

Short Communication

**Note on the fisheries and biology of the golden crab (*Chaceon fenneri*)
off the northern coast of Brazil**

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ABSTRACT. The occurrence of golden crabs (*Chaceon fenneri*) off the northern coast of Brazil was first reported in 2001. Since then, a few companies and boats have exploited this resource. In the state of Ceará, one company has been fishing for these crabs with a single boat since 2003. The production and fishing effort of this company indicated a decrease in the number of trips and total catches per year. Data collected on one trip in 2006 showed that the CPUE was highest at over 650 m depth. As registered for other geryonid crabs, *C. fenneri* was segregated by sex along the northern slope of Brazil. Male crabs were significantly larger than females, presenting an isometric relationship between carapace width and length and an allometric relationship between carapace width and body weight.

Keywords: biology, fishery, *Chaceon fenneri*, golden crab, Geryonidae, Brazil.

**Nota sobre la biología y la pesca del cangrejo dorado (*Chaceon fenneri*)
frente a la costa norte de Brasil**

RESUMEN. La presencia de cangrejos dorados (*Chaceon fenneri*) frente a la costa norte de Brasil fue primeramente descrita en 2001. Desde entonces, algunas embarcaciones y compañías se han dedicado a explotar este recurso. En el Estado de Ceará, una sola compañía ha estado pescando estos crustáceos desde el año 2003 con una sola embarcación. Se presenta la producción y esfuerzo pesquero aplicado por esa compañía, indicando la disminución en el número de viajes y captura total por año. Registros recolectados en un viaje realizado el 2006 muestran que los mayores valores de CPUE se obtienen a profundidades mayores de 650 m. Al igual que lo registrado en otros Geryonidae, agregaciones por sexo se determinaron en *C. fenneri* a lo largo del talud en la región norte de Brasil. Los machos fueron significativamente más grandes que las hembras, presentando una relación isométrica entre el ancho y longitud del caparazón; como también, una relación alométrica entre el ancho y el peso.

Palabras clave: biología, pesca, *Chaceon fenneri*, cangrejo dorado, Geryonidae, Brasil.

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Chaceon fenneri (Manning & Holthuis, 1984) is a geryonid crab (Brachyura: Geryonidae) occurring on the western Atlantic from the Gulf of Mexico to northeast Brazil. As all the other Geryonidae, *C. fenneri* is found along the continental slope between 200 and 1500 m deep. These animals present the usual *Chaceon* features, such as a large hexagonal cephalothorax ranging in width from 7.5 to 20 cm, ornamented by five antero-lateral teeth on each side, and

distinguished by its cream to tan color, with laterally compressed dactyls on the walking legs (Manning & Holthuis, 1989).

Geryonid crabs are found throughout the planet oceans, except for the east Pacific, in depths ranging from around 100 m to more than 2800 m (Manning, 1990). The family comprises four genera and 24 species, many of them of commercial importance to industrial and artisanal fisheries. In Brazil, fishing for

geryonid crabs started in the 1980s. Incipient efforts were restricted to the southeast/south coast and targeted *Chaceon ramosae* and *Chaceon notialis*, and were only definitely established in the late 1990s, stimulated by government policies (Pezzuto *et al.*, 2006). *C. notialis* is distributed south to 33°S, reaching Argentina, and is the most important geryonid in terms of Brazilian fisheries, with an estimated stock of 17,117.80 tons (Pezzuto *et al.*, 2002). *C. ramosae* is found between 27°S and 30°S, and almost half of the reported production comes from gill nets instead of the usual traps (Pezzuto *et al.*, 2006).

The first record of *C. fenneri* from Brazil was presented by Sankarankutty *et al.* (2001), based on specimens collected during a survey of the REVIZEE Program on the northeast coast. Since then, a few fishing boats from Natal and Fortaleza harbors have targeted the species. Today, only one company (based at Fortaleza) is known to be exploiting this resource, dedicating a single boat to this fishery.

This study describes the *C. fenneri* fishery off the coast of Ceará, presenting data on a few biological descriptors such as size structure, sex ratio, and spatial and bathymetric distribution.

The data related to production were obtained from the Interfrios Company, comprising the period between April 2003 and August 2007. Data regarding population estimations were obtained onboard the crab fishing boat, Incopesca I, property of Industria Naval do Ceará (INACE), from 19 to 23 July 2006. The fishing stations were located about 40 nm north of the Ceará coast, and were determined by the boat's crew with the aid of charts, GPS, and sonar. During five days of fishing, the traps were deployed nine times at six different stations (Fig. 1). The traps used were circular, with an iron structure and a 9-mm PE (polyethylene) net; they were baited with fish carcasses. A total of 198 traps were used (65 traps per fishing station). On average, the traps were soaked for 17 h (deployment to retrieval) at sites with depths ranging from 500 to 800 m.

Once the traps were retrieved, the boat's crew visually selected the crabs and all small crabs (CW < ~12.5 cm) were released. For each trap, we recorded the total number of crabs of each sex that were caught and released. After landing, the individuals were measured for carapace length (CL) and width (CW) using a caliper and weighed on an electronic semi-analytic scale (0.001 g precision). The CW was measured including the lateral spines. The CPUE was calculated in terms of the mean number of crabs caught per trap and the effective CPUE (CPUE eff.) using only the number of processed crabs. Statistical analy-

ses were done with the software Statistica 7.0 (Statsoft Inc.) and JMP 7.0.1 (SAS Institute Inc.).

From April 2003 to August 2007, a total of 37 fishing trips were conducted, resulting in 41,794 kg of golden crabs, for an average of 1,478.13 kg trip⁻¹ (Table 1).

The data on crab production from 2003 to the present show an irregular downward trend in effort and production. It is worth noting that Table 1 shows only the number of trips, since the company did not provide the number of days at sea or amount of traps deployed per trip. On the other hand, even considering large differences in effort per trip, an average of only five trips were conducted in each of the last four years. Until 2003, almost all production was exported, mainly to European countries, an activity that was favored by the currency exchange rates at that time. In 2004, the economic setting changed and the Brazilian currency appreciated strongly, impacting many activities such as shrimp and crab exportations. The fishing company tried to boost the local market with a feeble campaign restricted to Fortaleza, where the consumption of mangrove crabs (*Ucides cordatus*) is the largest in Brazil. In the following years, INACE kept fishing for crabs in an attempt to maintain the commercial channels opened. Today, golden crabs are sold to states in the southeast/south (São Paulo, Rio de Janeiro, and Paraná) and are exported to the United States of America.

Biologically, the data obtained so far reveal many similarities with other geryonid crabs. Table 2 shows the deployment depths of the traps, number of traps used, CPUE, and numbers of males and females captured and released. Males and females show a tendency for bathymetric segregation ($\chi^2 = 2806.26$, d.f. = 8, $p < 0.000001$), with males being more frequent at deeper sites and females more common in shallower areas. In the south Atlantic Bight, Wenner (1990) found a different pattern for this species, with more abundant males between 274 and 549 m depth and females predominating at the deeper sites (733-823 m). On the other hand, Lindberg & Lockhart (1993) showed that, in the Gulf of Mexico, *Chaceon fenneri* followed the same pattern found in Brazil. In *Chaceon notialis*, a species fished in more austral waters of the western Atlantic, females were also concentrated in shallower areas (Defeo *et al.*, 1991). Pinho *et al.* (2001) reported that the situation of *Chaceon affinis* in the Azores was similar to that described by Wenner (1990) for *C. fenneri* in the south Atlantic Bight, with males dominating in shallower areas. Gender segregation was also registered for other geryonids (Lindberg & Lockhart, 1993; Pinho *et al.*, 2001; López-Abellán *et al.*, 2002), and it seems that the distribution of these

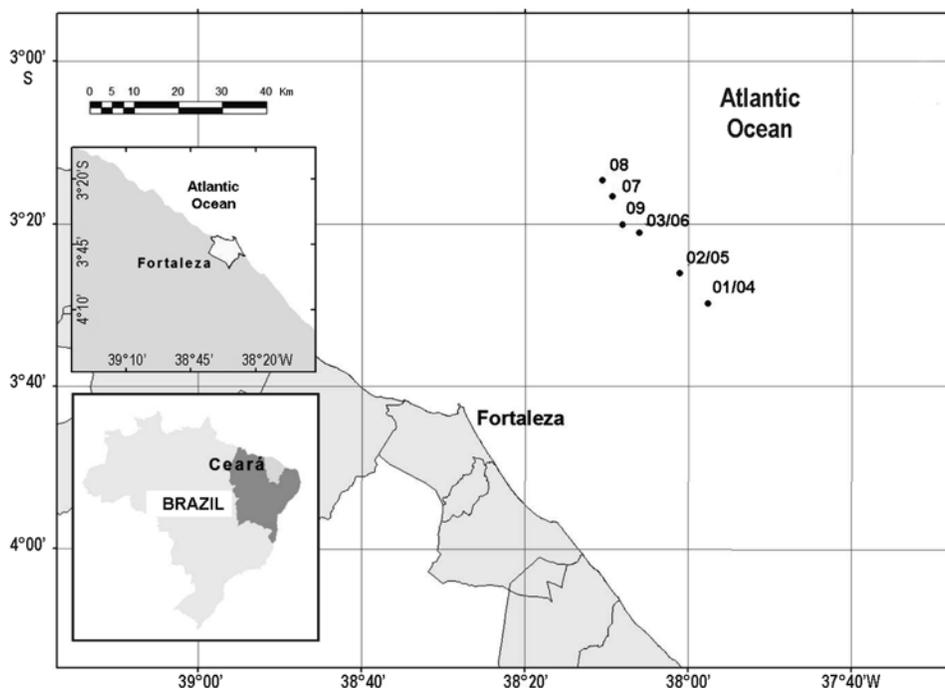


Figure 1. Location of the fishing stations for golden crabs off Ceará coast, Brazil.

Figura 1. Localización de los lugares en donde se realizaron las faenas de pesca frente a la costa de Ceará, Brasil.

Table 1. Yearly data on the number of fishing trips and amount of golden crabs caught off the Ceará coast.

Tabla 1. Datos anuales correspondientes al número de viajes de pesca y cantidad de cangrejos dorados frente a la costa de Ceará.

Year	2003	2004	2005	2006	2007
Number of trips	16	03	08	04	06
Average (kg trip ⁻¹)	1,478	1,503	783	1,033	540
Total (kg year ⁻¹)	23,650	4,510	6,263	4,131	3,240

species may be affected by their reproductive cycle or other unknown conditions.

In the north Atlantic, *C. fenneri* co-occur with another *Chaceon* species: *C. quinquedens*. The bathymetric distributions of these two species overlap, with *C. quinquedens* occurring mainly at deeper sites (Lindberg & Lockhart, 1993). In Brazil, no other geryonid species are captured in the traps, only the giant isopod *Bathynomus giganteus*. As no competitors seem to be present, the bathymetric range of *C. fenneri* in Brazil may extend to deeper limits.

In a subsequent attempt to capture golden crabs in February 2007, traps were mistakenly deployed at 450 m and only ovigerous females were caught; these were promptly released. On the same trip, attempts between 650 and 820 m depth were unsuccessful and not a single specimen was caught. This may indicate the reproductive period of *C. fenneri* in Brazil, although much more data are needed to support this. In southeastern Florida, the oviposition period of golden crabs occurs between August and October, with an incubation time of approximately six months, for hatching in

February and March (Erdman & Blake, 1988). Other authors have also reported a bathymetric migration of females related to the reproductive period (Lindberg *et al.*, 1990; López-Abellán *et al.*, 2002). If female golden crabs indeed migrate to shallower areas for oviposition or hatching, the establishment of exclusion depth ranges may constitute an important measure for resource administration.

Table 2 shows that about 42% of the females were released, compared to only 10% of the males. Although the overall sex ratio was almost 1:1, the activity has a greater impact on males, especially due to their larger sizes.

Regarding the CPUE, Table 2 shows that the best results were obtained at the deeper sites. These data must be analyzed carefully given the small number of sites and depths analyzed. At depths shallower than 650 m, the average CPUE was 2.975 crabs trap⁻¹ (S.E. = 0.890) whereas, at the deeper sites (≥ 650 m), the average CPUE was 3.552 crabs trap⁻¹ (S.E. = 0.397).

All sites were located at depths beyond 580 m, so it was not possible to compare the bathymetric distributions between Ceará and the north Atlantic. Wenner (1990) studied the bathymetric distribution of *C. fenneri* in the south Atlantic Bight, pointing out that maximum yields (12 crabs trap⁻¹) were obtained in the 458-549 m range. Later on, Lindberg & Lockhart

(1993) found a larger density of *C. fenneri* in the Gulf of Mexico between 350 and 550 m, with the largest animals being captured at 350 m depth. More recently, Harper *et al.* (2000) reported that the golden crab fishery in the Gulf of Mexico from 1995 to 2000 targeted mostly sites between 300 and 500 m deep. Future prospection must be conducted at these depths in order to establish the bathymetric distribution of this species along Brazil's northeast continental slope.

Since the fishing effort on the golden crab stock of the Brazilian northern slope is still very small, the prospects in terms of resource administration are good. Although the volume of data regarding the population of golden crabs along Brazil's northern continental slope is scanty, more data can be gathered in order to estimate the maximum sustainable yield and establish the rules for this fishery.

As for the sizes of the animals, Table 3 summarizes the variables measured. These data are biased and by no means represent the natural population. Males are consistently larger and heavier than females, corroborating the values presented by Sankarankutty *et al.* (2001). The average CL and CW shown in Table 4 are almost the same as those obtained by Harper *et al.* (2000) in the Gulf of Mexico.

For males, the relationship between CW and CL indicates isometric growth, as shown by the regression

Table 2. Fishing depth, number of traps deployed, and amount of *C. fenneri* males and females caught during one fishing trip. The CPUE is presented in terms of captured (CPUE) and processed crabs (CPUE eff.).

Tabla 2. Profundidad de pesca y número de trampas caladas y cantidad de machos y hembras de *C. fenneri* en un viaje de pesca. La CPUE está presentada en términos de captura (CPUE) y de cangrejos procesados (CPUE eff.).

Set #	Depth (m)	Males	Females	Released males	Released females	Total captured	Total released	Total processed	No. traps	CPUE	CPUE eff.
1	650	208	28	9	14	236	23	213	71	3.32	3.00
2	580	72	281	10	253	353	263	90	65	5.43	1.39
3	640	144	18	3	10	162	13	149	62	2.61	2.40
4	650	61	106	5	31	167	36	131	71	2.35	1.85
5	580	61	114	7	20	175	27	148	65	2.69	2.28
6	650	29	211	0	19	240	19	221	64	3.75	3.45
7	680	153	76	11	12	229	23	206	65	3.52	3.17
8	790	256	91	52	35	347	87	260	72	4.82	3.61
9	580	15	60	1	20	75	21	54	64	1.17	0.84
Total		999	985	98	414	1984	512	1472	599		

Table 3. The mean, standard deviation, mode, and median for carapace width (CW), carapace length (CL), and the weight of golden crabs captured off the Ceará coast.

Tabla 3. Media, desviación estándar, modas y mediana en el ancho del caparazón (CW), largo del caparazón (CL) y peso de los cangrejos dorados capturados frente a la costa de Ceará.

		Mean	Standard deviation	Mode	Median
Males (N = 87)	CW (cm)	14.56	0.91	14.4	14.4
	CL (cm)	12.64	0.82	12.9	12.7
	Weight (g)	980.17	209.97	858	970
Females (N = 23)	CW (cm)	13.56	0.75	14.5	13.40
	CL (cm)	11.77	0.58	12.4	11.80
	Weight (g)	701.70	70.75	720	720.00

presented in Figure 2 ($CL = 0.2831992 + 0.8484187 \cdot CW$; $R^2 = 0.89$). The regression with weight, on the other hand, indicates an allometric relationship (Fig. 3; $Weight = 0.2263566574 CW^{3.1212672783}$; $R^2 = 0.83$). The data available for females was insufficient for the same analysis. It is worth noting that the values used for these calculations are restricted to large adults processed by the fishing company.

A more thorough investigation on the size structure of the population, spatial and bathymetric distribution, and reproductive biology is required for a correct management of this resource. As this population has not yet been strongly targeted by fisheries, the need for further data is urgent.

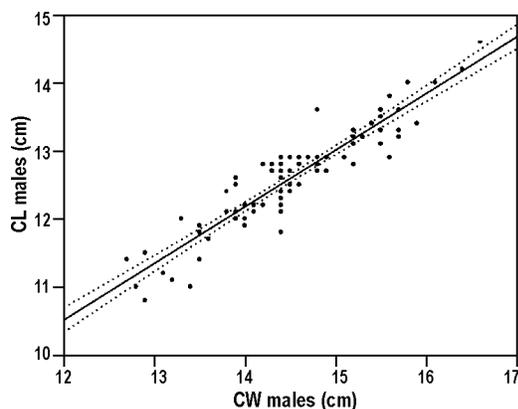


Figure 2. Scatter plot of carapace width (CW) vs. carapace length (CL), with regression lines and confidence curves for male golden crabs collected off Ceará coast.

Figura 2. Gráfico con las mediciones de ancho del caparazón (CW) vs largo del caparazón, con líneas de regresión y curvas de confianza, en cangrejos dorados capturados frente a la costa de Ceará.

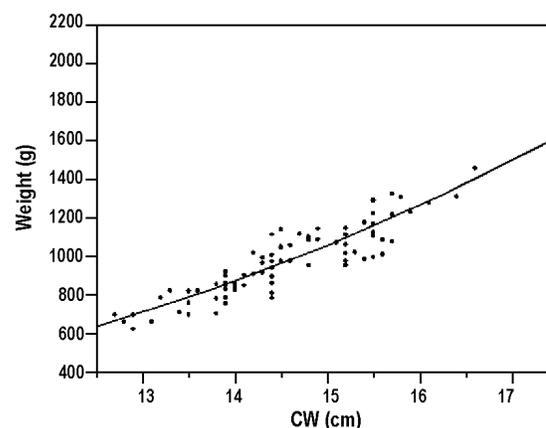


Figure 3. Regression of carapace width (CW) vs. weight for male golden crabs caught off the Ceará coast.

Figura 3. Regresión entre el ancho del caparazón y el peso en machos de cangrejos dorados capturados frente a la costa de Ceará.

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