CONTRIBUTION TO THE BIOLOGY AND FISHERY OF THE DEEP-WATER RED CRAB, *CHACEON AFFINIS* (A. MILNE-EDWARDS & BOUVIER, 1894) (DECAPODA, BRACHYURA, GERYONIDAE) IN DEEP WATERS OF THE CANARY ISLANDS (CENTRAL-EAST ATLANTIC)

BY

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ABSTRACT

Two exploratory trap fishing surveys were carried out from February to April and from June to July 2003, respectively, at depths ranging between 300 and 1200 m, with the objective to assess deep fishery resources of the Canary Archipelago. Despite the fact that the deep-water red crab, *Chaceon affinis* is a virtually unknown species for the artisanal fishermen of the islands, it was relatively frequent in catches, as an indication of its abundance in deep waters off the archipelago. This crab was captured in the whole range of depths sampled, although its highest abundance was found between 600 and 800 m, on muddy-rocky bottoms. Moreover, significant differences were observed in the average weight and length, according to depth of capture, island of origin, and date of survey. In general, the *b* parameter of length-weight relationship indicates a negative allometric growth pattern, although in some cases it was not statistically different from isometry, particularly in males. Males were heavier, larger, and more abundant in catches than females.

RESUMEN

Se realizaron dos campañas de pesca exploratoria de febrero a abril y de junio a julio de 2003, respectivamente, entre los 300 y 1200 m de profundidad con el objeto de evaluar los recursos pesqueros profundos del Archipiélago Canario. A pesar de que el cangrejo rey (*Chaceon affinis*) es una especie prácticamente desconocida para los pescadores artesanales de las Islas, fue relativamente frecuente en las capturas, prueba de su abundancia en las aguas profundas del Archipiélago. Este cangrejo fue capturado en todo el rango de profundidades muestreado, aunque su mayor abundancia

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se encontró entre los 600 y 800 m de profundidad, tanto sobre fondos fangosos como rocosos. Además, se observaron diferencias significativas en los pesos y tallas medias, según la profundidad de captura, isla y fecha de la campaña. En general, el exponente *b* de la relación talla-peso indicó un patrón de crecimiento alométrico negativo, aunque en algunos casos éste no fue estadísticamente diferente de la isometría, particularmente en machos. En las capturas, los machos fueron más pesados, grandes y abundantes que las hembras.

INTRODUCTION

The Canary Islands have narrow coastal shelves surrounded by deep waters, so they do not have important fishing grounds. Around these oceanic islands fishing is not very productive, because the sea floor is rough, which constitutes a handicap for the trawl fisheries, and the living resources that are present have only small biomass and are frequently inaccessible (Bas et al., 1995). Due to these difficulties, small-scale fishery has historically centred its activity on the neritic zone and particularly on demersal fish (mainly comprised of breams: *Dentex* spp., *Diplodus* spp., *Pagellus* spp., *Pagrus* spp., etc.) and benthic cephalopods (mostly *Octopus vulgaris* Cuvier, 1797) (cf. González-Pajuelo, 1997; Hernández-García et al., 1998). Curiously, crustaceans have never been significant in the landings of the artisanal fleet, reaching only 0.1% of total catches (Gonzalez & Santana, 1996; Melnychuk et al., 2001). However, the high fishing pressure developed during the last three decades has resulted in many fish species currently being overfished (Pajuelo & Lorenzo, 1995, 1996; among many others) and this has forced part of the artisanal fleet to move offshore for access to pelagic resources as chub mackerel (*Scomber colias* Gmelin, 1789), sardines (*Sardinella* spp.), tunas (particularly *Katsuwonus pelamis* (Linnaeus, 1758)), and various deep-water species (i.e., benthic sharks, *Centroscymnus* spp., *Dalatias licha* (Bonnaterre, 1788) *Centrophorus* spp., common mora *Mora moro* (Risso, 1810), offshore rockfish *Pontinus kuhlii* (Bowdich, 1825), blackbelly rosefish *Helicolenus dactylopterus dactylopterus* (Delaroche, 1809), etc.) (cf. Brito et al., 1998).

Since 1967, several research projects have been carried out off the Canary Islands to study the fauna that inhabits deep waters around the archipelago, and to assess its potential as a fishing resource for the local fleet. According to González et al. (1997, 2006), *Plesionika edwardsii* (Brandt, 1851) and *Chaceon affinis* (A. Milne-Edwards & Bouvier, 1894) appeared to be the most important new target resource among crustaceans from a biological and commercial point of view, although Castro et al. (2003) extend the estimated fishing interest also to *Paramola cuvieri* (Risso, 1816) and *Cancer bellianus* Johnson, 1861. However, fishing down to 200 m depth is rare among the Canaries fishermen, because it is a high cost fishery that initially requires important adaptations to the vessels, that should be fit to transport and handle larger and heavier traps. Furthermore, the risk of gear loss is rather high (over 10% of the traps per fishing trip; authors' unpubl. data). In addition, the catches are not really abundant (averages of 40.9 and 52.7 g/h for fish and crustaceans, respectively), and lower than those reported for other deep fishing grounds (i.e., to the N.W. of Spain, as reported by Pineiro et al. (2001), catches were over 20 times as high). Moreover, many of these deep-water species are not well accepted by the fish market, due to their unattractive morphology.

Until now, there is almost no biological information about deep-sea benthic resources around the Canary Islands. Even though research focused on the evaluation of deep communities, in view of the possibility to reorient part of the fishing effort towards some of those groups, the results obtained gave no clear impression of deep-water fishing potentiality. Most of the available information comes from trap surveys. Although, this method offers the advantage of deployment at all times and depths, most of the bias and problems with the use of this gear concern the way CPUE (Catch Per Unit of Effort) relates to resource abundance. Animals can avoid traps or escape from traps or be preyed upon while in it, and mesh size can be selected for or against the capture of certain sizes of individuals, so that CPUE is decoupled from resource abundance. Selectivity caused by the size of the entrance, mesh size, trap volume, type of bait, demersal time, and animal behaviour, are some of the factors shown to affect trap CPUE, but the real constraints on their use as a sampling tool are related to the characteristics of the data collected (Cappo & Brown, 1996). Nevertheless, this kind of trap has allowed the identification, with concurrent data on distribution and various biological features, of some potentially fishing target species in the area (González & Santana, 1996; Santana et al., 1997; González et al., 2001; Quiles et al., 2001).

In this context, deep-sea crabs like *Chaceon affinis* present a major attractive target for Canarian fishermen, due to the high prices that some species can reach at the local fish market. Yet, despite the fact that geryonid crabs (i.e., *Chaceon quinquedens* Smith, 1879) are commercially exploited in several parts of the North Atlantic (Lux et al., 1982; Manning & Holthuis, 1984; Elner et al., 1987; Erdman & Blake, 1988; Melville-Smith, 1988; Robinson, 2008; among many others), curiously this has not resulted in any specifically focused commercial activity on the islands. The development of this fishery appears to be hampered by a lack of biological information, as well as reliable data on distribution and abundance of the species in different areas. Therefore, the aim of this paper is to contribute to the knowledge of the deep-water red crab *C. affinis* off the Canary Islands, i.e., of its abundance by depth strata, and its geographical distribution.

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MATERIAL AND METHODS

In 2003, two exploratory fishing surveys were carried out, one from February to April and another between June and July, off five islands in the Canary Archipelago (fig. 1). Due to the regulations on fishing gears at the Canaries, fishing with traps was not allowed off the islands of El Hierro and Fuerteventura. Fishing was done using traps deployed from 300 to 1200 m deep. In each fishing area, traps were distributed among different depth strata (640 traps in total).

The traps employed were those traditionally used in the artisanal small-scale trap fishery (sensu Hernández-García et al., 1998; 35 mm mesh size). They were deployed in various ways, depending on the power and length of each of the fishing boats (6.25-11.15 m) used off each island (which conditioned the ability to hoist a maximum number of traps per series and their handling on the ship's deck). In this way, the unit of effort considered to calculate abundance (assumed as CPUE) was the time (hours) that each trap was fishing. Generally, traps were deployed in series of 2 or 3 units, separated 100 m from each other. The mean demersal time was 3.9 days (SD = 2.8), however, and due to bad sea conditions, eight traps (1.25%) were recovered twenty-four days after being deployed. The traps were baited with fresh chub mackerel or sardines. The boats used were all wooden artisanal vessels, equipped with a winch, used to hoist the traps, a fish echo sounding, and GPS.

During each fishing operation the GPS position, depth, time of fishing, and abundance (number of individuals and weight) of each species caught were recorded. Also, for each deep-water red crab caught, the carapace length (CL),

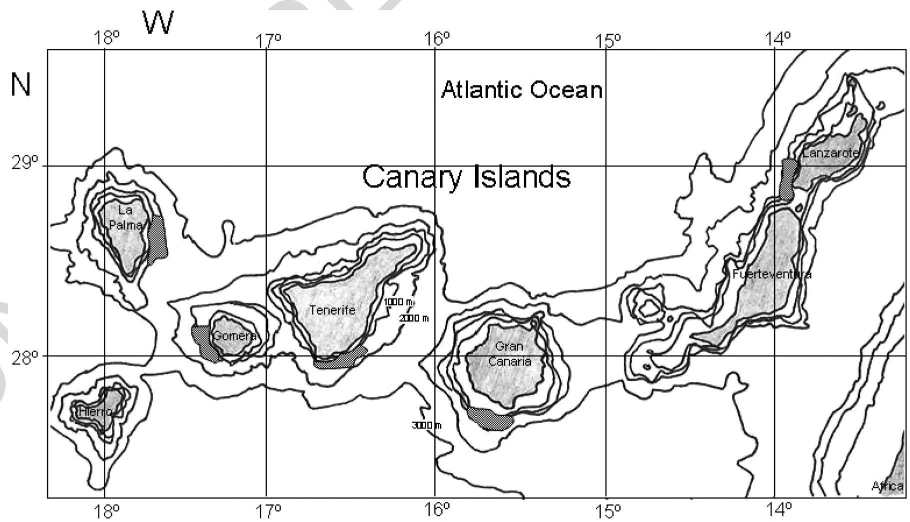

Fig. 1. Areas (dark shaded) off the islands Lanzarote, Gran Canaria, Tenerife, Gomera, and La Palma, where crabs were caught with traps.

carapace width (CW), and wet weight (W) were measured, and sex was recorded. Accompanying species were noted as well.

Catch per unit effort (CPUE) was calculated as total weight of deep-water red crab per hour of fishing (time of effective deployment of each trap).

RESULTS

Length and weight distributions and sex ratio

A total of 263 individuals of *Chaceon affinis* (110 females, 144 males, and 6 undetermined specimens) was captured in 98 traps (15.3% of total traps deployed). From the whole sample, the averages of key variables (CL, CW, and W) were significantly higher in males than in females (table I), but when analysed by island these differences were only significant at Gran Canaria and Tenerife (during the second survey, no females were caught off Lanzarote and no males off La Palma).

TABLE I

Sample size (N), range, mean, SD, and significance of differences between sexes in weight, carapace length, and carapace width of the deep-water red crab, *Chaceon affinis* (A. Milne-Edwards & Bouvier, 1894) measured and weighed during the fishing surveyed carried out around the Canary Islands

Survey			N	Range	Mean	SD	M-W test*
February-April	Weight (g)	Males	85	144.2-1612.2	997.9	366.9	$Z = 4.73$
		Females	28	241.6-1004.4	652.3	214.8	$P < 0.0001$
		Total	117	144.2-1612.2	908.3	372.9	
	CL (cm)	Males	85	6.8-15.5	12.5	2.0	$Z = 2.53$
		Females	27	7.9-15.5	11.8	1.7	$P = 0.01$
		Total	116	6.8-15.5	12.3	2.0	
	CW (cm)	Males	85	9.1-18.0	14.9	2.1	$Z = 3.13$
		Females	27	9.9-16.5	13.9	1.6	$P = 0.002$
		Total	116	9.1-18.0	14.6	2.0	
June-July	Weight (g)	Males	59	58.6-1626.1	970.9	363.7	$Z = 6.03$
		Females	82	72.5-1709.1	652.7	231.5	$P < 0.0001$
		Total	143	58.6-1709.1	791.2	337.2	
	CL (cm)	Males	59	5.2-17.0	12.9	2.0	$Z = 4.71$
		Females	82	6.0-15.0	11.7	1.5	$P < 0.0001$
		Total	143	5.2-17.0	12.2	1.8	
	CW (cm)	Males	59	6.1-18.5	14.7	2.2	$Z = 4.52$
		Females	82	6.8-18.5	13.4	1.7	$P < 0.0001$
		Total	143	6.1-18.5	14.0	2.0	

*Mann-Whitney U test.

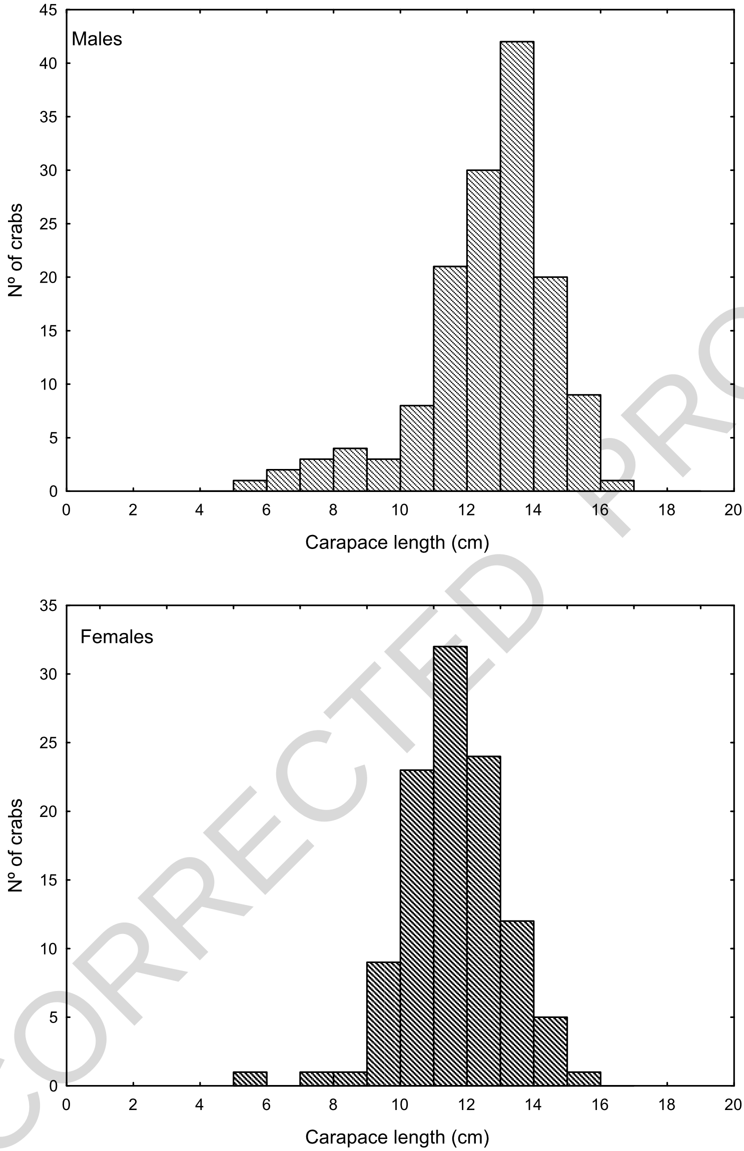

Fig. 2. Length frequency distribution of males and females of *Chaceon affinis* (A. Milne-Edwards & Bouvier, 1894) caught around the Canary Islands.

The length frequency distribution was unimodal for both sexes (mean CL was 14.8 and 13.5 cm, for males and females, respectively) (fig. 2).

Significant differences in the distributions of carapace length and weight were observed between the islands (One-way ANOVA, $F = 5.29$, $P < 0.00001$, fig. 3; and $F = 7.65$, $P < 0.00001$, fig. 4, respectively): crabs caught off Lanzarote being

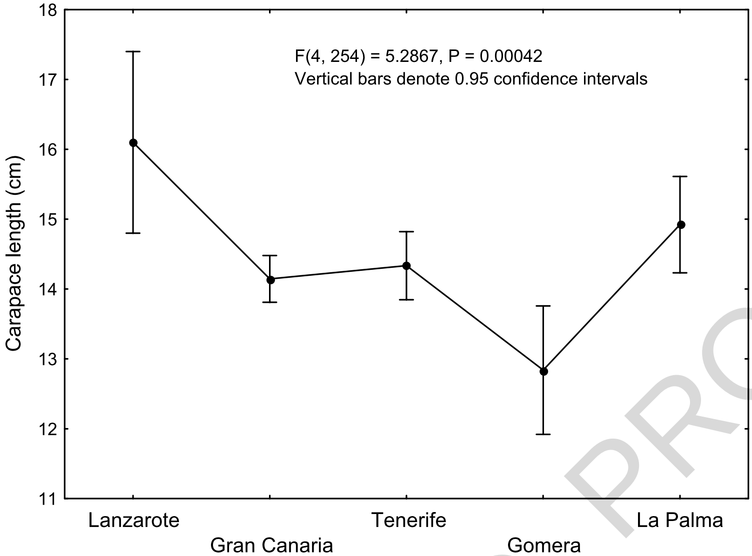

Fig. 3. Length range of the deep-water red crab, *Chaceon affinis* (A. Milne-Edwards & Bouvier, 1894) caught at each island's fishing ground (One-way ANOVA, F (4, 254) $= 5.87$, $P = 0.0004$) (sample size for each ground: Lanzarote = 9; Gran Canaria = 132; Tenerife = 59; Gomera = 20; La Palma = 39).

larger and heavier than the others from the rest of the fishing grounds, and those caught off La Gomera were the smallest and lightest ones. Moreover, there were significant differences in the length and weight distributions of crabs caught in both surveys (One-way ANOVA, $F = 5.35$, $P = 0.02$, for length; and $F = 7.04$; $P = 0.0008$, for weight), those individuals having been fished between February to April being larger and heavier than those obtained between June and July (table I).

The length-weight relationship of *Chaceon affinis* caught off the Canary Islands, as a whole, describes a negative allometric growth pattern (CL plotted against W). However, when individuals were analysed by sex and by island ground, in some cases the b parameter of this relationship was not statistically different from 3, particularly in males (table II).

Moreover, the sex ratio also varied from one island to another. Males were more abundant than females, except off Gran Canaria where this ratio was in favour of females but not significant (table III). A segregation of sexes by depth intervals was not observed (table IV; figs. 5 and 6).

Depth distribution and abundance of the deep-water red crab

Chaceon affinis were captured in a depth range from 300 to 1200 m. However, significant differences in bathymetric distribution were observed between islands

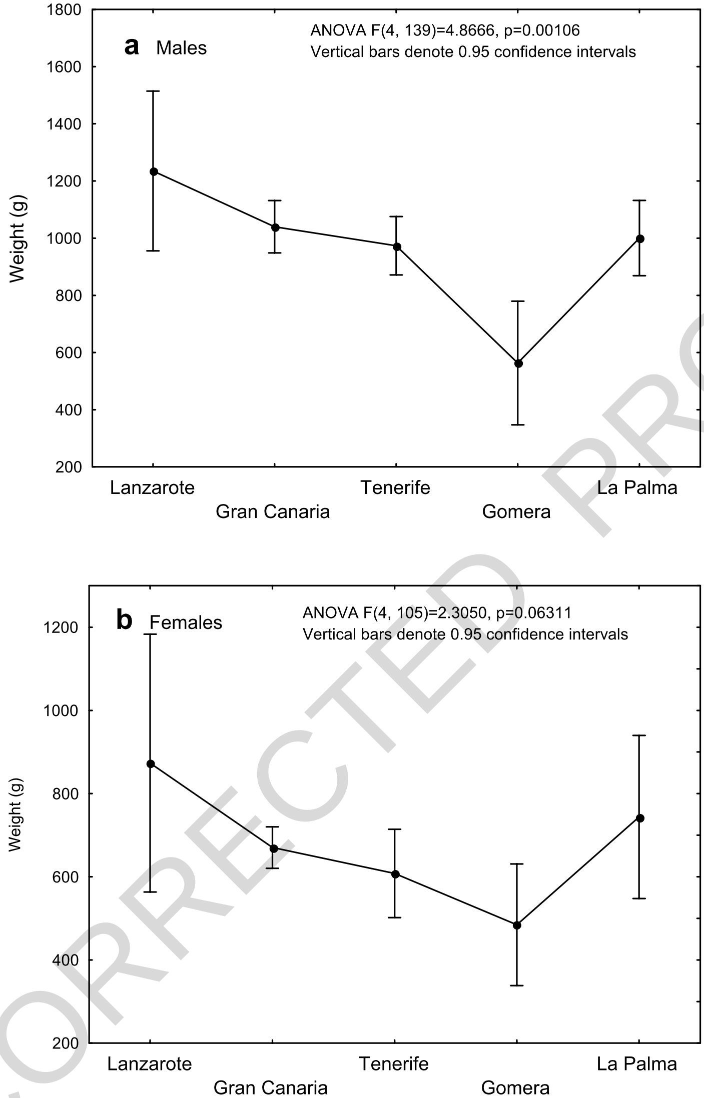

Fig. 4. Weight range of males and females of *Chaceon affinis* (A. Milne-Edwards & Bouvier, 1894) caught at each island's fishing ground (male sample size for each ground: Lanzarote = 6, Gran Canaria = 55, Tenerife = 43, Gomera = 10, and La Palma = 33; female sample size for each ground: Lanzarote = 3, Gran Canaria = 77, Tenerife = 13, Gomera = 10, and La Palma = 5).

(Kruskal-Wallis ANOVA, $H = 39.27$, $P < 0.0001$; fig. 5) and between the two fishing surveys (Mann-Whitney U test, $Z = -2.594$, $P = 0.009$; fig. 6). Moreover, the deep-water red crab presented a greater abundance around the central islands (Gran Canaria and Tenerife) during both surveys (Kruskal-Wallis

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TABLE II

Length-weight relationship (Pearson correlation, log/log plots) parameters for male and female deep-water red crabs *Chaceon affinis* (A. Milne Edwards & Bouvier, 1894) caught at the fishing grounds of the Canary Archipelago

		a	*b*	SE(*b*)	r	n	t	*P*	SE estimate
Total	All	0.087	2.58	0.11	0.83	257	24.53	<0.0001	0.127
	Males	0.196	2.50	0.15	0.82	144	17.21	<0.0001	0.140
	Females	0.311	2.33	0.15	0.83	109	15.47	<0.0001	0.093
Lanzarote	All	–	–	–	–	9	–	–	–
	Males	–	–	–	–	6	–	–	–
	Females	–	–	–	–	3	–	–	–
Gran Canaria	All	−0.283	2.93*	0,14	0.88	136	21.07	<0.0001	0.109
	Males	−0.295	2.97*	0.23	0.87	56	12.73	<0.0001	0.139
	Females	0.067	2.57	0.18	0.85	77	14.04	<0.0001	0.073
Tenerife	All	0.385	2.28	0.20	0.82	64	11.24	<0.0001	0.103
	Males	0.512	2.19	0.21	0.84	45	10.34	<0.0001	0.088
	Females	1.234	1.43	0.43	0.65	17	3.28	0.005	0.103
La Gomera	All	−0.076	2.64*	0.21	0.95	18	12.36	<0.0001	0.099
	Males	−0.084	2.66*	0.35	0.94	10	7.55	<0.0001	0.112
	Females	−0.069	2.61*	0.28	0.97	8	9.35	<0.0001	0.095
La Palma	All	0.122	2.59*	0.33	0.82	32	7.82	<0.0001	0.130
	Males	0.040	2.68*	0.32	0.86	27	8.30	<0.0001	0.124
	Females	–	–	–	–	5	–	–	–

*Not different from 3.

Legends: a, . . . ; *b*, . . . ; SE(*b*), . . . ; r, . . . ; n, . . . ; t, . . . ; *P*, . . . ; SE, standard error.

ANOVA, $H = 16.84$; N = 300; $P < 0.002$ during February-April; and $H = 65.62$, N = 339, $P < 0.001$, during June-July; fig. 7; tables V and VI).

Males and females showed a significant change in depth distribution according the two surveys (Mann-Whitney *U* test, $Z = 2.38$, $P = 0.017$, N1 = 28,

TABLE III

Sex-ratio of the deep-water red crab, *Chaceon affinis* (A. Milne-Edwards & Bouvier, 1894) caught at the insular fishing grounds of the Canary Archipelago (χ^2 analysis; $*P < 0.05$)

Island	N° males	N° females	Sex-ratio	χ^2
Total	144	110	1 : 0.76	4.55*
Lanzarote	6	3	1 : 0.50	1
Gran Canaria	56	77	1 : 1.37	3.32
Tenerife	45	17	1 : 0.37	12.65*
La Gomera	10	8	1 : 0.80	0.22
La Palma	27	5	1 : 0.19	15.13*

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TABLE IV

Sex-ratio of *Chaceon affinis* (A. Milne-Edwards & Bouvier, 1894) by depth intervals around the Canary Islands (χ^2 analysis; $^*P < 0.05$)

Depth range (m)	N° males	N° females	N° unsexed	Sex-ratio	χ^2
250-349	4	1	–	1 : 0.25	1.80
350-449	2	4	–	1 : 2.0	0.67
450-549	11	15	–	1 : 1.36	0.62
550-649	32	19	1	1 : 0.59	3.31
650-749	24	25	2	1 : 1.04	0.02
750-849	26	6	2	1 : 0.23	12.5*
850-949	20	28	1	1 : 1.40	1.33
950-1049	14	8	–	1 : 0.57	1.64
1050-1149	9	4	–	1 : 0.44	1.92
Deeper than 1150	2	0	–	1 : 0	2.00

N2 = 82), being caught at a deeper range during the February-April cruise (table VII; fig. 6). Ovigerous females (n = 11) were observed in March, April, and July, in the complete range of depth described above for the species (table V). These females ranged between 241.6 and 970.0 g in weight (Mean = 593.9, SD = 229.6), and between 9.5 and 13.5 cm in carapace length (Mean = 11.4, SD = 1.2).

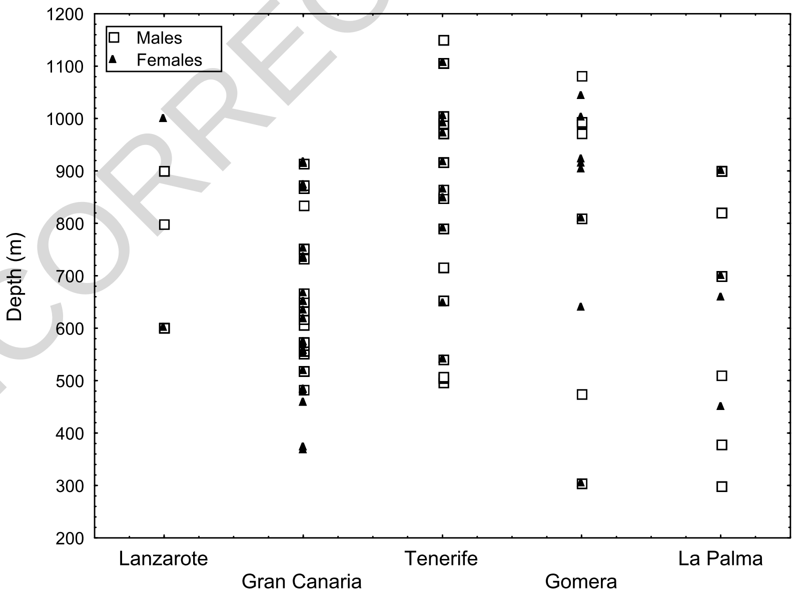

Fig. 5. Depth distribution of individuals of *Chaceon affinis* (A. Milne-Edwards & Bouvier, 1894) by island fishing ground (each dot may represent more than one individual at the same depth interval).

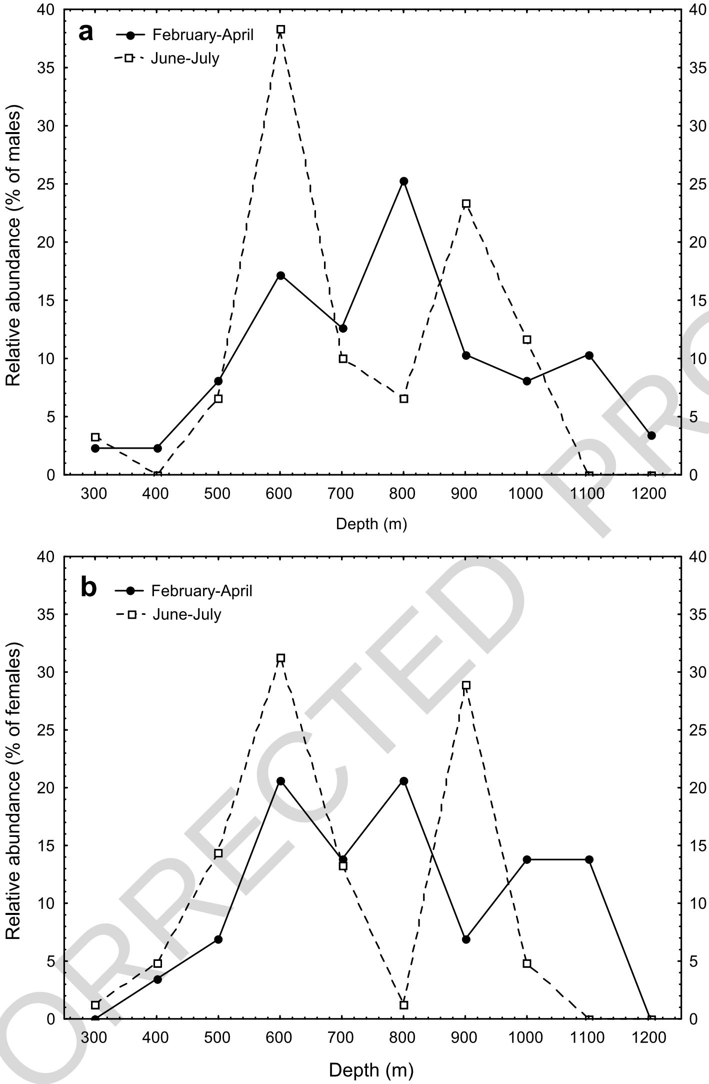

Fig. 6. Relative abundance (% of individuals caught) of *Chaceon affinis* (A. Milne-Edwards & Bouvier, 1894) by depth intervals: a, males; b, females.

Co-occurring species of crabs

Frequently, together with the deep-water red crab also other Brachyura were caught (46.9% of catches), in particular *Bathynectes maravigna* (Prestandrea, 1839) (24.5%), *Cancer bellianus* (20.4%), and *Paramola cuvieri* (13.3%) (table VIII).

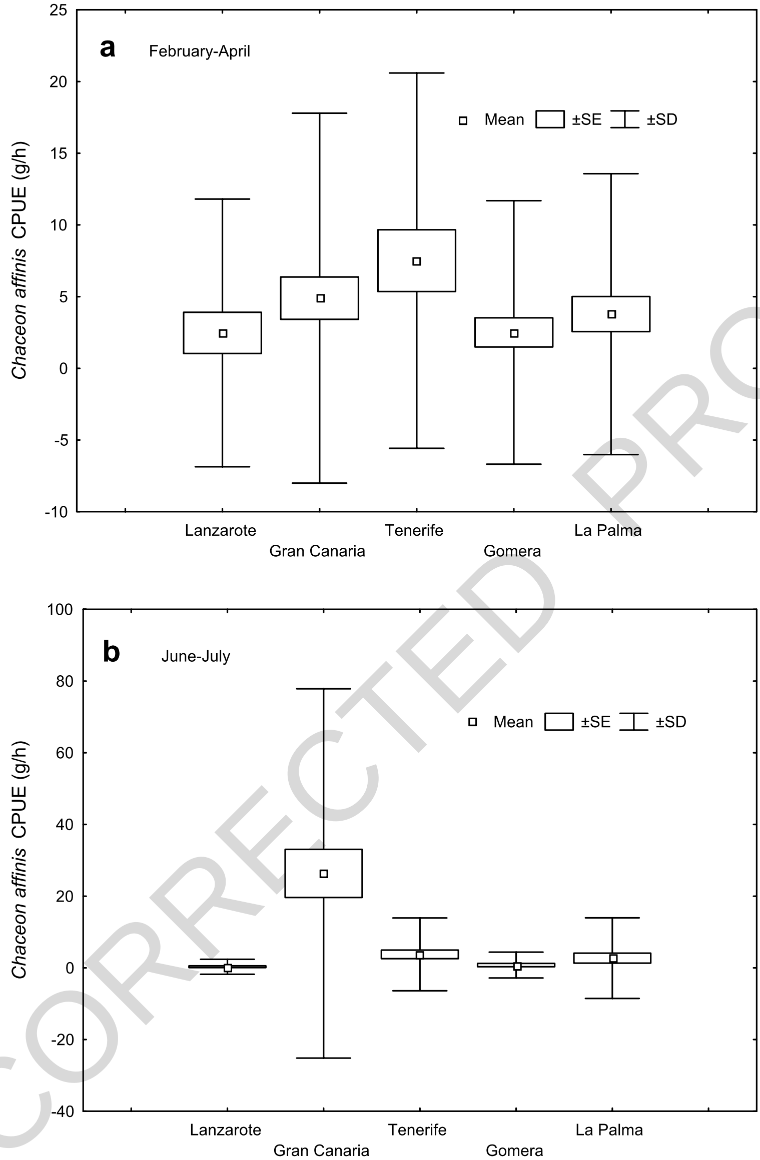

Fig. 7. CPUE of *Chaceon affinis* (A. Milne-Edwards & Bouvier, 1894) by island: a, February-April 2003; b, June-July 2003.

DISCUSSION

The deep-water red crab, *Chaceon affinis*, is the largest epibenthic brachyuran of the family Geryonidae (cf. Manning & Holthuis, 1989). Its geographical distribution is restricted to seamounts in the eastern Atlantic, from Iceland to Senegal, being also present in waters of the Azores, Madeira, and the Canary

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TABLE V

CPUE distribution of *Chaceon affinis* (A. Milne-Edwards & Bouvier, 1894) by depth strata, survey, and island (*presence of ovigerous females)

Island	Survey		300	400	500	600	700	800	900	1000	1100	1200
Total	Febr-April	N	73	34	36*	17	39	37*	24	32*	4*	3
		X	[illegible]	2.4	0.5	11.1	8.6	10.3	3.3	1.91	9.3	4.6
		SD	[illegible]	11.5	1.6	21.6	14.5	15.5	6.8	3.8	12.6	7.9
	June-July	N	77	36*	54	37	34*	21	41	39		
		X	[illegible].3	2.6	3.9	13.6	12.3	11.1	6.5	8.6		
		SD	2.9	7.8	10.9	24.1	58.1	26.1	19.5	24.5		
Lanzarote	Febr-April	N	11	3	7	3	6		5	6		
		X	[illegible]	0	0	24.5	0		3.1	2.5		
		SD	0	0	0	28.0	0		6.9	6.0		
	June-July	N	13	8	9	4	12	10	12	11		
		X	0	0	0	0	0	0.8	1.4	0		
		SD	0	0	0	0	0	2.4	5.0	0		
Gran Canaria	Febr-April	N	14	4	9*	8	16	12*	5	8		
		X	[illegible]	0	0	14.4	10.5	7.4	0	0		
		SD	0	0	0	25.4	15.5	13.7	0	0		
	June-July	N	8	9*	8	12	4*	2	9	7		
		X	[illegible]	7.0	19.5	36.3	94.7	66.9	16.9	35.5		
		SD	0	11.7	21.6	31.6	163.4	33.4	32.5	50.9		
Tenerife	Febr-April	N	9	3	4	3	6	5*		3*	1*	4
		X	[illegible]	0	2.7	0	9.8	29.1		7.2	26.7	4.5
		SD	0	0	3.2	0	9	22.6		4.5		7.9
	June-July	N	18		13	8	9	3	12	16		
		X	[illegible]		3.4	2.1	2.7	4.7	8.2	7.9		
		SD	0		6.7	4.1	8.0	4.8	21.1	8.4		
Gomera	Febr-April	N	24	12	8			13*	6*	15	3	
		X	[illegible]	5.6	0			6.4	3.0	1.6	3.5	
		SD	0	19.3	0			12.1	6.0	2.9	6.1	
	June-July	N	19	3	14	5		2	8	11		
		X	[illegible].4	0	0.7	1.3		0	0.1	0.6		
		SD	[illegible].9	0	2.7	2.9		0	0.2	1.7		
La Palma	Febr-April	N	15	12	8	3	11	7	8			
		X	[illegible]	1.3	0.9	0	10.0	9.2	5.7			
		SD	0	1.9	1.9	0	18.5	11.9	9.3			
	June-July	N	19	16	10	8	9	4				
		X	[illegible]	1.8	0	7.2	1.8	19.3				
		SD	0	7.2	0	13.4	5.3	38.6				

Depths in metres; N, number of crabs; X, [illegible] SD, standard deviation.

TABLE VI
Mean, SD, and ranges of CPUE (g/h) of *Chaceon affinis* (A. Milne-Edwards & Bouvier, 1894) by island and survey

Fishing ground	N	Mean CPUE	Range	SD	Survey
Total	639	5.1	0-337.7	19.3	All
	300	4.0	0-71.5	10.9	Febr-April
	339	6.1	0-337.7	24.3	June-July
Lanzarote	121	1.1	0-55.0	5.8	All
	42	2.5	0-55.0	9.3	Febr-April
	79	0.3	0-17.2	2.1	June-July
Gran Canaria	135	14.3	0-337.7	36.8	All
	74	4.9	0-71.5	12.9	Febr-April
	59	26.3	0-337.7	51.5	June-July
Tenerife	110	5.0	0-74.3	11.3	All
	37	7.5	0-51.3	13.1	Febr-April
	73	3.8	0-74.3	10.2	June-July
Gomera	143	1.6	0-66.9	7.3	All
	81	2.5	0-66.9	9.2	Febr-April
	62	0.8	0-25.6	3.6	June-July
La Palma	130	3.2	0-77.2	10.5	All
	64	3.8	0-51.5	9.8	Febr-April
	66	2.7	0-77.2	11.2	June-July

N, number of crabs caught.

TABLE VII
Depth distribution of the deep-water red crab, *Chaceon affinis* (A. Milne-Edwards & Bouvier, 1894) by sex and fishing survey

	Survey	N	Mean depht (m)	SD	Depth range (m)
Males	Feb-Apr	85	775.8	202.9	300-1152
	June-July	59	712.5	182.3	304-1004
Females	Feb-Apr	28	811.5	203.7	450-1108
	June-July	82	695.4	181.6	304-1004

N, number of crabs caught.

TABLE VIII
Other species of crabs caught together with *Chaceon affinis* (A. Milne-Edwards & Bouvier, 1894): 1, *Chaceon affinis* (A. Milne-Edwards & Bouvier, 1894); 2, *Cancer bellianus* Johnson, 1861; 3, *Paramola cuvieri* (Risso, 1816); 4, *Bathynectes maravigna* (Prestandrea, 1839)

	Total	1	1 + 2	1 + 3	1 + 4	1 + 2 + 3	1 + 2 + 4	1 + 3 + 4
Number of traps	693	98	12	3	20	7	1	3

and Cape Verde archipelagos, in a depth range varying between 140 and 2047 m, on muddy-rocky bottoms (A. Milne-Edwards & Bouvier, 1894; Kjenerud, 1967; Manning & Holthuis, 1981; Sánchez & Olaso, 1985; Fernández-Vergaz et al., 2000; Pinho et al., 2001). Also, the deep-water red crab has been caught near the Mendez Gwen hydrothermal vent, within the Azorean Exclusive Economic Zone (Biscoito & Saldanha, 2000), with a moderate fishery yield (Gonçalves & Pinho, 1994; Gonçalves & Santo, 1994).

Off the Canary Islands, previous studies had established the bathymetric range of the deep-water red crab as 533 to 1350 m (Balguerías et al., 1996; González et al., 1996; Fernández-Vergaz et al., 2000; López-Abellan et al., 2002), but with this study, that range has been increased to 300 m. Its maximal abundance was found between 600 and 800 m, similar to that reported by Balguerías et al. (1996), González et al. (1998), and Pinho et al. (2001) for the Canary and Azores archipelagos. Nevertheless, the abundance of *Chaceon affinis* varied considerably from one island to another, with the highest yield off the island of Gran Canaria probably due to the most extensive presence of sandy-muddy and sandy-rocky bottoms. The influence of the bottom condition on the distribution pattern of crabs of the family Geryonidae has been described by Hastie (1995).

On the other hand, the observed differences in abundance between fishing surveys, higher in February-April than in June-July, could be attributable to the biological cycle of the species, with seasonal displacements in its bathymetric distribution (Hastie, 1995), due to reproductive migrations toward shallower waters and/or the incorporation of recruits from deep to shallow waters (López-Abellán et al., 2002). These crabs were generally caught in deeper waters during the June-July survey in comparison with the February-April trip. As pointed out by López-Abellán et al. (2002), these seasonal displacements in depth could be related with strategies to diminish the competition with other crabs, as *Cancer bellianus* and, to a much lesser extent, *Paramola cuvieri*, particularly in the shallower limit of the deep-water red crab's bathymetric distribution. Therefore, and despite the fact that the crabs were always captured in the complete range of depth sampled, these seasonal migrations may explain the discrepancies between published reports about the depth range of maximal abundance of the species. Anyway, in this conclusion we should have into mind the limitations of the estimation of crab abundance, attributable to trap efficiency. The variability of catchability, made evident in SD values higher than their respective means (tables V and VI), indicates a non-homogeneous distribution of the resource and possible avoiding/escape effects. However, in relation with this last, we never observed remains of mandibles, appendices, or other body parts in any trap, that could have indicated and intense predation on crabs caught in the trap, by fishes, and most individuals were caught alive.

The length and weight ranges of *Chaceon affinis* found during this study agree with those given by López-Abellán et al. (2002) for the Canaries. However, these are higher than those observed by Pinho et al. (2001) in the Azores. The unimodal size frequency in both males and females appears to be the general pattern of the Geryonidae, and according to López-Abellán et al. (2002) in females this length distribution may be due to a short period of moulting in immature specimens and longer such periods after maturing.

The population of *Chaceon affinis* in the Canary Islands shows a negative allometric growth pattern, although in some cases, and particularly in males, it could be considered isometric as previously observed by Fernández-Vergaz et al. (2000), but was in contradiction with the positive allometric growth reported by Pinho et al. (2001) in the Azores. Nevertheless, the observed differences in the growth pattern of this species between sexes, grounds, and with data reported by other authors, probably result from environmental local differences, and may also indicate that samples sizes are really too small to gain an adequate knowledge of these aspects. Moreover, although the segregation of sexes with depth seems to be a characteristic of Geryonidae and Pinho et al. (1998) found that males were more abundant than females at depths greater than 800 m off the Canary Islands and Azores, we have not observed that phenomenon. Bathymetric distribution appears to be dynamic as suggested by Hastie (1995), and could change during an annual cycle as a result of migrations to shallow water due to reproduction, movements that explain the differences found between the two fishing surveys carried out by us. However, ovigerous females were observed during both surveys and distributed along almost the whole range of depths reported for this species. So, spawning could probably take places at different depths, depending on other characteristics of the habitat (temperature, oxygen concentration, etc.). Nevertheless, we should keep in mind that at the Canary Islands the real (horizontal) distances between the shallower and deeper areas of their habitat range are not long, due to the steep slopes of these oceanic islands.

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