covered by 2 or 3 rows of deep hexagonal follicular cell impressions (FCIs) (Fig. 9). Similar, but less deep imprints of follicular cells can be seen along the capsule ridges. A distinct hatching line separates the operculum from the rest of the egg capsule (Figs 2, 7). Micropyles (placed equatorially) are arranged in irregular rows; each orifice is surrounded by a raised lip. Chorion ornamentations: the surface of the main chorion and of the opercular region is covered by numerous thin granules, for example in the surroundings of the micropyles (Fig. 3). The egg ridges are almost smooth.

Affinities: the adult morphology in both sexes shows the close relationship to *P. intricatus*. However, the egg structure of *P. jurassicus* clearly differs from that of *P. intricatus*. In side view the capsule of *P. jurassicus* appears more rounded near the hatching line, giving the egg a shell shape. The attachment disc is triangular while it is globular and mushroom-like in *P. intricatus* (Figs 2, 5) (see following description). The ridges are much wider in *P. intricatus* (Fig. 11) than in *P. jurassicus* (Fig. 8). In *P. intricatus* the ridges also clearly show numerous rows of FCIs, contrasting with the smooth ridges in *P. jurassicus*. The granules on the chorion are smaller and more disseminated in *P. jurassicus* (Figs 3 and 6). Moreover, the triangular shape of the attachment disc in *P. jurassicus* is somewhat like that of *P. frisonanus* KHONO, 1943 (ISOBE 1997, p. 352, Fig. 10a–b).

Ecology: *P. jurassicus* is crenophilic, usually living in the close vicinity of large springs between 500 and 1200 m a.s.l. It can also live in small brooks and springs with very few water in summer. The adults emerge over a long period (V-X), near the largest springs where water temperatures are very stable.

Distribution area: *P. jurassicus* is known without doubt from the Jura Massif (France and Switzerland) (AUBERT 1965). In the close surrounding of the Jura Massif (Swiss “Plateau”, north-eastern Pre-Alps and Alps) it is replaced by *P. intricatus* (AUBERT 1965, 1985, 1989). Its record in the German Black Forest (EIDEL 1955) and Bâle region (KÜRY 1994) is not yet confirmed by adults and eggs.

The specimens previously assigned to *P. jurassicus* in the French Massif Central, in the Alps, in Bosnia and in the Slovakian Beskydes Massif (Nova Dedina, Ostravice, 560 m a.s.l., 1 ♂, 1 ♀; RAUSER det., in AUBERT coll.) belong to *P. intricatus* or *P. microcephalus*, on the basis of the mature eggs. Therefore we can consider that all the records of *P. jurassicus* far from the Jura massif are erroneous, and for the moment we can suppose that this species is endemic of the Jura massif.

Material examined: **SUISSE, Jura massif, Vaud**: Venoge River at l’Isle, 660 m, holotype, 1 ♂; 2 ♀ paratypes, 12-VI-42 (AUBERT coll.); Orbe River at Vallorbe, 2 ♂ ♂, 1 ♀, 20-VI-51 (AUBERT coll.); Areuse spring, 790 m, 1 ♀, 2 ex., 6-IX-95. **Jura**: spring trib. Doubs River, Soubey, 550 m, 1 ♂, 2 ♀ ♀, 26-V-97. **FRANCE, Jura massif, Doubs**: Spring of the Doubs River, above Mouthé, 940 m, 1 ♂, 50 ex., 14-VII-96; 1 ♂, 2 ex., 22-VII-96; 1 ♀, 5 ex. 27-VIII-96; 1 ♂, 3 ex., 15-X-96; **Jura**: Spring of the Ain River, Conte, 5 la. 13-IV-91; 1 ♂, 10 ♀ ♀, 19-VII-91 (AUBERT coll.).

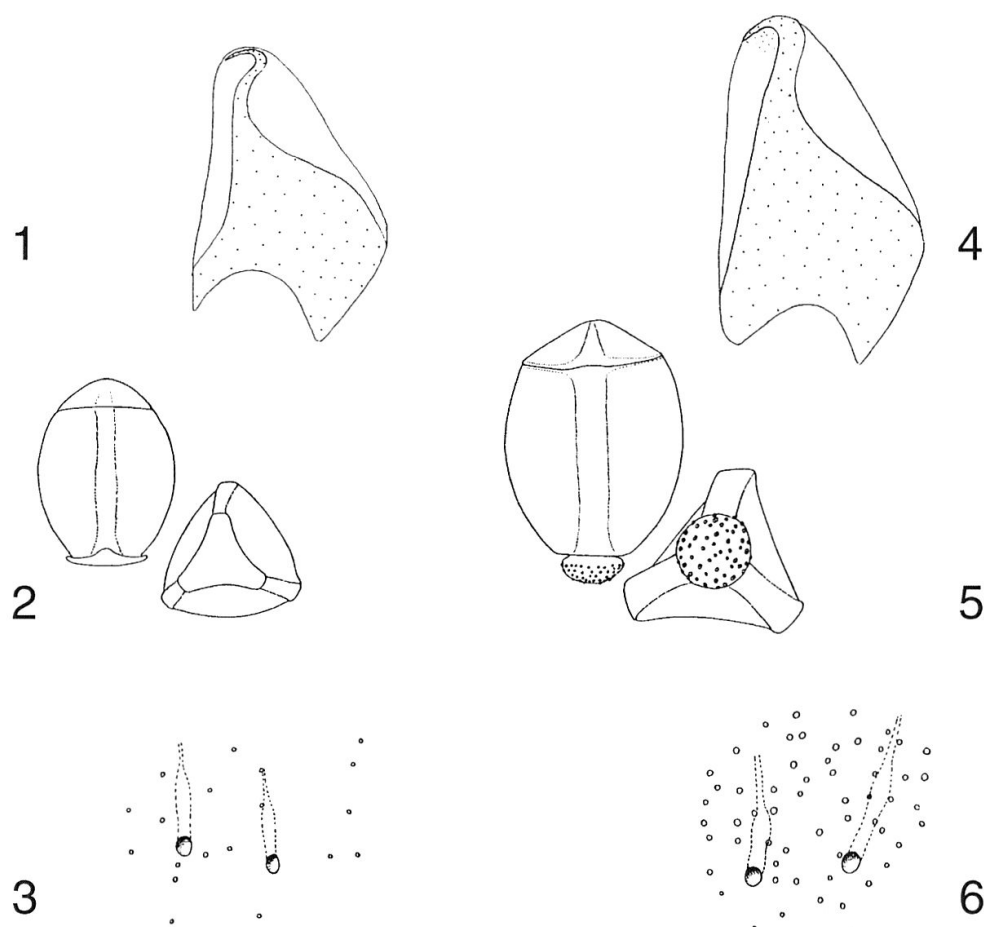
Complementary description of Perlodes intricatus (P ICTET, 1842)

The sclerite of the male EPLs has a much stronger rod than in *P. jurassicus*; the rod ends into a beak-shaped expansion (Fig. 4), instead of a sickle-shaped tip in *P. jurassicus* (Fig. 1). Egg-capsule (0.6 x 0.47 mm – 0.81 x 0.65 mm) brown; the broad operculum, the hatching line and the egg ridges are well defined. The attachment disc is small, button-like, with its outer surface convex (Fig. 5), but in some specimens there is a median depression (Figs 11–12); the anchor surface is covered with numerous mushroom-like structures (Figs 11–12); the collar is short, sub-triangular or almost circular. The micropyles are placed in equatorial rows, they have a small orifice surrounded by a raised lip. Chorion ornamentation: the sides of the capsule are covered with granules that are larger and more regularly placed than in *P. jurassicus* (compare Figs 3 and 6). The egg ridges are wide and rounded, showing numerous rows of FCIs.

Ecology: This species is very orophilic, living in high mountain springs and brooks (1200–2500 m a.s.l.).

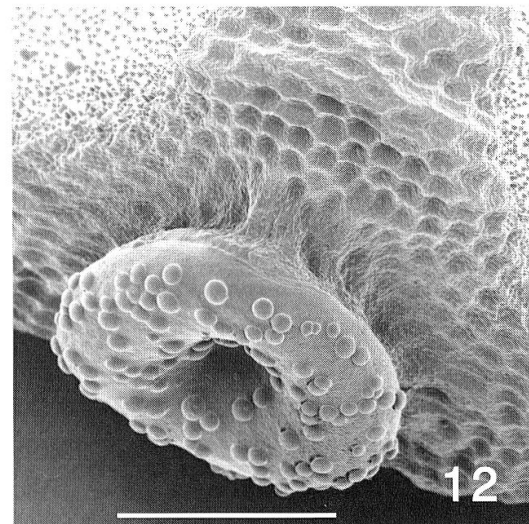
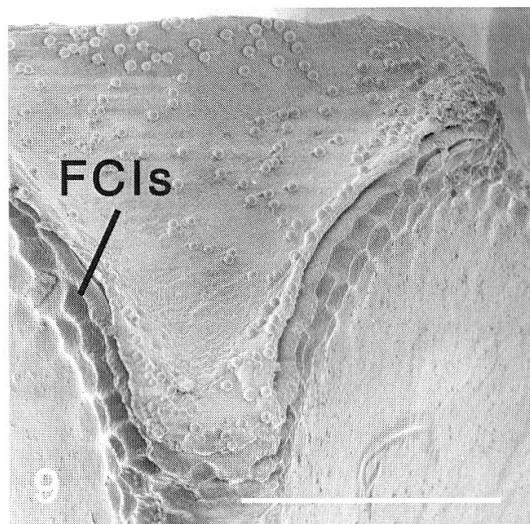
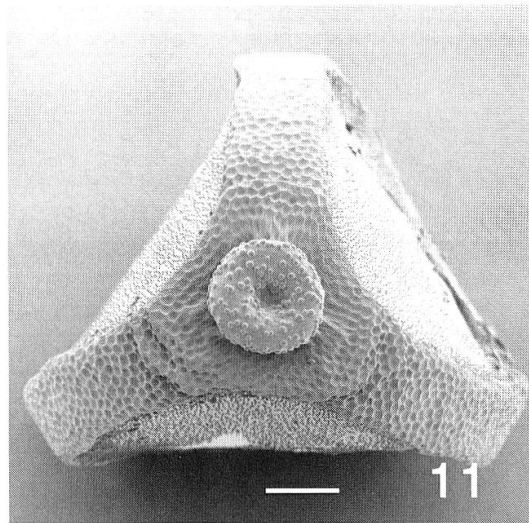
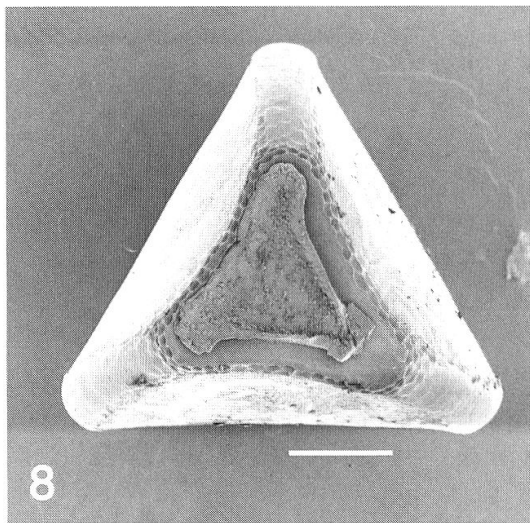
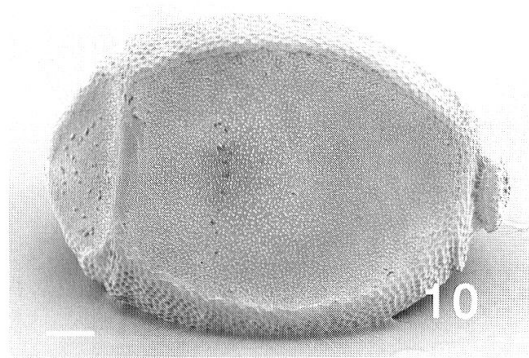
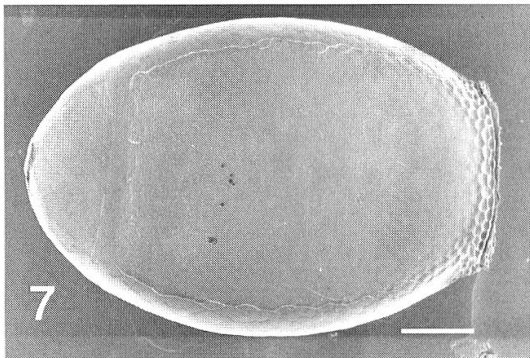
Distribution: This central south European species extends from the French and Spanish Pyrenees, to the French Massif Central, and from the Alps to the Carpathians (KIS 1974).

Material examined: **SPAIN: Pyrenees: Aragon**: Benasque, under the Venasque pass, spring, Esera trib. 2100 m, 1 ♂, 3 ♀ ♀, 28-VI-87. **ANDORRA: Pyrenees**: Encamp, Coma del Llops, Ensagents trib., 2300 m, 1 ♀, 15-VII-86; Arinsal, Coma Pedrosa, 2400 m, 1 ♀, 14-VII-86. **FRANCE: Pyrenees: Haute-Garonne**: Bagnères-de-Luchon, Pique tor. above Hospice de France, 1400 m, 1 ♀, 27-VI-87; **Ariège**: Pas de la Casa, riu Sant Josep, Ariège trib., 2200 m, 1 ♀, 19-VII-89; **Aude**: above Col de Jau, Madrès massif, Aiguette brook, 2000 m, 3 ♀ ♀, 10-VII-87; **Pyrénées-Orientales**: Puymorens pass,



Figs 1–6. *Perlodes jurassicus* (Figs 1–3) and *P. intricatus* (Figs 4–6). 1: *P. jurassicus*: male paraproct showing the EPL that ends into a sickle-shaped expansion. 2: *P. jurassicus*: entire egg in lateral and backwards views, showing the operculum, the hatching line, the egg ridges and the triangular attachment disc. 3: *P. jurassicus*: chorion ornamentation surrounding the micropyles. 4: *P. intricatus*: male paraproct showing the EPL that ends into a beak-shaped expansion. 5: *P. intricatus*: entire egg in lateral and backwards views, showing the operculum, the hatching line, the egg ridges and the globular attachment disc. 6: *P. intricatus*: chorion ornamentation surrounding the micropyles (Figs 2, 3, 5 and 6 from BERTHÉLEMY & LAUR 1975).

Courtal Roussou tor., 2180 m, 1 ♀, 4-VII-88; Font Romeu, Llose trib. above Bouillouse lake, under Etang Bleu, 2400 m, 1 ♀, 27-VII-87; above Fontpédrouse, Riberole tor., 2400 m, 1 ♀, 28-VII-87. **Massif-Central:** **Puy-de-Dôme:** below the Guéry lake, 1200 m, 1 ♀, 2-VI-58 (AUBERT coll.); **Alps:** **Savoie:** spring below the Mont Cenis lake, 1800 m, 1 ♀, 21-IX-91; Bonneval-sur-Arc, Arc trib., below the Iseran pass, 2300 m, 1 ♂, 21-VI-91; 1 ♂, 1 ♀, 20-VII-91; **Isère:** Bourg-d'Oisans, above the Lauvitel lake, under the Plan Vianney lake, 2000 m, 1 ♀, 17-VIII-87; Clavans, Ferrand br. under the Quirlies lake, 2200 m, 1 ♂, 1 ♀, 19-VIII-87; Chartreuse massif, Cirque de St Môme, 1000 m, 3 ♀ ♀, 21-VI-92; Vercors massif, spring of the Bruyant, trib. Furon, 1000 m, 1 ♀, 10-V-98; **Hautes-Alpes:** Queyras massif, Guil trib., above Egourgeou lake, 2700 m, 1 ♀, 3 la, 4-IX-88. **Alpes-de-Haute-Provence:** St Paul, Mary trib., Ubaye trib., 2500 m, 1 ♂, 1 ♀, 17-VII-92. **ITALY:** **Piemont:** **Pennines Alps:** Oropa, 1350 m, 1 ♀, 29-V-78 (RAVIZZA leg.); **Cottian Alps:** Casteldelfino, Varaita di Bellino, under Grange dell Autaret, 2500 m, 1 ♀, 27-IX-88; southward Susa, spring on the northern slope of the Finestre pass, 1900 m, 1 ♀, 5-VIII-01; Crissolo, Pian della Regina, 1710 m, 1 ♂, 1 ♀, 9-VI-99 (DELMASTRO leg.); Sampeyre, Pian delle Baracche, 2100 m, 1 ♀, 11.VIII.01 (DELMASTRO leg.). **SUISSE:** **Valais Alps:** Agenetal, 2180 m, 1 ♀, 21-VII-86; **Vaud:** Pont de Nant, Avançon River, 1250 m, 1 ♀, 29-VII-80; Hongrin, Lioson, 1 ♂, 1 ♀, 10-VI-45;



Figs 7–12. *Perlodes jurassicus* (Figs 7–9) and *P. intricatus* (Figs 10–12). 7: *P. jurassicus*: entire egg in lateral view (French Jura: Spring of the Ain River, 19-VII-91, VINÇON coll.). 8: *P. jurassicus*: base of the egg, showing the triangular attachment disc. 9: *P. jurassicus*: detail of the attachment disc with the mushroom-like structures. 10: *P. intricatus*: entire egg in lateral view (French Massif Central, Guéry, 2-VI-58, AUBERT coll.). 11: *P. intricatus*: base of the egg, showing the globular attachment disc. 12: *P. intricatus*: detail of the attachment disc with the mushroom-like structures (bars = 100 μ m).

Grisons: Davos, Grüensee, FONDEI, Prättigau valley, 1♀, 24-VI-43; **Engadine Alps:** Il Fuorn, Val Morabach, 1♂, 1♀, 12-VIII-35 (AUBERT coll.). **SLOVENIA:** st. 278, Dolina Korosice, Kamnik, 1800 m, 4♀, 21-VI-78; st. 258, Komna, Julian Alps, 1♀, 17-VI-76; st. 275, Matkov kot, Solcava, 2♀, 6-VIII-78; st. 578, Pisnica, Kranjska Gora, 1♂, 2♀, 11-IV-89; st. 771, Pozarnica Vuzenica, 4♂, 1♀, 12-IV-91; st. 778, Bohinj, 13♀, 9-VII-85; st. 1360, Savica Bohinj, 1♀, 12-VII-84. **SERBIA (KOSOVO):** st. 867, Suva Reka, 4♂, 6♀, 24-VII-84 (SIVEC coll.).

ACKNOWLEDGMENTS

We express our gratitude to Ulrike ASPÖCK (Wien, Austria), Giovanni B. DELMASTRO (Carmagnola, Italy), Malcolm ELLIOTT (Cumbria, England), Wolfram GRAF (Wien, Austria), Frank JENSEN (Århus, Denmark), Bernhard MERZ (Zürich, Switzerland), Carlalberto RAVIZZA (Milano, Italy), Herbert REUSCH (Suhlendorf, Germany), Michel SARTORI (Lausanne, Switzerland), Ignac SIVEC (Ljubljana, Slovenia), Wolfgang TOBIAS (Frankfurt, Germany) and Peter ZWICK (Schlitz, Germany), for the loan of *Perlodes* material, and to Jean Paul REDING (Neuchâtel, Switzerland) and John BRITAIN (Oslo, Norway) for reviewing the text. We are also very grateful to Geneviève L'EPLATTENIER (Lausanne, Switzerland) for the electron microscope photographs.

RÉSUMÉ

La description de *Perlodes jurassicus* AUBERT, 1946 basée uniquement sur des critères morphologiques puis la description de l'œuf par BERTHÉLEMY (1964) sur la base d'un spécimen appartenant en fait à *P. intricatus* (PICTET, 1842) a induit une confusion totale du statut de *P. jurassicus*. Cette espèce a par la suite été mentionnée par erreur plusieurs fois de différents pays Européens. Dans cet article, nous donnons une nouvelle description de *P. jurassicus* (paraprocte mâle et structure de l'œuf), en comparaison avec *P. intricatus*. *P. jurassicus* apparaît strictement endémique du Jura.

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(received August 26, 2002; accepted October 11, 2002)

