



## The first zoeal stage of *Glyptograpsus impressus*, with comments on the subfamilial arrangement of Grapsidae (Crustacea: Brachyura).

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**Abstract:** The first zoeal stage of the brackish-water crab *Glyptograpsus impressus* is described and illustrated from laboratory hatched material. This is the first description of a larval stage from the Central American genus *Glyptograpsus* which is traditionally placed within the grapsid subfamily Varuninae. Comparison of zoeal setation patterns revealed common features with the Varuninae, while other features are more typical for the Grapsinae and Plagusinae. Furthermore, zoeae of *G. impressus* are distinct in the setation of the maxillar endopod, which is unique within the Grapsidae and makes the inclusion of the genus *Glyptograpsus* within one of the presently recognized grapsid subfamilies questionable.

**Résumé :** Le premier stade zoé du crabe d'eau saumâtre *Glyptograpsus impressus* est décrit et illustré à partir de matériel éclos en laboratoire. Ceci représente la première description d'un stade larvaire d'un genre de l'Amérique centrale, *Glyptograpsus*, qui est traditionnellement placé dans la sous-famille des Varuninae. Une comparaison des soies des zoés révèle des structures communes avec les Varuninae, tandis que d'autres caractères sont plus typiques des Grapsinae et des Plagusinae. De plus les zoés de *G. impressus* sont différentes par les soies de l'endopodite maxillaire, unique parmi les Grapsidae, ce qui remet en question la place du genre *Glyptograpsus* dans l'une des sous-familles de Grapsidae.

**Keywords :** larval morphology, zoea, systematics, phylogeny, crabs.

### Introduction

The brachyuran family Grapsidae is presently subdivided into 4 subfamilies: Grapsinae Dana, 1851, Plagusinae Dana, 1851, Sesarminae Dana, 1851 and Varuninae Alcock, 1900. This taxonomic classification goes back to Alcock (1900) and has been adopted in subsequent systematic reviews of this family. The Varuninae comprise 22 morphologically and ecologically very diverse crab genera. Several morphological characters used by Alcock (1900) to

describe this subfamily are ambiguously defined and it is widely believed that the Varuninae represent an artificial grouping (P. Davie, D. Guinot, M. Türkay, R. Manning personal communications 1997).

The present taxonomy of the Brachyura is mostly based on adult morphological characters. Rice (1980) emphasized the relevance of larval morphology for phylogenetic studies within the Brachyura, which gained further evidence by recent studies (e.g. Clark & Webber, 1991; Marques & Pohle, 1995). In the Grapsidae, larval morphological characters have occasionally been related to their taxonomic classification (Bourdillon-Casanova, 1960; Wear, 1970; Wilson, 1980; Percyra Lago, 1993) and allowed to show

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diagnostic characters for the subfamily Grapsinae (Cuesta *et al.*, 1997). Within the Sesarminae and Varuninae, most genera are also very homogeneous in their larval morphology, while others show marked differences (Rice, 1980; Pereyra Lago, 1993; Schubart & Cuesta, in press).

Out of the 51 genera presently recognized within the Grapsidae, larval stages have been examined only in 33 genera. The lack of knowledge applies particularly to the Varuninae for which larval descriptions are only available for 8 out of 22 genera. Thus, to elaborate a taxonomic system for the Grapsidae based on both adult and larval morphology, it would be necessary to obtain descriptions of larvae from many more genera.

In this study, a larval stage of the grapsid genus *Glyptograpsus* is described for the first time. This genus is currently placed within the Varuninae and consists of two species which are restricted to Central America. The morphology of the first zoeal stage of *G. impressus* Smith, 1870 is compared with that of other Grapsidae. Based on these findings, the systematic position of the genus *Glyptograpsus* is discussed.

#### Materials and methods

Adult *Glyptograpsus impressus* were obtained from Farfán (Panama) in February 1996, without encountering any ovigerous female in the field, and transported to the University of Bielefeld (Germany). Two females and two males were kept in a 30 x 20 cm aquarium with access to brackish water (1-5 PSU) and to rotting wood which was used as food and shelter. Temperatures ranged from 21 to 24° C and the light : dark cycle was 14 : 10 hours. In 1996, females were placed in a separate aquarium following egg extrusion and were offered small containers with water of 0 and 16 PSU salinity for larval release. After hatching, approximately 300 larvae were maintained in groups of 5 individuals and in mass-culture conditions (> 50 individuals). Light and temperature regimes were the same as described above. Differential survival was tested in salinities of 16 and 32 PSU. Samples of larvae were fixed in either 5% formalin or 70% ethanol.

Drawings and measurements were based on 20 larvae and made using a Wild MZ6 and Zeiss compound microscope with Nomarski interference, both equipped with a camera lucida. All measurements were made through an ocular micrometer and refer to the following distances: rostro-dorsal spine length (rd): from the tip of the rostral spine to the tip of the dorsal spine; carapace length (cl): from the base of the rostrum to the posterior carapace margin; carapace width (cw): distance between the tips of the lateral spines; dorsal spine length (ds): from the base to the tip of the dorsal spine; rostral spine length (rs): from the base to the tip of the rostral spine; lateral spine length (ls)

from the base to the tip of the lateral spines; antennal length (al) from the base to the tip of the spinous process. Semipermanent mounts were made of whole larvae and dissected appendages were stained using CMC 10 and lignin pink. Due to the unusual setation pattern, more than 50 larvae were dissected for confirmation. One female crab and a sample of larvae were deposited in the United States National Museum of Natural History under the catalog number USNM cat. 284160.

#### Results

Several observations on the reproductive biology of *Glyptograpsus impressus* were obtained during 18 months of captivity. In 1996, prolonged copulations of the larger male with the two females were observed without previous molts of the females (*i.e.* in hard condition) from July to September. In July 1997, the surviving male and female remained in copula for two weeks. Females always became ovigerous 1 to 3 days after copulations. They carried eggs for 3 to 4 weeks. In 1996, the larger female of 20.6 mm carapace width (cw) copulated and carried eggs twice within the same molting cycle, while the smaller female (17.6 mm cw) only produced one brood. In 1997, the larger female (21.2 mm cw) released larvae only once, before molting in September. This last hatch consisted of approximately 3000 larvae. Fresh water was preferred for larval release in 2 out of 3 cases. In 1996, many larvae died as prezoaea. There were no significant differences in survival of first zoeal stage maintained in salinities of 16 or 32 PSU. Unfortunately no larva lived longer than eight days and no successful molt to the second zoeal stage was achieved. The small size of the larvae apparently did not allow them to feed on *Artemia* sp. nauplii. Detritus enriched water or rotifer cultures (in 1997) also failed to extend survival.

#### Description

*Glyptograpsus impressus* Smith, 1870  
Zoea I (Figs. 1, 2)

Dimensions: rd:  $0.66 \pm 0.03$  mm; cl:  $0.37 \pm 0.01$  mm; cw:  $0.48 \pm 0.01$  mm; ds:  $0.21 \pm 0.02$  mm; rs:  $0.16 \pm 0.01$  mm; ls:  $0.08 \pm 0.01$  mm; al:  $0.16 \pm 0.02$  mm.

Carapace (Fig. 1A). Globose and smooth. Dorsal spine slightly curved, thin rostral spine straight, both well developed. Lateral spines slightly curved and directed anteriorly. Pair of dorso-lateral simple setae near base of dorsal spine. No setae on lateral margin. Eyes sessile.

Antennule (Fig. 1C). Uniramous. Endopod absent. Exopod unsegmented with two unevenly sized aesthetascs and two thin simple setae.

Antenna (Fig. 1D). Well developed protopod, almost equal in length to rostral spine, proximally bearing two rows