EMBRYONIC AND EARLY POSTEMBRYONIC DEVELOPMENT OF THE BURROWING CRAYFISH, *Virilastacus araucanius* (Faxon, 1914) (Decapoda, Parastacidae) UNDER LABORATORY CONDITIONS

BY

ERICH H. RUDOLPH and CAROLINA S. ROJAS
Department of Basic Sciences, Universidad de Los Lagos, Casilla 933, Osorno, Chile

ABSTRACT

The stages and duration of the embryonic and early postembryonic development of the burrowing crayfish, *Virilastacus araucanius* are described, in water at temperatures between 10.0 and 21.0°C, with 8.5 to 9.0 mg/l of dissolved oxygen, pH 6.8 to 8.5, and hardness of 49.8 ppm CaCO₃. The morphological changes observed on the egg surface allow to distinguish 5 embryonic stages. After hatching, two moults separate three juvenile stages. The first two juvenile stages lack uropods and remain attached to the female. In stage 3, the juvenile is similar to the adult, both in morphology and behaviour, and becomes independent from the mother. Embryonic development lasts 120 days, and the postembryonic stages take another 20 days until the emergence of juvenile stage 3. The development is direct, with incubation of large eggs, rich in yolk, and parental care over juvenile stages 1 and 2.

RESUMEN

Se describen los estados del desarrollo embrionario y postembionario temprano del camarón excavador *Virilastacus araucanius*, y la duración de ellos en aguas a temperaturas entre 10.0 y 21.0°C, con 8.5 a 9.0 mg/l de oxígeno disuelto, con pH entre 6.8 y 8.5 y una dureza de 49.8 ppm de CaCO₃. Los cambios morfológicos observados en la superficie de los huevos, permiten distinguir 5 estados embrionarios. Luego de la eclosión dos mudas separan 3 estados juveniles. Los dos primeros juveniles carecen de uropodos y permanecen sujetos a la hembra. El tercero es igual al adulto en su morfología y comportamiento e inicia una existencia independiente de la madre. El desarrollo embrionario tiene una duración de 120 días y el postembrionario tarda otros 20 días hasta que emerge el tercer juvenil. El desarrollo es directo con incubación de huevos grandes, ricos en vitelo, con cuidados parentales que incluyen los dos primeros estados juveniles.

INTRODUCTION

Our biological knowledge on the ten South American species of the family Parastacidae is limited. The scarce data available are mostly related with their taxonomy and distribution (Faxon, 1898, 1914; Holthuis, 1952; Bahamonde &
Physico-chemical characteristics of the water during the embryonic and early postembryonic development of *Virilastacus araucanius* (Faxon) under laboratory conditions

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>$\bar{X}$</th>
<th>$\pm$SD</th>
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<tbody>
<tr>
<td>Temperature ($^\circ$C)</td>
<td>10.0-21.0</td>
<td>17.3</td>
<td>1.30</td>
</tr>
<tr>
<td>pH</td>
<td>6.8-8.8</td>
<td>8.0</td>
<td>0.65</td>
</tr>
<tr>
<td>Dissolved oxygen (mg/l)</td>
<td>8.5-9.0</td>
<td>8.8</td>
<td>0.21</td>
</tr>
<tr>
<td>Hardness (ppm CaCO$_3$)</td>
<td>35.6-71.2</td>
<td>49.8</td>
<td>0.84</td>
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</table>

López, 1963; Riek, 1971; Hobbs, 1974, 1989, 1991; Buckup & Rossi, 1980), analysis of phylogenetic relations (Crandall et al., 2000), and studies of the sexual system (Rudolph, 1995 a, b, 1997, 1999, 2002; Almeida & Buckup, 2000; Rudolph & Almeida, 2000; Rudolph et al., 2001). The embryonic and early postembryonic stages have been described in only three of the four Chilean species of this family (Rudolph & Zapata, 1986; Rudolph & Ríos, 1987; Rudolph & Iraçabal, 1994).

*Virilastacus araucanius* (Faxon, 1914) is the least known Chilean parastacid, with very few records. Over more than 70 years, it was known only through the type specimen, a male captured in 1908 in a cascade near Corral (39°51'S 73°24'W) in southern Chile. Faxon (1914) described it as a possibly burrowing species for the shape of its cephalothorax, which is very much laterally compressed. Jara (1983) found a male specimen in Valdivia (39°50'S 73°16'W) co-existing with *Parastacus nicoleti* (Philippi, 1882). Later, Rudolph & Rivas (1988) collected a male specimen in a semi-marshy land at Hualqui (36°56'S 72°55'W), together with specimens of *Parastacus pugnax* (Poeppig, 1835). Martínez et al. (1994) captured two males and six females at Cosmito (36°46'S 73°01'W) in the same conditions as described by Rudolph & Rivas (1988). These findings confirm that *Virilastacus araucanius* is a burrowing species with a very discontinuous geographic distribution, which would extend from Cosmito to Corral in the Center South Chilean zone. Even though there are no studies related to its sexual system, the species has been considered gonochoristic (Rudolph & Almeida, 2000). Other aspects of its biology are completely unknown.

The objectives of the present work were: (1) to describe and illustrate the stages of embryonic and early postembryonic development of *Virilastacus araucanius* and their duration under laboratory conditions; and (2) to compare them with those of other species, in particular Astacoidea and Parastacoidea.

**MATERIALS AND METHODS**

In July 2001, seven ovigerous females of *Virilastacus araucanius* were captured with a vacuum pump at Rucapihuel (40°35'S 73°34'W) in southern Chile. The