

Giovanni Pasini\* & Alessandro Garassino\*\*

## A new phyllosoma form (Decapoda, ?Palinuridae) from the Late Cretaceous (Cenomanian) of Lebanon

**Abstract** – A single specimen from the Late Cretaceous (Cenomanian) of Hadjula (Lebanon) is assigned to a phyllosoma stage (?Palinuridae Latreille, 1802). The phyllosoma stages known to date were reported only from the Upper Jurassic (Tithonian) of Germany. So the studied specimen represents, in the fossil record, the first report of a phyllosoma stage from the Late Cretaceous.

**Key words:** Decapoda, Palinuridae, phyllosoma stage, Late Cretaceous, Lebanon.

**Riassunto** – Prima segnalazione di fillosoma (Decapoda, ?Palinuridae) nel Cretacico superiore (Cenomaniano) del Libano.

Un esemplare, rinvenuto nel Cretacico superiore (Cenomaniano) di Hadjula (Libano), è attribuito allo stadio fillosoma (?Palinuridae Latreille, 1802). Attualmente, stadi fillosoma sono descritti solo nel Giurassico superiore (Tithoniano) della Germania. L'esemplare studiato rappresenta quindi la prima segnalazione nel record fossile di uno stadio fillosoma nel Cretacico superiore.

**Parole chiave:** Decapoda, Palinuridae, fillosoma, Cretacico superiore, Libano.

### Introduction and geological setting

The studied specimen was discovered in the limestone of Hadjula (Lebanon) from the Late Cretaceous (Cenomanian) (Dalla Vecchia *et al.*, 2002). The rich Lebanese decapod fauna was widely described by some authors (see Garassino & Schweigert, 2006, for complete references). Förster (1984), Garassino (1994, 2001) and Garassino & Schweigert (2006) reported some palinurid specimens, belonging to *Palinurus* sp. and *Linuparus* sp. (Palinuridae Latreille, 1802), *Palibacus praecursor* (Dames, 1886), *Jasus* sp. (Scyllaridae Latreille, 1825), and *Cancrinus libanensis* Garassino & Schweigert, 2006 (Cancrinidae Beurlen, 1930). Even though this new phyllosoma stage represents, in the fossil record, the first record from the Late Cretaceous, its state of preservation and the absence of certain morphological characters do

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\*Museo Civico dei Fossili di Besano, Via Prestini 5, 21050 Besano (Varese), Italy,  
e-mail: juanaldopasini@tiscali.it

\*\* Museo Civico di Storia Naturale, Corso Venezia 55, 20121 Milano, Italy,  
e-mail: agarassino63@gmail.com



not allow a comparison and ascription to one of the genera belonging to the above-mentioned families.

### Previous studies on palinurids phyllosoma stages

The only decapod larvae discovered as fossils are phyllosoma stages of palinurids. These specimens were considered for many years as pantopods or confused with arachnids or other classes of arthropods (e.g. insects).

Polz (1970, 1971, 1972, 1973) described many specimens (complete sample of more than 1600 of which only some hundreds were analysed in the papers) from the Upper Jurassic (Tithonian) of Solnhofen (Bavaria, South Germany) as belonging to different early pelagic stages of palinurids or scyllarids. Later, Polz (1975) considered these specimens as exuviae belonging to different larval stages of palinurids. Polz (1970, 1973) described three different phyllosoma stages: Form A (= *Phalangites priscus* Münster, 1836), Form B (= *Palpipes cursor* Roth, 1851) and Form C (Polz, 1971, 1987) (= "*Dolichopus*" *tener* Walther, 1904). The author expressed also "the possibility of an hypothetical link between the different development series of the Forms B and C".

Finally, Polz (1995) recorded a fourth large palinurid phyllosoma stage, as Form D. Today, some authors considered *Phalangites priscus* Münster, 1836 (= *Phyllosoma prisca* in Frickhinger, 1994) as probable larval stage of ?eryonids (Frickhinger, 1994), *Palpipes cursor*, Roth 1851, is considered as an exuvia of a post-larval stage of *Palinurina* sp., and "*Dolichopus*" *tener* Walther, 1904, is now invalidated (Polz, 1971; Frickhinger, 1994). However, the ascription of these larval stages to palinurid fossil genera is still debated.

Previously this report, *Eryoneicus ?sahel-almae* Roger, 1944, was the only crustacean larval stage known to date from the Upper Cretaceous of Lebanon (Roger, 1944). Later, Glaessner (1969) considered erroneously the ascription of *E. ?sahel-almae* to a larval stage. Now, this species is considered by Aguirre-Urreta *et al.* (1990) as a postlarval crustacean stage of eryonid. Roger (1946) discussed another arthropod specimen from Sahel Alma, describing it as an arachnid of the Order Opiliones (= *Phalangida* Petry, 1833), *Opiliones* sp. At present, Polz (pers. comm., 2007) affirmed that this specimen is instead a phyllosoma stage, even though any author has never reviewed it. Moreover Polz (pers. comm., 2007) affirmed: "I own a poor preserved phyllosoma larva from Lebanon (Hael) - donated by Dr. U. Hüchel in 1975 - which represents an A4 embedding position" and also "... in the Geol. and Paleontol. Inst. at Tübingen, where then several phyllosoma larvae were housed in their Lebanese collection". Unfortunately the specimens of Tübingen were never recorded or described in scientific papers and we were unable to have their detailed information. For this reason we consider the studied specimen as the first record of phyllosoma stage from the Late Cretaceous of Lebanon.

### Material

A single specimen in anatomical connection, flattened and compressed on the surface of a thick layer of yellow sub lithographic limestone. The specimen is housed in the Paleontological Collections of the Museo di Storia Naturale di Milano (MSNM). The measures, expressed in millimetres, were taken by a digital calliper.



### Systematic Palaeontology

Infraorder Palinura, Latreille 1802  
Superfamily Palinuroidea, Latreille 1802  
?Family Palinuridae, Latreille 1802  
Genus and species indeterminate  
Figs. 1-2

**Type locality:** Hadjula (Lebanon).

**Geological age:** Late Cretaceous (Cenomanian).

**Material:** one specimen in dorsal view, well preserved and almost complete. MSNM i15175.

Maximum length: 23 (from the tip of the front to the end of the abdomen)

Maximum width of thorax: 6.7 (without pereopods)

Maximum length of the thorax: 8.1

Maximum width of the abdomen: 5.7

Maximum length of the abdomen: 7.2 (without tail fan)

Length of the tail fan: approximately 4.6

### Description

**Carapace.** The cephalic shield is not preserved, most probably, indicating an exuvia (Polz, 1975). Frontal part narrow and shallow with two well-developed orbital spines slightly divergent forming a prolongation of the margin.

**Abdomen.** Subrectangular somites I-V with a smooth median carina, narrowing caudally. Tail fan, folded under the abdomen, is not well-preserved.

**Cephalic appendages.** Poorly preserved antennulae having superimposed thin flagella creating a continuum with a probable very short rostrum. Antennal flagella with three distinct basal peduncles, moderately elongate with pointed distal extremity. Small and kidney shaped (or kidney?) eyes arranged externally to the front and the antennae, visible only by UV light. Short 1<sup>st</sup> maxilliped with three? short articulate segments and uncinat dactylus, also visible only by UV light. Second maxilliped with exopodite, converging toward three small median mandibular structures, subtriangular in shape, suboval and well mineralized. Third maxilliped, more than twice longer than second, wider, and biramous with well-developed exopodites.

**Thoracic appendages.** P1-4 biramous with well-developed and elongate exopodites starting from the basis and joining at merus. All exopodites, longer than merus, with rectangular basal segment and longer annulate and flagellate distal part, probably originally thinnish pinnulate. All endopodites with short and wide cox and basis, strong merus, short carpus, and elongate propodus narrowing distally. Dactyli of the pereopods not visible. P1-4 directed forward, P5 directed backward, P5 right is disarticulated and very poorly preserved. P1 shorter than P2-5. P2 longer than P1, 3-5. Smooth ornamentation on pereopods.

**Abdominal appendages.** Not preserved.

### Discussion

The studied specimen shares some generic morphological features with phyllosoma stages and at the same time it has some peculiar morphological features. It has in common with the phyllosoma stages, as follows: organization and body shape, membranous (unpreserved) cephalic shield, pedunculate eyes arranged externally



to the front probably for the presence of an elongate eye-stalk, elongate pereopods with propodus longer than merus and short basis; exopodites on the P1-4; P1 shorter than P2, P2 longer than P1, 3-5. It differs from the phyllosoma stages as follows: frontal cuticular part of the cephalic region already well delineate, presence of well-developed orbital spines; well-developed subrectangular thorax, elongate and bifurcate pereopods with well-developed annulate exopodites longer than merus, wide abdomen narrowing caudally with well-developed somites, fragments of the tail fan already well developed.

The studied specimen was compared with the different phyllosoma larval stages from the Upper Jurassic of Germany, particularly with the Form B Polz, 1970 (*Palpipes cursor* Roth, 1851), Form A Polz, 1970 (*Phalangites priscus* Münster,



Fig. 1 – Phyllosoma stage, MSNM i15175. Natural light / Luce naturale (x 4).



1836) (= *Phyllosoma prisca*), and Form D Polz, 1995, even though considering the different geological age and ecosystems. The studied specimen has in common with Form B the strong shape and disposition of the pereopods, even though the German species has not the typical bifurcation with well-developed exopodites. Moreover Form B has well-developed antennae with very elongate flagella, already present in the palinurid adults, while it lacks the well-developed orbital spines, the broad abdomen and tail fan, well developed in the studied specimen. The Form A is distinct from the studied specimen in possessing different shape of the front, absence of rostrum, globular or oval shape of thorax, different disposition of the pereopods, short exopodites, and narrow abdomen. Form D is too much peculiar in size, preservation and morphology; presumably a last larval stage perished when



Fig. 2 – Phyllosoma stage, MSNM i15175. Ultraviolet light / Luce ultravioletta (x 4).



molting to the puerulus and preserving the cephalic shield (Polz, 1995). For these reasons we don't find comparable characters with this unusual stage, if not in general characters, attesting an advanced larval stage also for the studied specimen. Holthuis (pers. comm.) suggested that Form D might be placed in the genus *Justitia* (Palinuridae Latreille, 1802) on account of its transversal grooves in the abdominal segments (Polz, pers. comm., 2007). Finally, the studied specimen was compared with different larval stages of extant palinurids, housed in the collection of the Département Milieux et Poupements Aquatiques (Muséum national d'Histoire naturelle, Paris), without recognizing ontogenetic stages with similar morphological features.

## Conclusion

The ontogeny of the larval fossil decapods is not well known because of their rare preservation in the fossil record. The ontogeny usually comprises the embrionic, larval, post-larval and adult stages. In Palinuroidea, the first postembryonic pelagic larva is a discoidal or leaf-shaped, long-legged phyllosoma, with a commonly setose and bifurcate nature of their appendages that serve as aid in flotation (Moore & McCormick, 1969). We can recognise in the extant palinurid decapods many larval stages and sub-stages of phyllosoma, extremely different according to the genus. All these stages have a subcircular transparent body with membranous cephalic shield, pedunculate eyes, filiform and elongate pereopods having radial arrangement around the thorax, biramous, with annulate and pinnulate exopodites. As already reported in the above-mentioned section, the comparison among the studied specimen and the fossil and extant phyllosoma stages pointed out some different morphological features. The studied specimen could represent one of the last phyllosoma stages for the cuticular mineralization of front and abdomen, long P5, and the presence of a developed tail fan. In fact, as pointed out by Polz (1987), these body structures usually appear only in the last larval stages in extant palinurids. We exclude that the studied specimen can belong to the Scyllaridae, a family without rostrum, different front outline and with very short antennal flagella. We suppose instead that the studied specimen could belong to the Palinuridae having orbital spines, moderately elongate antennal flagella, elongate pereopods, with pereopod II longer than the others, pereopod I shorter and elongate sharp of the thorax. Finally, we suggest that the studied specimen could represent an exuvia belonging to unrecorded last stage (or Form) of phyllosoma, "pre-puerulus" of the family Palinuridae.

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