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Key to the families of decapod crustacean larvae collected off northern Chile during an El Niño event[1]

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ABSTRACT. Only 15 families of decapod crustaceans living as larvae in oceanic waters of northern Chile survived the strong impact of the El Niño 1982-83 event. A key considering only their most conspicuous external characters, without specimens dissection, is given. These families represent one third of the total reported for the area living under "normal" oceanographic conditions; and at the level of species the 22 collected are almost one seventh of their total of 150. Species introduced in the area with more septentrional waters belong to the families Penaeidae and Sicyoniidae. Collected larvae were mainly those from intertidal and sublittoral waters.

Key words: keys, decapod crustaceans, larvae, El Niño event, Chile.

Clave de larvas de crustáceos decápodos recolectadas frente al norte de Chile durante un fenómeno El Niño[1]

RESUMEN. Solo 15 familias de crustáceos decápodos representadas por larvas sobrevivieron la fuerte influencia de El Niño 1983. Se entrega una clave que considera sólo los caracteres externos más conspicuos de estas larvas, sin la disección de los ejemplares. Estas familias representan un tercio del total que viven en el área bajo condiciones oceanográficas normales. A nivel de especies, las 22 recolectadas constituyen casi la séptima parte del total de 150. Las especies introducidas en el área por la influencia de aguas más septentrionales pertenecen a las familias Penaeidae y Sicyoniidae. Las larvas recolectadas pertenecen principalmente a aguas intermareales y sublitorales.

Palabras claves: claves, crustáceos decápodos, larvas, Fenómeno El Niño, Chile.

INTRODUCTION

Larval development of decapod crustaceans is perhaps one of the most important pieces of their life cycle. The larval condition implies a total change in the style of life of the organisms as members from the benthic or pelagic communities when they pass to integrate part of the plankton. Morphologic change facilitates dispersion. Many times it is the principal source of the geographic and bathymetric distribution of the species as adults. Larval morphology represents additional taxonomic elements for their specific identification. In many cases, morphological features of larvae are complementary characters necessary for the understanding of the evolution of the species. Success in the larval life is one of the principal determinants for a successfull recruitment and it is an important element to evaluate a species fishery.

The decapod crustaceans recognized here as families are larvae that survived the impact of an unprecedented strong intensity El Niño event (1982-83). Characteristics and effects of this event on the South Eastern Pacific marine biota have been detailed documented (Arntz, 1984; Arntz and Valdivia, 1985a, 1985b; Báez, 1985; Méndez, 1987).

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The captured larvae represent a small fraction from a greater number of families that live in the sampled area under "normal" oceanographic conditions (Báez and Martin, 1992).

The main objetives of this paper have been to document the event to serve as a reference point for later comparisons, either with the meroplankton of the area collected during an El Niño event and with material obtained from palaeoenvironmental research or from normal years.

MATERIALS AND METHODS

The material consists of 44 samples collected along 11 parallel eastwest transects (4 stations each) taken between 18°38'00''S and 28°04'00''S from near coast (5 km offshore) to about 200 km west approximately, between Arica and Puerto Huasco, northern Chile.

Samples were collected by means of a WP2 net (UNESCO, 1968) with an internal mouth diameter of 57 cm, a total length of 261 cm, and a mesh size of 300 microns. Depth ranged between 0-74 and 0-100 m. Additional data on collecting techniques and cruise data have been published elsewhere (Rojas and Orellana, 1984; Báez and Martin, 1992).

Plankton samples were preserved in 5% formalin prepared with seawater and divided in 4 aliquots using a Folsom apparatus. Decapod larvae were removed and studied from two of the four quarters per sample.

Here I present only those characters possible of being determined without dissection, having in mind to use the key for preliminary sortings. Also, the characters used in the key are those that do not change significantly through the successive larval stages. Larval identification of the stages was as follows (Penaeiodea: nauplius, protozoea, mysis, and postlarva; Caridea,Thalassinidea, Brachyura and Anomura: prezoea, zoeae and megalopa). I followed descriptions made by Palma and Kaiser (1993) considering mysis and postlarva to be equivalent with zoea and megalopa, respectively.

Identification of the larvae to the family level was accomplished by using published literature on the larval development of Chilean decapod species (e.g., Fagetti, 1960, 1970; Fagetti and Campodonico 1971a, 1971b; Quintana and Saelzer, 1986). Also, personal unpublished observations were used. Those species for which larval stages have not been described yet, or that were new for the area, were identified from the literature describing related taxa from other geographic areas. More details and references used to identify larvae at different taxonomic levels are in Báez and Martin (1992), Boschi (1981), Bourdillon-Casanova (1960), Gurney (1939, 1942), Hart (1971), Rice (1980); Scelzo (1976), Williamson (1957a, 1957b, 1960, 1982) and Wear (1970).

RESULTS

KEY TO THE LARVAL STAGES OF DECAPOD CRUSTACEANS FOUND IN EL NIÑO EVENT

1. Contour of the body as a simple pear shape form. With a simple median eye in th anterior region of the body.....**Nauplius** (Fig. 1a)

\- Contour of the body not as above. With coumpound eyes.....**2**

2. Carapace not covering completely the thorax (some thoracic terga remaining free). Antennal exopod segmented to base.....**Protozoea** (Fig. 1b)

_ Carapace covering completely the thorax (thoracic terga completely covered). Antennal exopod unsegmented or segmental at tip only. **3**

3. Without well-development pleopods. Swimming by maxilliped exopods.....**Zoea** (Fig. 1c)

_ Whit at least one pair of well - developed pleopods. Swimming by swimming - legs.....**4**

4. Shrimp-like shape. Pereipods with well developed exopods.....**Mysis** (Fig. 1d)

\- Crab-like shape. Pereipods without well-developed exopods.....**Megalopa** (Fig. 1e)

KEY TO THE FAMILIES OF DECAPOD CUSTACEANS RECORDED AS ZOEA, OR MYSIS FROM THE PLANKTON DURING AN EL NIÑO EVENT

1. Body with carapace markedly globular, abdomen thin and relatively short. Swimming setae restricte to exopodite of first and second maxillipeds.....**8**

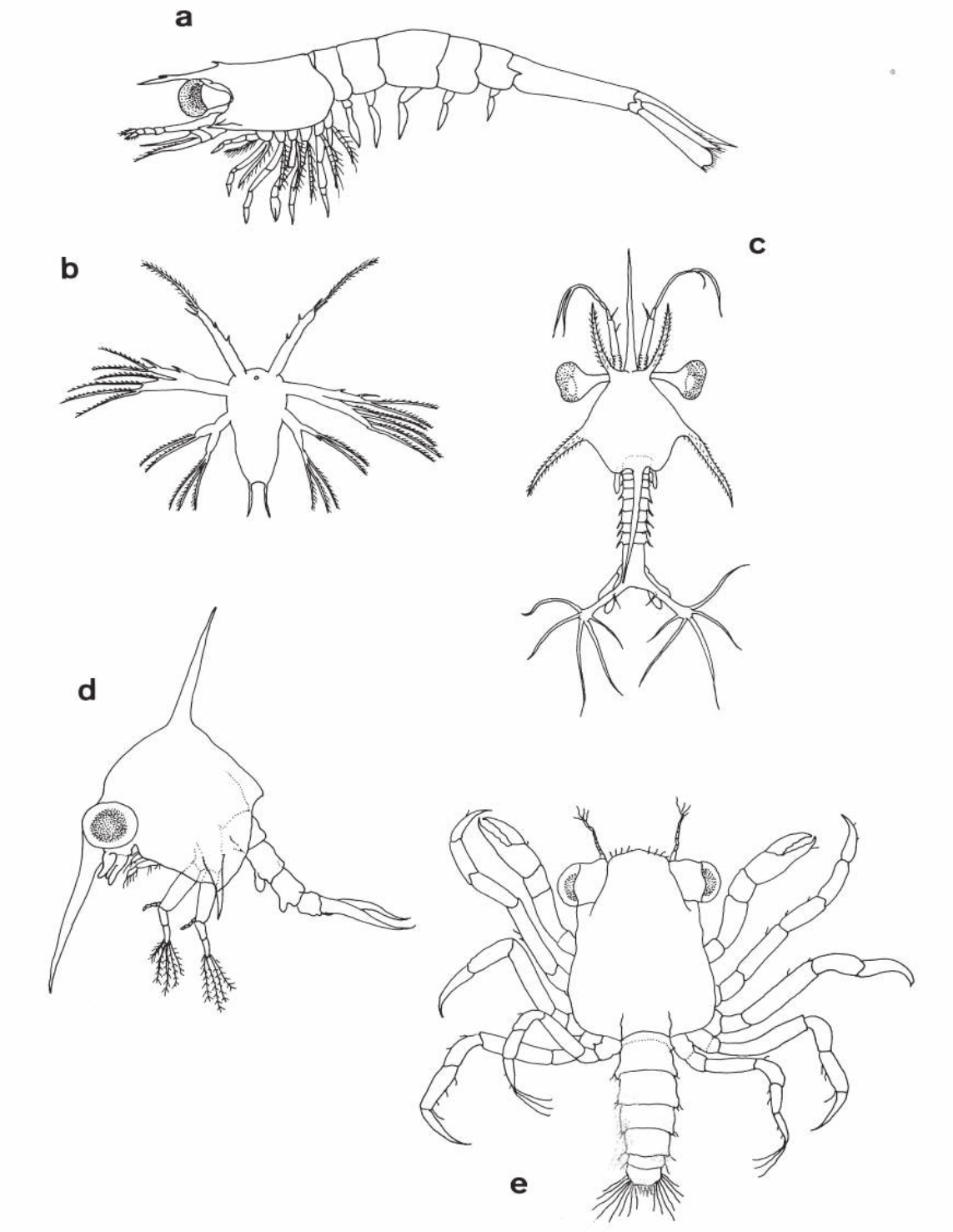

Figure 1. Types of decapod crustacean larval stages collected off northern Chile during El Niño 1982-83 event. a. Mysis, b. Nauplius, c. Protozoea, d. Zoea, e. Megalopa.

Figura 1. Tipos de larvas de crustáceos decápodos recolectados en el norte de Chile durante el evento El Niño 1982-83. a. Mysis, b. Nauplius, c. Protozoea, d. Zoea, e. Megalopa.

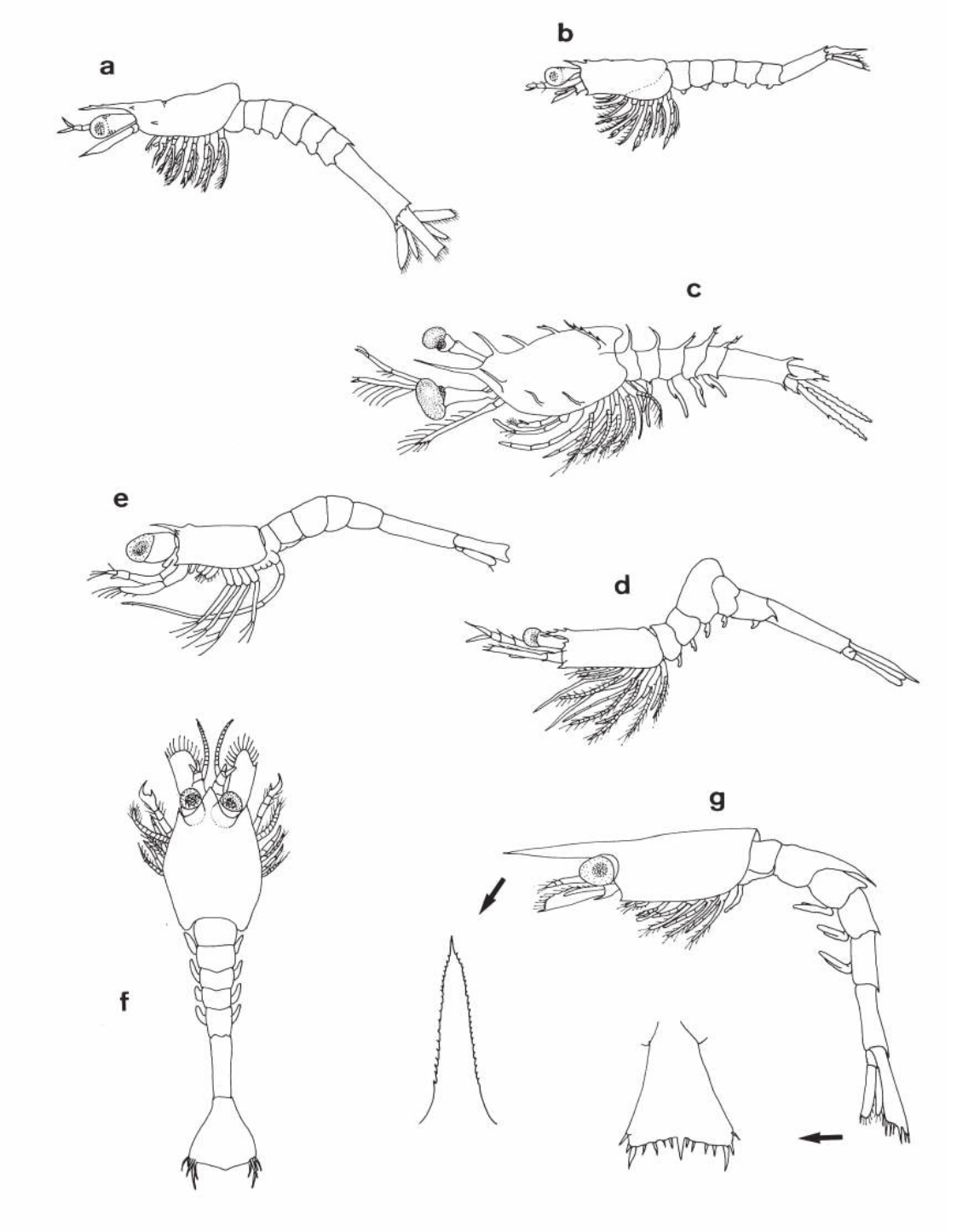

Figure 2. Mysis from the families of decapod crustaceans collected during El Niño 1982-83 event: Suborders. Dendrobranchiata and Pleocyemata (Infraorders Caridea, Astacidea, Thalassinidea). a. Penaeidae, b. Sicyoniidae, c. Sergestidae, d. Oplophoridae, e. Alpheidae, f. Crangonidae, g. Callianassidae.

Figura 2. Mysis de familias de crustáceos decápodos recolectados durante el evento El Niño 1982-83: Subórdenes. Dendrobranchiata y Pleocyemata (Infraórdenes Caridea, Astacidea, Thalassinidea). a. Penaeidae, b. Sicyoniidae, c. Sergestidae, d. Oplophoridae, e. Alpheidae, f. Crangonidae, g. Callianassidae.

- Body with carapace markedly cylindrical; abdomen well developed, relatively long. Swimming setae on more than first and second maxillipeds**.**.....**2**

2. With developing chelae of similar size on pereiopods 1-3. Without a spine near middle or outer side of margin exopod from each uropod.....**3**

- Whitout chelae, subchelated, or if with developing chelae only on pereiopods 1-2. With a spine near middle of each uropod outer margin.....**4**

3. Carapace antero-lateral borders with spines. Telson not deeply forked...**Penaeidae** (Fig. 2a)

- Carapace antero-lateral borders without spines. Telson deeply forked ....**Sicyoniidae** (Fig. 2b)

4. Carapace with several large lateral spines, some dorsal spines, and one median spine posteriorly, in addition to large supraorbital and rostral spines. Abdominal somites with large lateral and/or dorsal spines ..**Sergestidae** (Fig. 2c)

- Carapace not as above. Abdominal somites, without spines or with very small spines.....**5**

5. All pereiopods with exopods. Abdominal somite 4 projected into a rounded hump.....**Oplophoridae** (Fig. 2d)

- Not all pereiopods with exopods. Abdominal somite 4 not projected into a rounded hump **6**

6. Rostrum relatively thin and laterally compressed. Fifth pereiopods longer than the others.....**Alpheidae** (Fig. 2e)

- Rostrum relatively wide and depressed. Fifth pereiopods no longer than the others.....**7**

7. Ocular peduncles hemispheric and almost touching each other on medial line. Distal margin of telson tending to be convex, without a large medial spine.....**Crangonidae** (Fig. 2f)

- Ocular peduncles not hemispheric and well separated each other on medial line. Distal margin of telson tending to be concave, with a large medial spine... .**Callianasidae** (Fig. 2g)

8. Carapace tending to be oval-shaped. Without a"cephalic" or "dorsal" spine.....**9**

- Carapace tending to be spherical. With a "cephalic" or "dorsal"spine.....**12**

9. Carapace without lateral spines. Telson with round or convex distal margin and with a small spine on each side.....**10**

- Carapace with lateral spines thin and long. Telson divided and/or concave on distal margin and with a strong spine on each side.....**11**

10. Posterior margin of the carapace not serrated. Abdominal somites with spines on posterior margins.....**Paguridae** (Fig. 3a)

- Posterior margin of the carapace serrated. Abdominal somites without spines on posterior margins.....**Galatheidae** (Fig. 3b)

11. Rostral spine at least twice as long as carapace and lateral-posterior spines or processes as long as or longer than carapace. Distal margin of telson with long setae.....**Porcellanidae** (Fig. 3c)

- Rostral spine less than twice as long as carapace and lateral-posterior spines or processes not as long as carapace. Distal margin of telson with short spines.....**Hippidae** (Fig. 3d)

12. Rostral spine length equal to, or longer, than carapace length. Dorsal or cephalic spine length equal to, or longer, than carapace length.....**13**

- Rostral spine length less than carapace length. Dorsal or cephalic spine length less than carapace length.....**14**

13. Abdominal somites 3 to 5 with lateral-posterior spines, whose lengths are notoriously more than half of the somite length. Antennal length equal to ¾ , or more, of rostrum length ... .**Atelecyclidae** (Fig. 3e)

- Abdominal somites 3 to 5 with lateral-posterior spines, which are notorious in later stages, but their lengths are a little more than half the somite length. Antennal length less than ¾ of rostrum length .....**Cancridae** (Fig. 3f)

14. Telson fork short and without accessory lateral spines. Abdomen segments 3 to 5 with short lateral-posterior spinous processes or spines .....**Grapsidae** (Fig. 3h)

- Telson fork long and often spinulose, usually with at least one accessory spine. Abdomen segments 3 to 5 with long lateral-posterior processes or spines.....**Xanthidae** (Fig. 3g)

The diversity of decapod crustaceans species living as adults in northern Chile at the sampled area

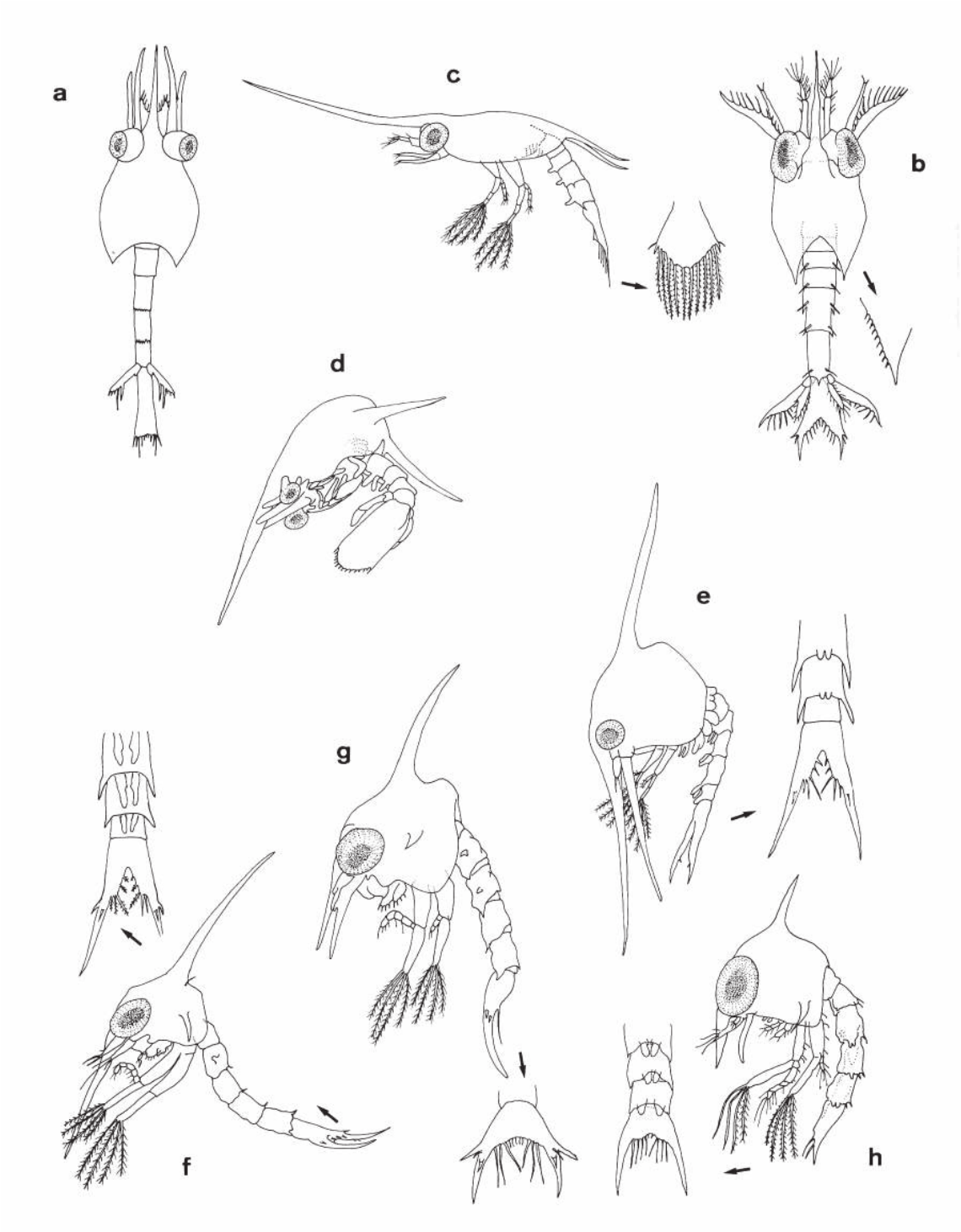

Figure 3. Zoeae from the families of decapod crustaceans collected during El Niño 1982-83 event: Suborder Pleocyemata Infraorder Anomura: a. Paguridae, b. Galatheidae, c. Porcellanidae, d. Hippidae. Infraorder Brachyura: Atelecyclidae, f. Cancridae, g. Xanthidae, h. Grapsidae.

Figura 3. Zoeas de familias de crustáceos decápodos recolectados durante el evento El Niño 1982-83: Suborden Pleocyemata Infraorden Anomura: a. Paguridae, b. Galatheidae, c. Porcellanidae, d. Hippidae. Infraorden Brachyura: Atelecyclidae, f. Cancridae, g. Xanthidae, h. Grapsidae.

Table 1. Families of decapod crustaceans living as adults in northern Chile.
Tabla 1. Familias de crustáceos decápodos cuyos adultos viven en el norte de Chile.

Family	Bathymetric zones I	S	A	P	K	N° sp.	EN
Suborder Dendrobranchiata							
Infraorder Penaeoidea							
Penaeidae	-	+	-	-	-	1	+
Sicyoniidae	-	+	+	-	-	1	+
Sergestidae	-	-	-	+	-	2	+
Aristeidae	-	-	+	-	-	1	-
Solenoceridae	-	-	+	-	-	1	-
Suborder Pleocyemata							
Infraorder Caridea							
Oplophoridae	-	-	-	+	-	8	+
Pasiphaeidae	-	-	-	+	-	2	-
Rhynchocinetidae	-	+	-	-	-	1	-
Campylonotidae	-	+	-	-	-	1	-
Palaemonidae	+	+	-	-	+	1	-
Alpheidae	+	+	-	-	-	4	-
Hippolytidae	-	+	+	-	-	3	-
Pandalidae	-	-	+	+	-	2	-
Crangonidae	-	-	+	-	-	2	+
Glyphocrangonidae	-	-	+	-	-	3	-
Infraorder Astacidea							
Nephropsidae	-	-	+	-	-	1	-
Infraorder Thalassinidea							
Callianassidae	-	+	-	-	+	1	+
Infraorder Palinura							
Polychelidae	-	-	+	-	+	1	-
Infraorder Anomura							
Coenobitidae	-	+	-	-	-	1	-
Diogenidae	-	+	-	-	-	2	-
Lithodidae	-	-	+	-	+	9	-
Paguridae	+	+	+	-	+	4	+
Parapaguridae	-	+	-	-	-	3	-
Chirostylidae	-	-	+	-	-	1	-
Galatheidae	-	-	+	-	+	11	+
Porcellanidae	+	-	-	-	+	14	+
Albuneidae	+	+	-	-	+	2	-
Hippidae	+	-	-	-	+	2	+
Infraorder Brachyura							
Homolodromiidae	-	-	+	-	-	1	-
Calappidae	-	+	+	-	-	2	-
Leucosiidae	-	+	-	-	-	1	-
Majidae	+	+	+	-	+	11	-
Hymenosomatidae	+	+	-	-	-	1	-
Atelecyclidae	+	+	+	-	+	6	+
Cancridae	-	+	-	-	+	4	+
Corystidae	-	+	-	-	-	3	-
Portunidae	-	+	-	+	+	4	-
Platyxanthidae	+	+	-	-	-	2	-
Xanthidae	+	+	-	-	+	10	+
Grapsidae	+	-	-	-	+	10	+
Pinnotheridae	+	+	-	-	+	5	-
Ocypodidae	+	-	-	-	-	5	-
Total	14	24	17	5	16	150	14

I = intertidal S = sublittoral N° sp. = número de especies
A = archibenthic P = pelagic - = without species of the family living in the zone
\+ = one or more species of the family living in the zone
K = existing knowledge on larvae based on species living in Chilean waters
EN = species occurring as larvae in the area during the El Niño 1982-1983 event

reaches today to 151 species under "normal" oceanographic conditions (Table I). Six of them are Dendrobranchiata and 144 are Pleocyemata. They totalize 42 families some of which are benthic, other pelagic. The benthic ones have species that can be intertidal, sublittoral or archibentic. Some of them can live within wider bathymetric limits occupying two of the three cited zones. Only five families belong exclusively to the oceanic realm. From the total of larvae reported from the area, only 22 species belonging to 15 families, were encountered during El Niño 1982-83 event.

DISCUSSION

Larval development of decapod crustaceans living in Chilean waters is still unknown for the majority of species (Wehrtmann and Báez, 1997). The existing knowledge of the larvae from the decapod Crustacea of Chile derives mainly from laboratory larval rearing experiments, and, secondarily, from larvae taken from the plankton. Unfortunately, from the larva obtained from the plankton, no mention has never been made if they were collected under normal or "abnormal" El Niño conditions. The paper and a previous one (Báez and Martin, 1992) represent the first contribution to understand the effect on decapod larvae of a notoriuos seawater temperature elevation. It will allow comparisons with planktonic material captured under "normal" conditions and with larval vestiges obtained through palaeoenvironmental investigations.

Zoeae were the most frequently found and easily sorted larval stage. Nevertheless, some morphological and morphometrical variability was noticed comparing zoea specimens with those from the literature, as it has been reported within the family Xanthidae by Wear (1970) and for the species from the subfamily Sesarminae, among the Grapsidae by Costlow and Fagetti (1967), and among many others papers.

Nauplii, protozoeae and megalopae were found only occassionally. The total of 22 species found belong to 17 genera. They represent, at a specific level, almost one fifth of the total of species living in the area and two thirds at a familial level. Among them only the following genera, and some few species were identified: *Xiphopenaeus (X. rivetti), Penaeus, Sicyonia, Sergestes, Sergia, Acanthephyra, Callianassa, Pleuroncodes, Cancer sp*. (Species "A" and *C. edwardsii*), *Homalaspis (H. plana), Cyclograpsus (C. punctatus*). No conspicuous differences were found, either in general shape or color, between these larvae and those captured or cultured under normal colder conditions.

Species introduced in the area as larvae by El Niño were: *Xiphopenaeus rivetti* Bouvier, 1907, ranging from Sinaloa, México, to Paita, Per{u as a benthic shrimp that lives off the river mouth and on the continental shelf to 70 m depth (Chirichigno, 1970; Pérez y Farfante, 1970). Its nauplius stage, selected by discard and confirmed with its range extention as adult to Pisco, Perú (Vélez and Zeballos, 1985), extended its distribution to the reported Chilean northern waters under these El Niño conditions. The family Sicyoniidae has been cited by Méndez (1981) for Perú by the genus *Sicyonia* with four species*: S. aliaffinis, S. disdorsalis, S. affinis* and *S. picta*. From them *Sicyonia disdorsalis* and *S. aliaffinis* extend their limits more to the south (Vélez and Zeballos, 1985) and would appear as more problable for them to live in the sampled area during El Niño events.

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