

Retropluma Gill, 1894 (Crustacea, Decapoda) from the Eocene of the eastern Pyrenees (Spain, France)

Pedro Artal¹, Barry W.M. van Bakel² & Juan Castillo³

¹c/o Museo Geológico del Seminario de Barcelona, Diputación 231, E-08007 Barcelona, Spain; e-mail: partal@optimus.es

²c/o Oertijdmuseum De Groene Poort, Bosscheweg 80, NL-5283 WB Boxtel, the Netherlands; e-mail: barry.van.bakel@wolmail.nl

³c/o Museo Geológico del Seminario de Barcelona, Diputación 231, E-08007 Barcelona, Spain

Received 21 September 2005; revised version accepted 27 March 2006

A new species of *Retropluma* Gill, 1894, *R. gallica*, is described from lower Eocene deposits of Fontcouverte (Aude, southern France), and compared to *R. eocenica* Via, 1959, of which a more detailed description is given based on numerous new specimens. The new material allows us to assess intraspecific variation. The subspecies *R. eocenica folgarolensis* Via, 1980, falls within the range of variation of *R. eocenica*. The preferred habitats of the genus through time are discussed, showing soft-bottom shelf environments to rank first.

KEY WORDS: Crustacea, Decapoda, *Retropluma*, Pyrenees, France, Eocene, new species.

Introduction

The systematic study of fossil decapod crustaceans occurring in Ilerdian (lower Eocene, see Table 1) strata, along the northern and southern slope of the Pyrenees, has provided a notable number of well-preserved specimens belonging to the genus *Retropluma*.

Material described in the present paper was recovered from three different localities: Fontcouverte (Corbières, Aude) in the south of France; Bacamorta (Huesca province, Aragón) and Terrades (Girona province, Catalonia) in northeast Spain.

Plaziat & Secretan (1971) described a small assemblage of decapods from Corbières, but the genus *Retropluma* was not among the reported crabs. *Glyphithyreus wetherelli* (Bell, 1858), as well as two new taxa; *Goniocypoda edwardsi audensis* and *Portunus pusillinus*, were described. The specimens described in the present study were collected from a surface area of a few square metres, from hard limestones, less than a kilometre east from the village of Fontcouverte.

From the Catalonian area, Via (1980) mentioned, but did not figure, three specimens from the Ilerdian of Terrades which were assigned to *Retropluma eocenica* Via, 1959. Two of these are housed in the collections of the Museo Geológico del Seminario de Barcelona (MGSB23738), both are incomplete and badly weathered. New material recently donated to the Museum from the same stratigraphic levels, allows us to emend the description of the species.

Despite the fact that deposits of Ilerdian age in the provinces of Lérida and Huesca have been yielding a great variety of crabs, there are very few records in the literature. Some preliminary notes were published by Via (1959, 1969), Artal & Via (1989) and Fraaye (1995); yet, those authors did not report the genus *Retropluma* from this area. Recently, some carapaces assignable to this genus have

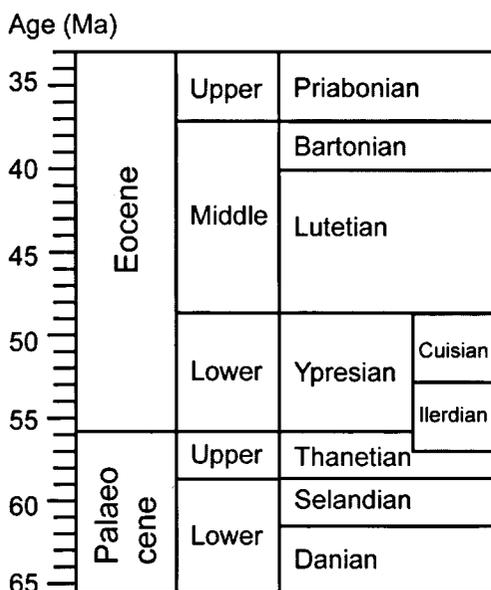


Table 1. Schematic stratigraphic table.

been collected from marly limestones exposed near the village of Bacamorta, representing deposits of deep euphotic environments of late Ilerdian age.

The new discoveries presented here add new data on the genus and in particular on its geographic and stratigraphic distribution. The material collected allows us to erect a new species, *Retropluma gallica*, and to confirm the presence of *R. eocenica* in middle and upper Ilerdian strata. In addition, descriptions of *R. eocenica* published by Via (1959, 1969, 1980) are complemented, noting minor differences between specimens coming from the same levels. The new material extends the known stratigraphic range of this species.

Localities and stratigraphy

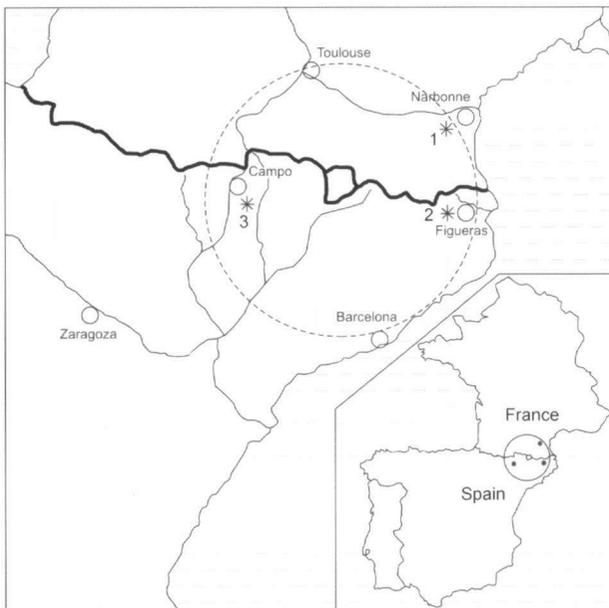


Figure 1. Schematic map of the Pyrenees showing localities (asterisks) from which material described in the text has been collected. Key: 1 = Fontcouverte (Corbières, southern France); 2 = Terrades (Catalonia, Spain); 3 = Bacamorta (Huesca, Spain).

The outcrops discussed here are situated in Corbières (southern France) and in Ribagorça and Ampurdà (northern Spain; see Fig. 1); all expose marine strata of Ilerdian age. Since Hottinger & Schaub (1960) first characterised the Ilerdian stratotype in Lérida, and a parastratotype in Huesca, many authors have studied these areas.

Deposits in Corbières are several metres thick (no more than 10 m in the section from which *Retropluma* was recovered) and correspond to the alveoline limestones or basal Ilerdian limestones described by Plaziat & Secretan (1971). Similar deposits are widely distributed (Serraduy Formation; Cuevas-Gozaló *et al.*, 1985) in Huesca, showing three distinct intervals of different lithology. The lower unit, Calizas de *Alveolina* or alveoline limestones (Nijman & Nio, 1975; Cuevas-Gozaló *et al.*, 1985; Mutti *et al.*,

1985) is considered to be of early Ilerdian age, and the sedimentary environment a shallow shelf with abundant large porcellaneous foraminifera. According to Plaziat & Secretan (1971), decapods were buried in a quiet habitat, without transport or under low levels of water energy, during the early stages of a transgression. The specimens described in the present paper were found to co-occur with a large number of brachyurans of the genus *Glyphithyreus* Reuss, 1859, numerous small oysters and rare fish remains (*Eotrigonodon* sp.).

The lower Eocene sediments examined in Huesca are located near Bacamorta. The crab specimens were recovered from marly limestones, very rich in siliceous sponges, corresponding to the Roda Formation (Cuevas-Gozaló *et al.*, 1985). This formation is considered middle Ilerdian to early Cuisian in age, with the level from which the crabs were collected being late Ilerdian in age. The sedimentary environment was interpreted by Tosquella (1988) as an outer aphotic shelf facies. The associated macrofauna comprises *Xylospongia* sp., *Zanthopsis dufouri* (H. Milne-Edwards, 1850), *Spondylus* sp., pectinids, brachiopods and large oysters.

Outcrops at the third locality are situated less than one kilometre to the northwest from the village of Terrades; the sediments are grey to dark grey marly limestones, somewhat sandy, and assignable to the Sagnari Formation (Gich, 1969, 1972). Chronostratigraphically they are considered middle Ilerdian in age. The sedimentary environment was interpreted by Pallí (1972) as a shallow shelf facies. The crabs were collected together with an impoverished fauna comprising rare small oysters, serpulids, and indeterminate organic remains.

Systematic palaeontology

Abbreviations — The following abbreviation is used in the text to denote the repository of specimens:

MGSB Museo Geológico del Seminario de Barcelona

Superfamily Retroplumoidea Gill, 1894

Family Retroplumidae Gill, 1894

Genus *Retropluma* Gill, 1894

Type species — *Archaeoplax notopus* Alcock & Anderson, 1894, by monotypy.

***Retropluma gallica* n. sp.**

Figures 2.2, 3.1-3.2

Types — Holotype, a complete carapace MGSB68408; the paratype MGSB68409, lacks part of the left side of the carapace.

Additional material — MGSB68410, MGSB68411, MGSB68412 and MGSB68413.

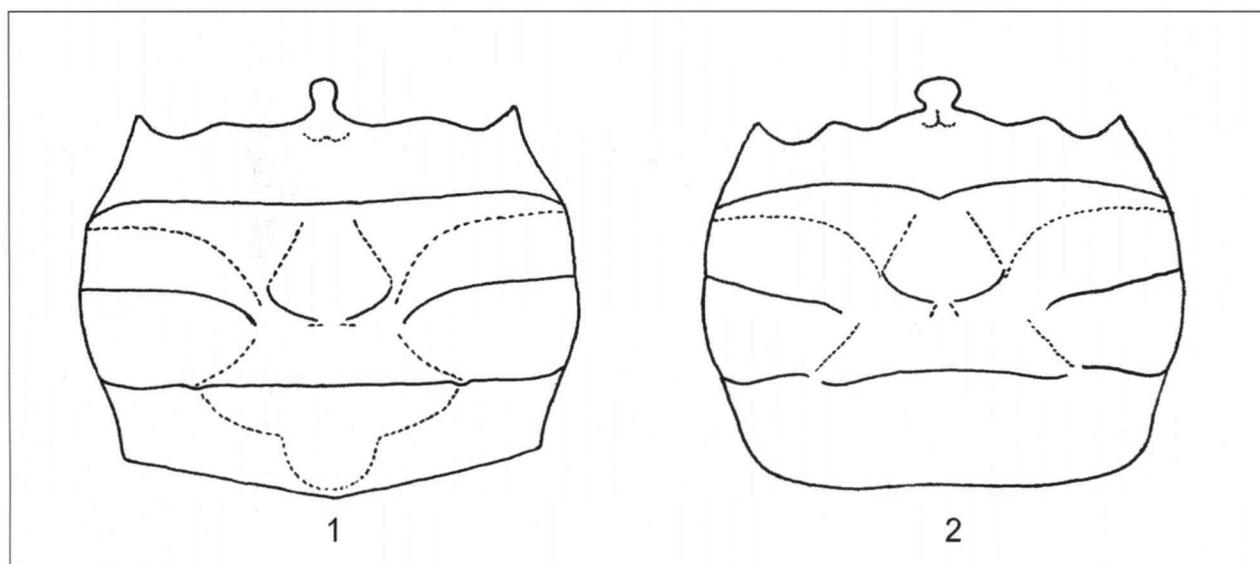


Figure 2. Comparison of carapace morphology in: (1) *Retropluma eocenica* Via, 1959 and (2) *Retropluma gallica* n. sp.

All specimens collected from the basal Ilerdian alveoline limestones (see Plaziat & Secretan, 1971) at Fontcouverte (Corbières, southern France).

Diagnosis — Medium-sized *Retropluma*, carapace subrectangular in outline; orbitofrontal margin strongly sinuous; rostrum markedly deflexed and broadly spatulate; posterior ridge noticeably interrupted by branchiocardiac furrows.

Derivation of name — From *gallicus*, the Latin name of the French province.

Description — The carapace is subrectangular in outline, wider than long, and broadly arched laterally. In cross-section it is weakly convex longitudinally, and transversely flattened. It possesses a length/width ratio of 0.85, reaching maximum width in the mesobranchial area, between the second and third transverse carapace ridges. The orbitofrontal margin is distinctly sinuous, each sinus curving anteriorly, and delimited by robust triangular extraorbital spines. It bears two small but noticeable epigastric lobes at the base of the front. The rostrum is stout and strongly downturned; the proximal portion is narrower and the distal portion is markedly broader, rounded laterally, and gently arched at the end. The orbits are large and directed forward. The anterolateral margin is very short and straight. The posterolateral margin is considerably longer, and broadly arched. Posterior margin gently rounded, weakly concave axially, and distinctly broader than the orbitofrontal margin. Dorsal side of the carapace is covered with a set of three elevated carinae. The anteriormost carina is continuous, and formed by two smooth arcs directed forwards, curving backwards axially at the level of the mesogastric region, forming a broad V-shape midway. The median carina is formed by pronounced epibranchial lobes, not

continuous, markedly oblique in direction and nearly straight. The mesogastric region, bounded by shallow grooves, is broadly swollen and bears two gastric incisions posteriorly. The posterior-most carina is interrupted at the indentation of the branchiocardiac grooves, and divided into three portions; the median portion is displaced towards the posterior margin. Dorsal carapace surface without well-defined regions; it is unornamented except for the scarcely granulated mesogastric region and the carinae. The margins are finely granulated. Ventral side and chelipeds / appendages are not preserved.

Remarks — *Retropluma gallica* differs from fossil and extant congeners in showing a noticeable interruption of the posterior-most ridge and a slight displacement of the median portion towards the rear of the carapace. This feature has only been mentioned by Beschin *et al.* (1996) in the clearly distinct genus *Loerenthopluma*, which differs from *Retropluma* by its diverging lateral margins and broader orbital margin. In members of *Retropluma* the interruption of the posterior-most ridge is unknown, with the exception of a new Belgian form now under study (van Bakel *et al.*, in prep.). From the known fossil members, *Retropluma gallica* is close to *R. eocenica* from the Middle Lutetian of Spain (Via, 1959) and the Middle Eocene of Italy (Beschin *et al.*, 1996). *Retropluma eocenica* is easily distinguished in having a continuous posterior carina, a straighter anterior carina, with the epibranchial carina less oblique, nearly subparallel to the other two; the rostrum is more rounded anteriorly, depressed at the centre and less downturned; the orbitofrontal margin is less sinuous and the posterior margin is more rounded.

A specimen from the Oligocene of Italy described by Larghi (2003), despite being incomplete and of poor preservation, could perfectly be assigned to *Retropluma eocenica* based on the nature of the carinae.

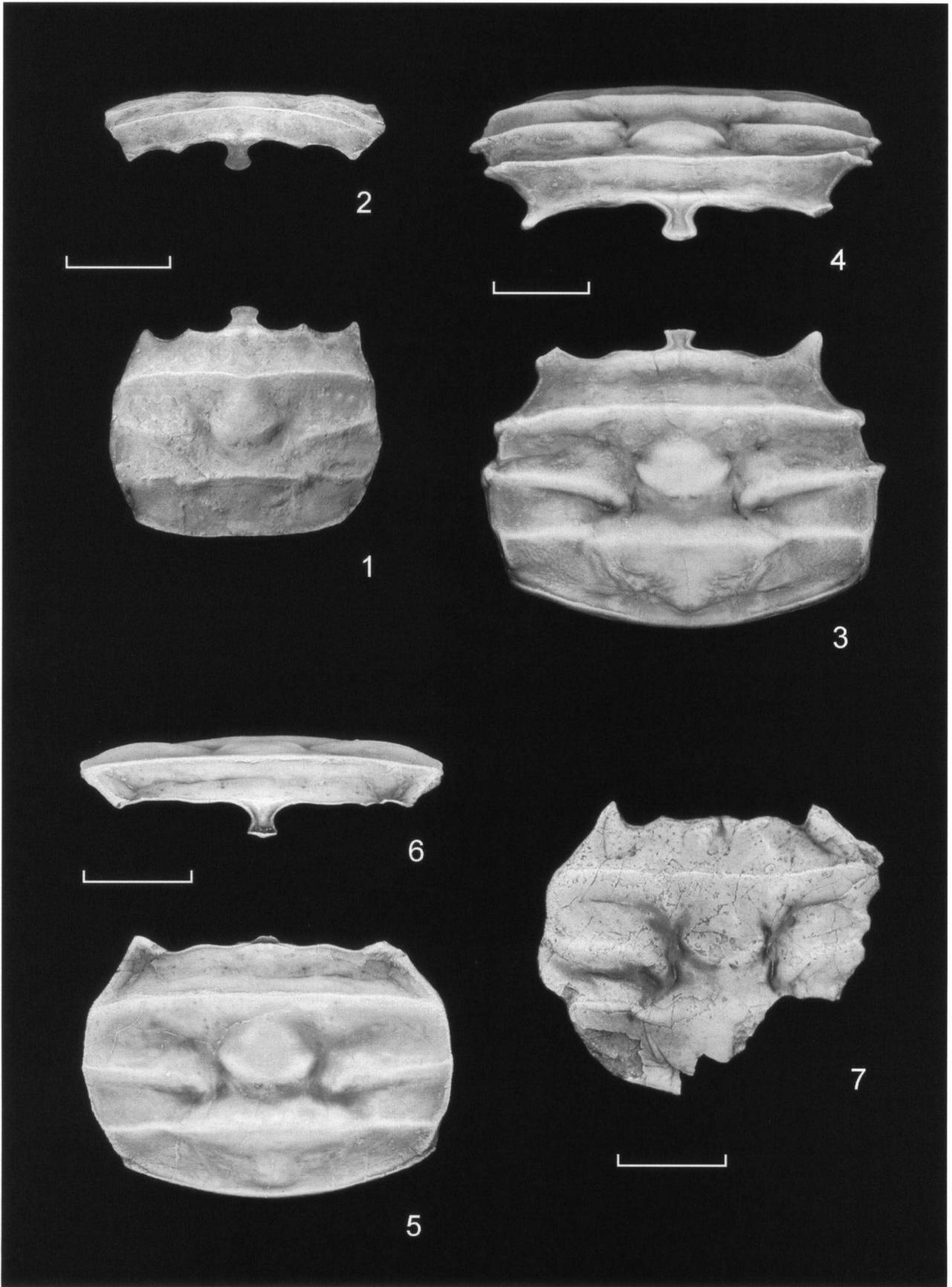


Figure 3.

Figure 3. Specimens were blackened with ink prior to coating with ammonium chloride. Scale bars equal 5 mm.

Retropluma gallica n. sp.

(1-2) Holotype (MGSB68408), in dorsal and (oblique) orbital view, respectively. Ilerdian alveoline limestone, lower Eocene, Fontcouverte (Corbières, southern France).

Retropluma eocenica Via, 1959

(3-4) Carapace (MGSB68417), in dorsal and (oblique) orbital view, respectively. Upper Ilerdian, lower Eocene, Bacamorta (Huesca, Spain).

(5-6) Carapace (cast MGSB68420), in dorsal and (oblique) orbital view, respectively. Middle Lutetian, middle Eocene, Vilada, type locality (Catalonia, Spain).

(7) Carapace (MGSB23738), in dorsal view. Middle Ilerdian, lower Eocene, Terrades (Catalonia, Spain).

Retropluma craverii (Crema, 1895), from the Pliocene of Italy, possesses less acute transverse ridges, and epibranchial ones are faintly pronounced. The anterolateral and posterolateral margins form a different angle, and at their intersection a robust node is present. *Retropluma laurentae* Collins *et al.*, 2003, from the Miocene of Sabah, Malaysia, shows a more oval carapace outline, and the posterior carina is markedly interrupted by a pair of cardiac nodes, a unique feature in this genus. The late Miocene *Retropluma borealis* Fraaije *et al.*, 2005 from Gram, Denmark, differs in having more straight lateral margins, and uninterrupted, horizontal carinae. *Retropluma gallica* is most closely allied to a new species from the Eocene of Belgium (van Bakel *et al.*, in prep.); this new taxon bears a noticeably interrupted posterior carina, a straight anterior carina, and the epibranchial carinae are straighter and more oblique. However, its rostrum is more slender and spinuous.

Retropluma eocenica Via, 1959

Figures 2.1, 3.3-3.7

1959 *Retropluma eocenica* Via, p. 392, fig. 19.

1980 *Retropluma eocenica folgarolensis* Via, p. 7, pl. 1, fig. 4, 4a.

Material — Four specimens (MGSB23738, MGSB68414, MGSB68415, MGSB68416) from the middle Ilerdian of Terrades (Catalonia, Spain), three specimens (MGSB68417, MGSB68418, MGSB68419) from the upper Ilerdian of Bacamorta (Huesca, Spain), one of them (MGSB68419) containing a near-complete plastron.

Diagnosis — Large-sized *Retropluma*, carapace subrectangular in outline; rostrum deflexed and rounded distally; posterior carina continuous; epibranchial crests nearly straight, subparallel to the posterior and anterior ones, becoming weakly curved axially.

Description — Carapace subrectangular in outline, with convex lateral and posterior margins; broader than long, its maximum width behind the median carina; nearly flat transversely, gently arched longitudinally, marked by the concave portions produced by the transverse ridges, being more elevated in the central area. The anterior margin, slightly less broad than the posterior, is gently sinuous with the outer orbital spines produced. On average, they are

rather slender but vary to broadly triangular. Rostrum narrow and spatulate, noticeably deflexed, almost circular at the distal end and slightly depressed in the centre, spoon-shaped. Short anterolateral margin, variable from slightly concave to nearly straight in some specimens. The posterolateral margin is markedly arched. The posterior margin is noded and slightly broader than the orbitofrontal. The dorsal surface of the carapace is transversely carinate; the anterior crest being continuous and nearly straight, only gently arched reaching the lateral margins. The epibranchial carinae are nearly straight in the lateral portion, subparallel to the anterior and posterior carinae. They are curved backwards when reaching the gastric region, from which they are separated by deep furrows. The posteriormost carina is straight and continuous; in some specimens it is slightly indented by the branchiocardiac furrows, but not markedly interrupted or partially displaced. Ventral sternites 5, 6 and 7 nearly horizontal and subrectangular, with a diagonal crest at each sternite. The dorsal carapace surface is generally smooth, horizontal posterior gastric incisions and small epigastric protuberances are present; in some specimens the intersections of carinae at the lateral margins are marked by small but pronounced nodes.

Remarks — Via (1959) erected this taxon, the first fossil member of the genus, based on rare, poorly preserved specimens, lacking rostra. Nevertheless, placement in the genus and assignment to a Pliocene species from Italy, *Retropluma craverii* (Crema, 1895) to the genus, has been accepted by subsequent authors. Via (1980) emended the description of *Retropluma eocenica* with a new specimen (MGSB33000), and erected a new subspecies, *R. eocenica folgarolensis* (MGSB33001). Of the latter, the number was correctly placed in figure and museum registers but erroneously indicated as MGSB33000 in the main text. Re-examination of the holotype, and Via's (1980) specimen (MGSB33000) permit us to confirm that the rostrum is also broken distally. Numerous specimens collected during recent years from the same levels and localities (near the villages of Vic and Vilada, Barcelona province, Spain) contribute to an emended description of dorsal and ventral characters and the confirmation that species and subspecies are not distinguishable. The produced rostrum is always spatulate, depressed in the central part, and clearly rounded at the anterior end; extraorbital spines are slender to broadly triangular; the general outline of the carapace is similar in more than fifty specimens examined, with differ-

ences of fossilisation or deformation due to the delicate preservation in soft marly deposits (Vic and Vilada areas, types origin). The Italian material assigned to this species by Beschin *et al.* (1996) matches Via's description perfectly. The distinction between *Retropluma eocenica* and other species was outlined by Via (1959, 1969), Beschin *et al.* (1996), and is discussed above.

Discussion and concluding remarks

Extant species assigned to the genus *Retropluma* usually inhabit sandy or muddy bottoms in depths between 50 and 450 metres (Saint Laurent, 1989). Of the six extant species known, Sakai (1976) mentioned that *R. denticulada* Rathbun, 1932, has been observed at different localities in Japan in depths from 50 to 150 metres.

Retropluma eocenica is known from well-defined outer shelf facies (Serra Kiel *et al.*, 1994). Beschin *et al.* (1996) interpreted the middle Eocene deposits in Italy as neritic habitats. The specimens from Terrades and *Retropluma gallica* have been collected from deposits defined as shallow-shelf facies. Most likely the specimens collected at Bacamorta represent deeper environments, since strata at this locality have been described as deep outer shelf with very little light. According to the information available, habitats for both fossil and extant members are very similar: soft bottoms on inner to outer continental shelves.

Retropluma gallica is the oldest member of the genus; *R. eocenica* is here confirmed to be of middle and late Ilerdian age, and also occurs in middle Lutetian beds in Spain as well as middle Eocene deposits and most likely Oligocene strata in Italy. The representatives from Malaysia (Sabah) and Denmark are of Miocene age, while *R. craverii* stems from the Pliocene of Italy.

The confirmed restriction of extant species to the south of Asia, Japan and eastern African seas, the presence of fossil species in Sabah during the Miocene and older ones in France, Spain and Italy, indicate a Tethyan origin of the genus.

Acknowledgements

Our warm thanks go to Dr. Antonio Barnolas for providing useful items of literature and valuable discussions on the geological setting; to Antonio de Angeli for providing literature and for sharing views on the genus; and to Dr. John W.M. Jagt for linguistic improvements of the manuscript. Critical review of Dr. René H.B. Fraaije improved the manuscript.

References

Alcock, A. & Anderson, A.R. 1894. Natural History notes from H. M. Indian Marine Survey Steamer "Investigator", Commander C.F. Oldham, R.N., commanding. Series II, n° 14. An Account of a Recent Collection of Deep Sea Crustacea from the Bay of Bengal and Laccadive Sea. *Journal of the Asiatic Society of*

Bengal 63, 141-185.

Artal, P. & Via, L. 1989. *Xanthilites macrodactylus pyrenaicus*, nueva subespecie del Ilerdiense medio del Pirineo de Huesca. *Batalleria* 2, 57-61.

Beschin, C., Busulini, A., De Angeli, A. & Tessier, G. 1996. Retroplumoidea (Crustacea, Brachyura) nel Terciario del Vicentino (Italia settentrionale). *Lavori - Società Veneziana di Scienze Naturali* 21, 83-102.

Collins, J.S.H., Lee, C. & Noad, J. 2003. Miocene and Pleistocene crabs (Crustacea, Decapoda) from Sabah and Sarawak. *Journal of Systematic Palaeontology* 1, 187-226.

Crema, C. 1895. Sopra alcuni decapodi terziari del Piemonte. *Accademia Reale delle Scienze di Torino* 30, 5-22.

Cuevas-Gozalo, M., Donselaar, M.E. & Nio, S.D. 1985. *Eocene clastic tidal deposits in the Tremp-Graus Basin (Prov. of Lérida and Huesca)*. 6th European Regional Meeting I.A.S., Lérida. Guidebook Excursion n° 6, pp. 215-266.

Fraaije, R., Hansen, J. & Hansen, T. 2005. Late Miocene decapod faunas from Gram, Denmark. *Palaeontos* 7, 51-61.

Fraaye, R.H.B. 1995. A new raninid crab, *Pseudorogueus rangiferus* (Decapoda, Crustacea), from the Eocene of Spain. *Estudios Geológicos* 51, 65-67.

Gich, M. 1969. Las unidades litoestratigráficas del Eoceno Pirenaico del Ripollés oriental (Prov. de Gerona y Barcelona). *Acta Geológica Hispánica* 4, 5-8.

Gich, M. 1972. *Estudio geológico del Eoceno Prepirenaico del Ripollés oriental*. Unpublished Ph.D. thesis. University of Barcelona, 477 pp.

Gill, T. 1894. A new Bassalian type of crabs. *American Naturalist* 8, 1043-1045.

Hottinger, L. & Schaub, H. 1960. Zur Stufeneinteilung des Paleocaens und des Eocaens. Einführung der Stufen Ilerdien und Biarritzien. *Eclogae geologicae Helveticae* 53, 453-480.

Larghi, C. 2003. First record of Oligocene retroplumid crab (Crustacea: Decapoda: Brachyura) from Italy. *Bulletin of the Mizunami Fossil Museum* 30, 57-60.

Mutti, E., Rosell, J., Allen, G., Fonescu, F. & Sgavetti, M. 1985. The Eocene Baronia tide-dominated delta-shelf system in the Ager basin. In: Mila, M.D. & Rosell, J. (eds.): *6th European Regional Meeting I.A.S., Lleida (Spain) Excursion Guidebook*. pp. 521-576.

Nijman, W. & Nio, S.D. 1975. The Eocene Montañana Delta (Tremp-Graus Basin, provinces of Lérida and Huesca, Southern Pyrenees, Northern Spain). In: Rosell, J. & Puigdefàbregas, C.: *Sedimentary Evolution of the Paleogene South Pyrenean Basin*. IX ème Congrès de Sédimentologie, Nice Excursion 19, part B, 20 pp. XXXVI pls.

Pallí, L. 1972. Estratigrafia del Paleógeno del Empordà y zonas limítrofes. Publicaciones de Geología de la Universidad Autónoma de Barcelona, Bellaterra, 338 pp.

Plaziat, J.C. & Secretan, S. 1971. La faune de crustacés décapodes des calcaires à alveolines yprésiens des Corbières septentrionales (Aude). *Geobios* 4(2), 117-142.

Reuss, A.E. 1859. Zur Kenntnis fossiler Krabben. *Denkschriften der Akademie der Wissenschaften in Wien* 17, 1-90.

Sakai, T. 1976. *Crabs of Japan and the Adjacent Seas*. Tokio, Kodansha Ltd., 3 vol.: I-XXIX, 773 pp.

Saint Laurent, M. de 1989. La nouvelle superfamille des Retroplumoidea Gill, 1894 (Decapoda, Brachyura): systématique, affinités et évolution. In: Forest J. (ed.), *Résultats des Campagnes Musorstom, 5. Mémoires du Muséum national d'histoire naturelle (A)* 144, 103-179.

Serra Kiel, J., Canudo, J.I., Dinarès, J., Molina, E., Ortiz, N.,

- Pascual, J.O., Samsó, J.M. & Tosquella, J. 1994. Crono-estratigrafía de los sedimentos marinos del Terciario inferior de la Cuenca de Graus-Tremp (Zona central Surpirenaica) *Revista de Sociedad Geologica España* 7, 273-297.
- Solé, J. & Via, L. 1989. Crustacis Decàpodes fòssils dels Països Catalans (Recopilació i actualització de dades desde 1855 a 1988). *Batalleria*, 23-42.
- Tosquella, J. 1988. Estudi sedimentològic i biostratigràfic de la Formació Gresos de Roda (Eocé, Conca de Tremp-Graus). Unpublished Tesis Licenciatura University of Barcelona, 540 pp.
- Via, L. 1959. Decápodos fósiles del Eoceno español. *Boletín del Instituto Geológico y Minero de España* 70, 331-402.
- Via, L. 1969. Crustáceos Decápodos del Eoceno español. *Pirineos* 91-94, 1-469.
- Via, L. 1980. Ocyphodoidea (Crustacés Décapodes) du Cénozoïque méditerranéen. Origine et évolution de cette superfamille. *Annales de Paléontologie (Invertébrés)* 66, 51-66.