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CANCER JOHNGARTHI, N. SP. AND
CANCER PORTERI (BELL)
(CRUSTACEA, DECAPODA):
COMPARISONS AND HYPOTHESIS

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Abstract.—*Cancer johngarthi*, long mistaken for *C. porteri*, is described. It is known in the eastern Pacific from Isla Guadalupe, Mexico (29°N), south to Panama (7°N), on soft bottoms at depths exceeding 90 m. Differences from *C. porteri* are discussed with an emphasis on biological aspects: *C. johngarthi* shows an isometric growth of chelipeds in relation to carapace width, while in *C. porteri* a strong positive allometry is evident after the puberal molt. These two conditions may reflect different mating systems.

The species *Cancer porteri*, described by Bell (1835) as *C. longipes*, was transferred to the genus *Platycarcinus*, synonym of *Cancer*, by H. Milne-Edwards & Lucas (1844), and given its present name by Rathbun (1930). Nations (1975) included it in the subgenus *Cancer* s.s. The holotype was collected in Valparaíso, Chile. Faxon (1895) recorded it from Panama Bay as deep as 523 m (*Albatross*). These two eastern Pacific localities, 33°S and 7°30'N, respectively, were long considered as the geographic distributional limits of the species.

Garth (1957) cited a continuous distribution "from Callao, Peru to Valparaiso, Chile, 0-24 fms" and an extralimital record from Panama. Nevertheless, he also included in the list of examined material one male collected by the Lund University Chile Expedition at Talcahuano (36°41'S), some 450 km south of Valparaíso. This latter record has been confirmed by Retamal & Yáñez (1973). Garth (1961) recorded *C. porteri* from the coast of Sinaloa in the Gulf of California, between 108 and 128 m, and mentioned that the species "may now be reported as a bi-temperate species that transgresses the tropics by submergence, being found in the Gulf of California, the

Bay of Panama in 210 to 286 fathoms, and from Peru to Chile in the Sublittoral."

Information gathered during almost 150 years supported the idea that *C. porteri* was a eurybathic species with a wide geographic distribution. In fact, the case has been used as a paradigm of the peculiar tropical submergence distribution pattern (Ekman 1953, Garth 1961).

Careful study of several specimens recently collected off Baja California Sur and the reexamination of virtually all specimens identified with *Cancer porteri* from the Northern Hemisphere, along with several specimens from Chile and Peru, leads to the conclusion that they belong to two different species. The morphological differences, scarcely evident in young specimens, may express divergence in their mating systems.

Cancer johngarthi, new species
Figs. 1, 3A, 4B

Cancer longipes, Faxon, 1895:16; Rathbun, 1930:199 (in part).

Cancer porteri Rathbun, 1930:199 (in part); Garth, 1957:50 (in part); 1961:122; Parker, 1964:173; Chirichigno, 1970:45 (in part); Retamal & Yáñez, 1973:12 (in part);

Nations, 1975:43 (in part); 1979:154, 156, 178 (in part); Retamal, 1981:30 (in part).

Carapace granulated, widely oval, very convex and moderately areolated, with protuberances on proto- and mesogastric regions and on borders of epi- and mesobranchial regions. Both mesobranchial regions swollen and nearly meeting in median line. Frontal region convex. Front projected and furnished with 3 teeth, median slightly longer and narrower than others. Inner orbital tooth pointed and slightly shorter than frontal teeth. Anterolateral margin finely granulated, cut into 9 teeth; granulations enhanced posteriorly. Posterolateral margin granulated and furnished with 2 teeth, first small and second vestigial, sometimes imperceptible. Pterygostomial region swollen and coarsely granulated towards outer edge. Whole carapace remarkably thin; epi- and subbranchial and pterygostomial regions may be easily flexed.

Buccal cavity well delimited anteriorly by projections of pterygostomial border, with 2 strong vaults separated by a longitudinal keel.

Maxillipeds granulated, with ischium and merus widened distally. Merus with outer face concave and a notch on distal half of inner margin where palp inserts.

Chelipeds: fingers with tips and cutting edges dark, starting from proximal tooth. Palm granulated, with 4 longitudinal carinae on lower half of outer face. Propodus 2.7 times as long as wide in adult males. Carpus rough, with irregular granulated carinae and anterosuperior pyramidal tooth. Merus with subtriangular section and upper distal margin granulated.

Walking legs long and slender, without spines or setae on proximal articles. Propodus with scarce setae on distal end of lower margin. Dactylus with 4 symmetrical longitudinal rows of setae and a deep groove along inner and outer faces, respectively.

Abdomen in adult males with terminal segment narrowly rounded distally, lateral margins slightly concave and 1.1 times as

long as wide. Adult males with second pleopod slightly overreaching second segment of thorax; first pleopod slightly overreaching third segment of thorax.

Holotype.—In the collection of the Allan Hancock Foundation: male (carapace 14 cm wide, 8.7 cm long); Isla Guadalupe, Mexico; 183 m; 15 Nov 1968, *Velero IV* sta. 12460-68; catalog number AHF 6815.

Material examined.—Paratypes: Isla Guadalupe, Mexico (29°N); 183 m, 15 Nov 1968, *Velero IV* sta. 12460-68; 4 males, 1 female, AHF 6816. Off Río San Lorenzo, Sinaloa, Mexico (24°15'N), 108-128 m; May 1959; 2 males, 6 females; AHF 5929. Off Bahía Magdalena, B.C., Mexico (24°15'N), 90-125 m; Jul 1987, 1 male, 3 females, CIB, La Paz. Bahía de Panama; 384 m; Mar 1891; *Albatross* sta. 3389; 1 female, MCZ, Harvard University.

Distribution.—Eastern Pacific from Isla Guadalupe, Mexico to Bahía de Panama. Southern Gulf of California.

Habitat.—Soft bottoms, 90-523 m.

Etymology.—Named in honor of Dr. John S. Garth, Chief Curator Emeritus, Allan Hancock Foundation, University of Southern California, Los Angeles, California.

Comparison with *Cancer porteri*

The observations listed below and also data for Figs. 3 and 4 resulted from the examination of 17 specimens of *C. johngarthi* (carapace widths from 35 to 140 mm) and 43 specimens of *C. porteri* (c.w. 22.8 to 123 mm). These latter came from Valparaíso, Chile and from the following localities in Peru: Bahía Independencia, Bahía San Juan, Isla San Lorenzo, Bahía San Nicolás, Callao, Isla Lobos de Afuera.

1. Chelipeds of adult males noticeably stronger in *C. porteri* (Fig. 2a). As shown in Fig. 3B this allometric character is better expressed after the molt of puberty.

2. Darkening in cutting edges of cheliped fingers starts proximally in *C. porteri* but in *C. johngarthi* it starts at first tooth.

3. The most remarkable difference at any

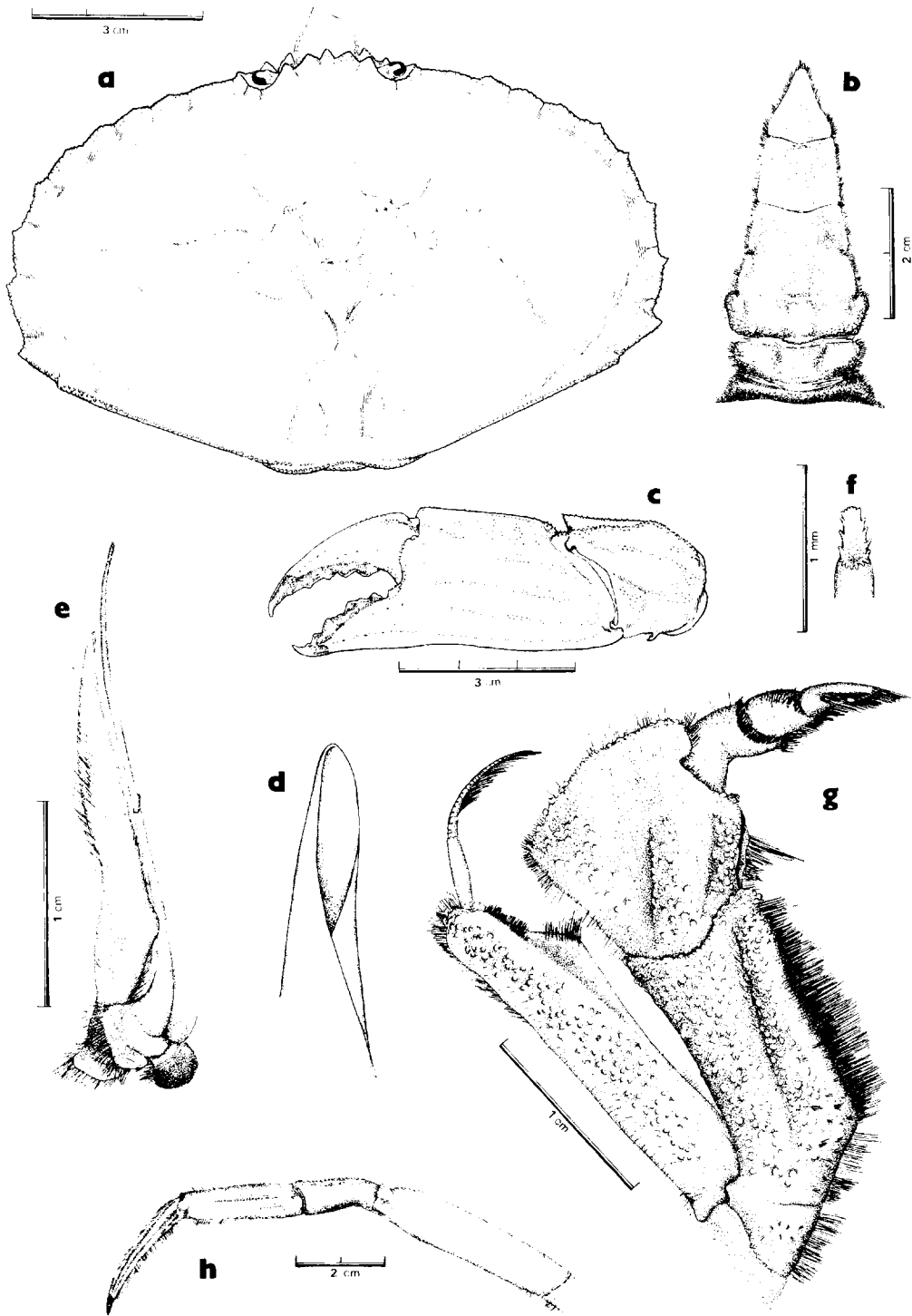


Fig. 1. *Cancer johngarthi*, male: a, Carapace, dorsal; b, Abdomen; c, Left cheliped; d, Second pleopod, distal end; e, First and second pleopods; f, First pleopod, distal end; g, Third maxilliped.

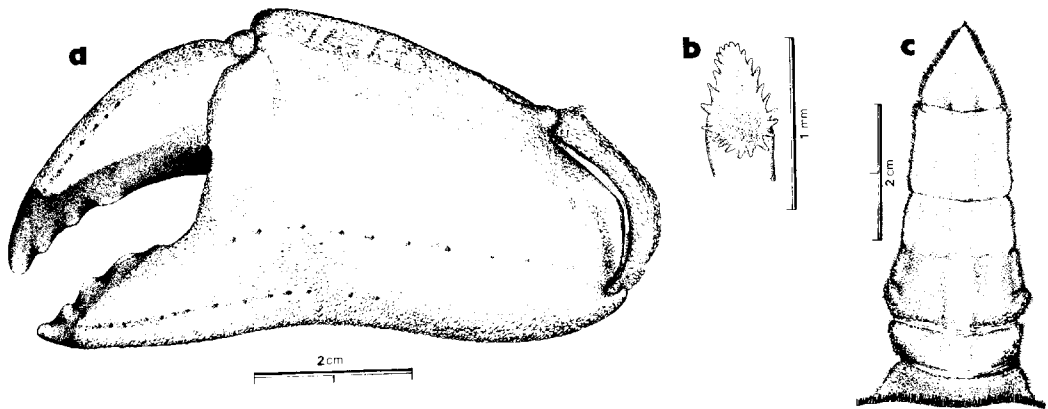


Fig. 2. *Cancer porteri*, male: a, Left cheliped; b, First pleopod, distal end; c, Abdomen.

age is consistency of the carapace. *C. johngarthi* seems to be a paper shell species.

4. Terminal segment in abdomen of males with straight lateral margins in *C. porteri* and slightly concave margins in *C. johngarthi* (Figs. 1b and 2c).

5. Pereopods proportionately longer and dactyli of walking legs longer in relation to propodi in *C. johngarthi*.

6. Width/length relation of carapace significantly greater in *C. johngarthi* (Fig. 4).

7. As shown in Figs. 1f and 2b, apex of first male pleopods quite different in each species.

Habitat preferences of each species are not sufficiently documented, but *C. johngarthi* seems to prefer deeper waters; it has not been collected shallower than 90 m while *C. porteri* inhabits waters from the intertidal to more than 350 m (Yáñez 1974). This scheme agrees with the well known relation of *Cancer* and water temperature: species in this genus usually live at latitudes greater than those where the surface isotherm of 20°C is to be found (MacKay 1943, Nations 1979). At lower latitudes depth compensates thermal needs; such is the case of *C. borealis* and *C. irroratus* in Florida, and especially *C. guezeti* in Madagascar (Crosnier 1976).

The Hypothesis

The genus *Cancer* originated in the north-eastern Pacific (Ekman 1953, Nations 1975, 1979) and dispersed southward along the west coast of the Americas. Four species may be found in Peru and Chile; one of these is *C. porteri*. This species, now separated from *C. johngarthi*, ranges from Isla Lobos de Afuera (6°57'S) to Talcahuano (36°41'S), covering most of the Peruvian-Chilean province (sensu Briggs 1974). The morphological affinity and geographic distribution of the two species suggest the existence of a common ancestor that traveled—perhaps in the Miocene—between North and South America (Nations 1979).

Morphological divergence between *C. johngarthi* and *C. porteri* may have resulted from different mating systems. Orensanz & Gallucci (1988) explain some differences among four sympatric species of *Cancer*, such as dimorphic development of chelipeds, according to the models of polygyny established by Emlen & Oring (1977). Mating systems of species with precocious development of a strong cheliped may be interpreted as a case of resource defense polygyny: in *C. oregonensis* each male holds a refuge area—limited resource—which al-

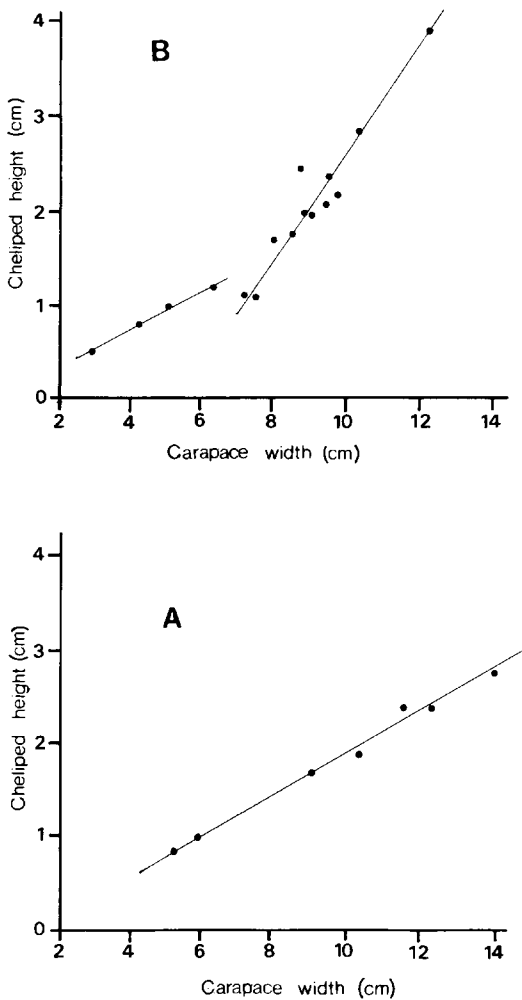


Fig. 3. Cheliped height plotted against carapace width in males: A, *Cancer johngarthi*; B, *Cancer porteri*.

lows him to monopolize females. Precocious development of strong chelipeds is required for an early appropriation of adequate refuges. The case of harem defense polygyny involves direct access to females; therefore, defense strategies are only needed once reproductive size is reached. Positive allometric growth of chelipeds, consequently, starts just after the molt of puberty. This seems to be the case for *C. porteri*, as indicated by allometric growth of male chelipeds (Fig. 3B) and also by data in Antezana

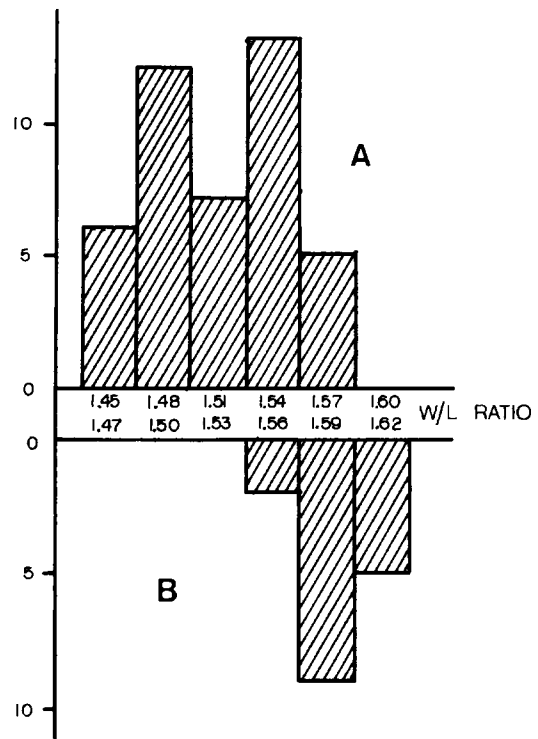


Fig. 4. Frequencies of width to length ratios in carapaces: A, *C. porteri*; B, *C. johngarthi*.

et al. (1965) who determined a figure of 5 females per each male after one year of monthly sampling.

In the third model, male dominance polygyny, mates or critical resources are not economically monopolizable. Males aggregate during the breeding season and females select males from these aggregations. Sexual dimorphism in the development of chelipeds is not expected here. Orensanz & Galucci (1988) included *C. magister* in this category, stressing the fact that *C. magister* is the only species in the genus *Cancer* in which chelipeds are of the same size in males and females. I suggest that this is also the case for *C. johngarthi*, in absence of dimorphic development of chelipeds. Several additional arguments uphold this hypothesis. As expected, sex ratio is almost 1:1 and sexual selection nearly null; from a total of

27 known specimens of *C. johngarthi*, 15 are males and the rest females. Since breeding assemblages are not permanent, breeding season should be normally restricted to a short period of time; this seems a reasonable explanation for the lack of ovigerous females in the collected material.

On the other hand, there is a relation between size of cheliped and quality of substrate. Species inhabiting soft and homogeneous bottoms of fine sand have chelipeds proportionately weaker than those from irregular rocky substrates. Lawton & Elnor (1985) stated that these differences account basically for the type of feeding, but they left aside an important element of analysis, the role of chelipeds in sexual selection, which is common to most decapod Crustacea. Evidently, differences in size and shape of chelipeds of dimorphic species are not due to differences in diet of each sex; male chelipeds fulfill other functions such as the defense of a territory or of a harem. Sudden development of cheliped dimorphism at molt of puberty in many species is strong evidence of cheliped morphology depending primarily upon sex requirements. Open soft-bottom environments, compared to complex rocky substrates, allow fewer possibilities of delimitation and defense of a territory; therefore, different mating systems are involved. Following this idea, lack of dimorphism in chelipeds of *C. johngarthi* may be interpreted as a consequence of a male dominance polygyny mating system that in turn results from inhabiting open soft bottoms.

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Literature Cited

- Antezana, T., E. Fagetti, & M. T. López. 1965. Observaciones bioecológicas en Decápodos comunes en Valparaíso.—*Revista de Biología Marina (Chile)* 12:1–60.
- Bell, T. 1835. Observations on the genus *Cancer* of Dr. Leach (*Platycarcinus* Latreille) with descriptions of three new species.—*Proceedings of the Zoological Society, London* 3:86–88.
- Briggs, J. C. 1974. *Marine zoogeography*. New York, McGraw-Hill, 475 pp.
- Chirichigno, N. F. 1970. Lista de Crustáceos del Perú (Decapoda, Stomatopoda) con datos sobre su distribución geográfica.—*Informe del Instituto del Mar, Perú* 35:1–115.
- Crosnier, A. 1976. Donnés sur les Crustacés Décapodes capturés par M. Paul Gueze a l'île de la Réunion lors d'essais de pêche en eau profonde.—*Travaux et Documents, ORSTOM* 47: 225–256.
- Ekman, S. 1953. *Zoogeography of the sea*. London, Sidgwick & Jackson, 417 pp.
- Emlen, S. T., & L. W. Oring. 1977. Ecology, sexual selection and the evolution of mating systems.—*Science* 197:215–223.
- Faxon, W. 1895. The stalk-eyed Crustacea: Report on an exploration off the west coast of Mexico, Central and South America, and off the Galapagos Islands, in charge of Alexander Agassiz by the U.S. Fish Commission Steamer ALBATROSS during 1891. XV.—*Memoirs of the Museum of Comparative Zoology, Harvard* 18: 1–212.
- Garth, J. S. 1957. Reports of the Lund University Chile Expedition 1948–49, No. 29. The Crustacea Decapoda Brachyura of Chile.—*Lund University Arsskrifter*, (2)53:1–128.
- . 1961. Distribution and affinities of the brachyuran Crustacea.—*Systematic Zoology* 9: 105–123.
- Lawton, P., & R. W. Elnor. 1985. Feeding in relation to morphometrics within the genus *Cancer*: Evolutionary and ecological considerations. Pp. 357–379 in B. R. Melteff, ed., *Proceedings of the Symposium on Dungeness Crab Biology and Management*.—University of Alaska, Alaska Sea Grant Reports.
- MacKay, D. C. G. 1943. Temperature and world distribution of crabs of the genus *Cancer*.—*Ecology*, 24:113–115.
- Milne-Edwards, H., et H. Lucas. 1844. Crustacés. Pp.

- 1-37 in A. D'Orbigny, ed., *Voyage dans l'Amérique Meridionale*.
- Nations, J. D. 1975. The genus *Cancer* (Crustacea: Brachyura): Systematics, biogeography and fossil record.—*Scientific Bulletin of the Natural History Museum, Los Angeles County* 23:1-104.
- . 1979. The genus *Cancer* and its distribution in time and space.—*Bulletin of the Biological Society of Washington* 3:153-187.
- Orensanz, J. M., & V. F. Gallucci. 1988. A comparative study of postlarval life-history schedules in four sympatric *Cancer* species (Decapoda: Brachyura: Cancridae).—*Journal of Crustacean Biology* 8:187-220.
- Parker, R. H. 1964. Zoogeography and ecology of some macroinvertebrates, particularly mollusks, in the Gulf of California and the Continental Slope of Mexico.—*Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening* 126: 1-178.
- Rathbun, M. J. 1910. The stalk-eyed Crustacea of Peru and the adjacent coast.—*Proceeding of the United States National Museum* 38:531-620.
- . 1930. The cancrioid crabs of America.—*Bulletin of the United States National Museum* 152: 1-609.
- Retamal, M. A. 1981. Catálogo ilustrado de los Crustáceos Decápodos de Chile.—*Gayana (Zoología)* 44:7-110.
- , & L. A. Yáñez. 1973. Análisis cuali y cuantitativo de los decápodos de los fondos sublitorales blandos de la Bahía de Concepción, Chile.—*Gayana (Zoología)* 23:1-47.
- Yáñez, E. 1974. Distribución y abundancia relativa estacional de los recursos disponibles a un arte de arrastre camaronero frente a la costa de Valparaíso (Invierno y Primavera 1972).—*Investigaciones Marinas (Chile)* 5:125-138.

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