

Occurrence of Blue Crab, *Callinectes sapidus* (RATHBUN, 1896) (Crustacea, Brachyura) on the Turkish Mediterranean and the Adjacent Aegean Coast and its size Distribution in the Bay of İskenderun

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Abstract: Distribution and occurrence of the blue crab *Callinectes sapidus* on the Mediterranean and Aegean coast of Turkey and Greece are described for the years 1985-1995.

Key Words: Mediterranean, Turkish, *Callinectes*, distribution, occurrence

Mavi Yencegin, *Callinectes sapidus* (RATHBUN, 1896) (Crustacea, Brachyura) Türkiye'nin Akdeniz ve Komşu Ege Kıyılarındaki Varlığı ve İskenderun Körfezi'ndeki Boy Dağılımı

Özet: Türkiye'nin Akdeniz ile Yunanistan ve Türkiye'nin Ege kıyılarındaki mavi yengeç *Callinectes sapidus*'un 1985-1995 yıllarındaki varlığı ve dağılımı tanımlanmıştır.

Anahtar Sözcükler: Akdeniz, Türkiye, *Callinectes*, dağılım, mevcudiyet

Introduction

Callinectes sapidus originally occurs along the eastern coast of America between Nova Scotia and Uruguay. Its main distribution is on the north American coast, where it forms an important fishery resource.

The occurrence of *C. sapidus* is also reported on the European coast. However, this species has not established itself for extended periods. The occurrence of the first living individual was reported by Bouvier (1) in the harbor of Rochefort (south-west France). The next reports were made from the coasts of the Netherlands: in 1932 in the River Zaan, near the water reservoir; in 1934 in the harbor of Amsterdam (2, 3, 4). In Denmark one living individual was found in the Sund, north of Copenhagen (3). In addition, in the general fishery economy bulletin the occurrence of *C. sapidus* was reported in 1965 for the region of the Elbe estuary.

The occurrence of this crustacean in the Mediterranean Sea was first reported by Giordani Soika (5). However, the species was misidentified and described

as *Portunus pelagicus*. The preserved specimens were checked later by Holthuis (6) and it was concluded that these were undoubtedly *C. sapidus* based on their form and color.

Artüz (7) reported that this species was introduced artificially (transplanted) between 1935 and 1945 to the northern Aegean Sea, particularly in the bays of Saros and Thessaloniki. *C. sapidus* initially did well there but was later displaced to the southern Aegean and gradually came to occupy the Turkish coasts in the north eastern Mediterranean.

On the north coast of Israel at various places this species was well established (6, 8). Findings were also made in Egypt and Lebanon in the mid sixties (9).

During a sampling excursion of the University of Leiden/Netherlands to Turkey and the Balkan region (carried out in March-July 1959), four male and two female *C. sapidus* were sampled in the Akyatan lagoon (46 km south of Adana/Turkey). In addition, in the Aegean Sea near the harbor Lagos, 2 female individuals were caught. One of them was an adult having a

carapace length of 144 mm, and the other was a juvenile with a carapace length of 96 mm.

Occasionally, living individuals were caught also on the southern coast of Cyprus between Cape Andreas and Cape Greco (10).

Holthuis (11) wrote on page 51, "One of the most surprising discoveries of the present expedition is that of the occurrence of *Callinectes sapidus* both in Turkey and Greece. In the two places the species proved to be perfectly acclimatized and both formed the subject of a fishery, be it on a small scale. When this American species has been introduced there will probably remain an unsolved problem." The problem studied here is the extent of the distribution and occurrence of this species in the northern Mediterranean water system.

Material and Method

Between 1985 and 1995 seven excursions were carried out along the Turkish Mediterranean coast. During these excursions, 15 locations were systematically visited (Figure 1) and several days were spent at each site. Material collection was achieved with the help of local fishermen and examination of the material was made on the site. The results of these qualitative sampling trips are summarized below.

In April, 1989, following a storm a large number of dead *Callinectes* were washed out to the beach of Deveciüağı (Yumurtalık Figure 1). Some 30% of the individuals were heavily damaged and so not suitable for examination. Individuals in good condition were measured (Figure 2 and Table 1) and sexed. The ma-

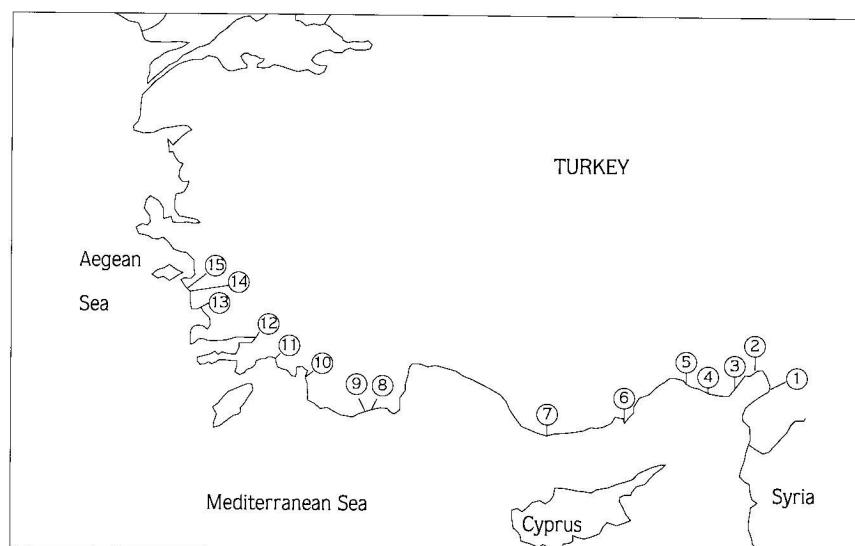


Figure 1. Overview of the study area and systematic sampling locations on the Turkish Mediterranean and Aegean coast.

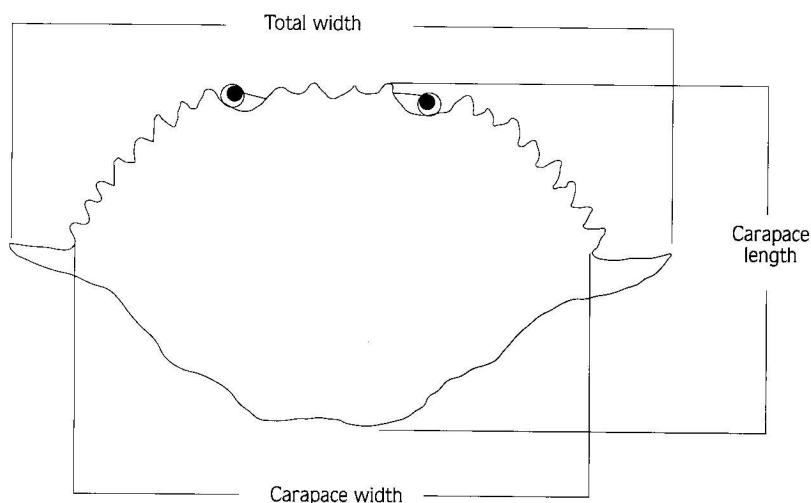


Figure 2. Measurements of *C. sapidus*.

Table 1. Measurements of *C. sapidus*.

Male			(Juvenile) Female			(Adult) Female		
Total width	Carapace width	Carapace length	Total width	Carapace width	Carapace length	Total width	Carapace width	Carapace length
27	22	13	30	24	14			
27	24	14	33.5	27.5	16			
31	27	16	33.5	27.5	17			
32	28	16	35	31	18			
34	28	17	35	30	18			
34.5	27.5	17	45	39	22			
38	32	19	46	38	23			
38.5	33.5	20	48	40	24			
39.5	33.5	20	61	52	31			
59	49	29	66	60	33			
59.5	50.5	30	68	57	33			
62	53	31	68	58	34			
63	55	33	69	59	34			
66.5	58.5	36.5	69.5	61.5	36			
67	58	34	70.5	58	34			
69.5	59.5	34.5	74	61	35			
69.5	61.5	37.5	77	64	37.5			
71	63	37.5	77	66	38			
73	62	39.5	77	67	40			
73	65	39	78	65	38			
76	64	36	78.5	66.5	37			
76	67	37	78.5	66.5	38			
76	68	38	79	68	39			
76.5	67.5	41	79	69	40			
77	67	39	80	70	41			
77	69	41	81.5	66.5	40.5			
79	69	39.5	82	70	40			
80	68	40	82.5	69.5	40			
82	71	41	87	74	43			
84	74	41	92	79	45			
84	74	42	93	79	44			
85	73	42	93	80	47			
86.5	73.5	44	96	83	48			
88	78	45	96.5	83.5	48			
89	77	44	98	85	48			
90	77	44	99	81	45			
91	77	44	103	89	50			
93	79	45	103.5	86.5	46.5			
93.5	78.5	44	104	86	47			
94	82	45	108	88	51	108	85	48
95	78	43				110	86	48
95	82	48				111	85	48
96.5	83.5	47				111	88	48.5
99	87	49.5				111	88	50.5
101	91	52				112	89	48
101	87	46				114	89	51
103	91	52				115	89	49.5
104	90.5	48.5				115	91	51.5
108	94	52				115	92	52
111	91	50				120	94	53.5
122	109	54				122	96	52.5
						124.5	94.5	54.5
						125	99	56.5
						126	100	55
						129	103	55.5
						132	106	58
						134	105	61
						135	106	60
						151	119	64

terial measured consisted of 51 males (45%), 21 females (19%) and 41 juvenile females (36%).

In spring 1995 the "black spot disease" was observed at some locations in *C. sapidus*. Ten individuals randomly taken out of the net were examined at each location listed in Table 3.

Results and Discussion

The results are documented according to the sea regions and the chronology of the collection at the sites visited.

Occurrence on the Greek coast The Aegean Sea

Riedl (11) indicated a decline in *C. sapidus* stocks on the Greek coast as early as 1983. The systematic sampling scheme applied and the cross check with the local fishermen revealed that the *C. sapidus* on the Thracian coast between Asprovalta and Alexandropolis had totally disappeared. Questioning of the local fishermen and the people working in the lagoons indicated the following:

- In the region of Alexandropolis the species disappeared totally in 1978. With the start of the 70's, catches dropped drastically and only a few individuals were caught in this period.

- In the lagoon region of Msei there existed for two years a very good fishery on *C. sapidus*; however, it collapsed suddenly in 1981. Unfortunately, no information was available with regard to overfishing, epidemic illnesses or ecological changes or combinations thereof.

Cross checks of the information collected from local fishermen in the lagoon regions of Fanarion and Lagos, including the shallows at Lagos (Figure 3), indicated clearly that this species disappeared totally in 1982.

Occurrence on the Turkish coast-The Mediterranean and the Aegean Sea

The most favored habitats described earlier by several authors for this species are located along the Turkish coasts. In numerous lagoons and in the estuaries of large rivers, *C. sapidus* finds optimal conditions (brackish water, mud-and clay-covered bottom and suitable territory). Therefore, this species is able to form large and durable populations.

Locations of the occurrence of *C. sapidus* found during the surveys are indicated with Arabic numbers in Figure 1. detail charts are also provided (Figures 4-7).

01 - Iskenderun (Figure 1): As compared to 1985, the number of individuals caught per night has decreased. Only a few individuals are found in the nets of fishermen working with stationary shallow water (5 m depth) gill and entangling nets.

02 - Burnaz (Figure 1): Iskenderun bay: The small Burnaz river crosses a lagoon region. At the delta region *C. sapidus* is frequently caught.

03 - Deveciüsağı (Yumurtalık) (Figures 1 and 4): Throughout the bay a massive population is present. Higher concentrations were found at the southern tip.

04 - Akyatan lagoon (Figures 1 and 4): A massive population of *C. sapidus* occurs in the lagoon with a maximum depth of 1.2 meters. Due to intensive agricultural activity, the lagoon has become increasingly eutrophied especially since 1990. The fishing activity is often halted because of huge algal development. Between 1985 and 1991, no significant decrease in the population of *C. sapidus* was observed.

During the excursion carried out in spring, 1995, it was observed that in this region there exists a large effort to collect young specimens of *Sparus auratus* for cultivation in ponds. Since the nets used are a non-selective type, they destroy all other faunal components, including young fish of other species.

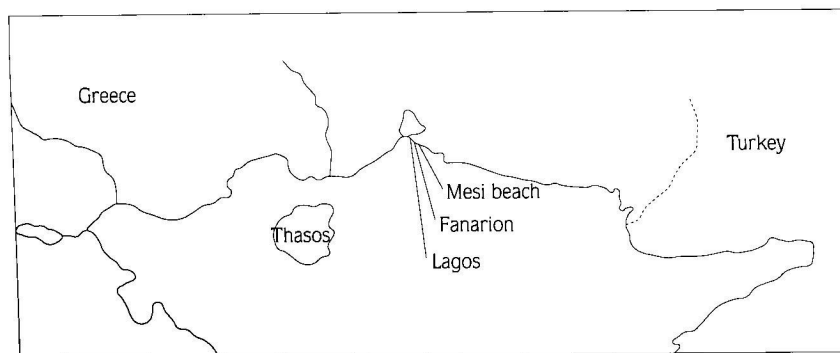


Figure 3. Locations of disappeared *C. sapidus* populations in Greek waters-Aegean Sea.

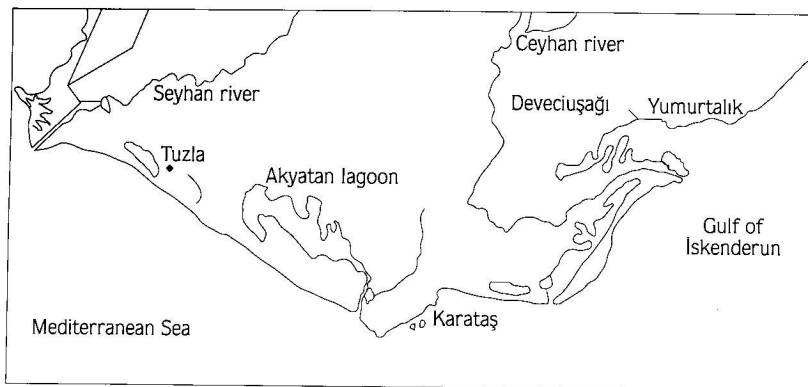


Figure 4. Area of study around Karataş.

At the lagoon region of Akyatan (Figure 4) a huge amount of plastic material was observed. East of the lagoon mouth, many juvenile *Callinectes* were found earlier. However, this area is now totally occupied by plastic debris of different origins and hence there are no longer any juvenile *Callinectes* at this location.

05 - Tuzla (Figures 1 and 4): Only sporadically some individuals were found in the nets of fishermen working in depths of 2-5 meters. The main location of the occurrence of *C. sapidus* is the estuary region of the River Seyhan and the lagoon areas.

In the second half of April, many adult specimens were landed by the local fishermen of Karataş working with stationary nets. The male to female ratio of landed specimens is 1:2.

06 - Silifke region (Figures 1 and 5): The main location of the occurrence of this species is the lagoon region, which is not easily accessible. At the eastern part (Atakent - Kapızlı, Figure 5) large individuals are sometimes found in the drainage channels. In the western part, the population is remarkably reduced. The main reason for this reduction might be the decreased fresh water input to the lagoon. Possibly, the

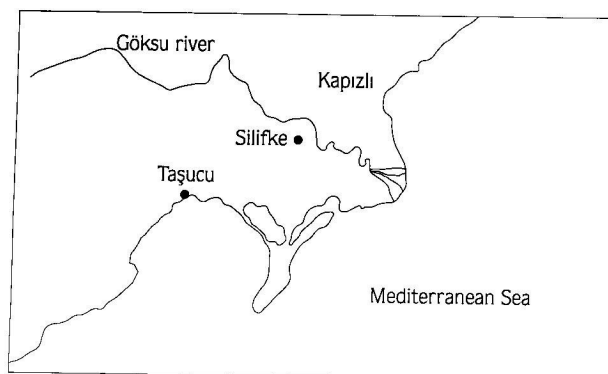


Figure 5. Region of Silifke

discharge water of the paper mill also affects the fauna of the region. More and more albino and thin-shelled mollusks have also been observed in the last years.

At locations around Limankalesi, some individuals were also caught in the stationary nets. It is assumed that these are from the lagoon region.

07 - Anamur (Figure 1): A large population is present in the estuary of the Memure river. Occasionally dead animals were found at the beach, west of Anamur castle.

08 - Finike (Figure 1): A population occurs at the influence region of the freshwater input in the eastern part of the harbor. Occasionally, specimens were caught in the nets of the local fishermen in the eastern fishing grounds.

09 - Bemelek lagoon (east of Kale/Demre) (Figure 1): This is a large lagoon region with an intensive fishing industry. A large, well developed *C. sapidus* population exists in the region.

10 - Fethiye Bay (Figure 1): Sometimes only single specimens were caught in fishing nets. Some dead individuals were found on the beach.

11 - Dalyan (Lagoon region, Figures 1 and 6): In the lagoon region between Köyceğiz lake and the Sea there exists an extensive population of *C. sapidus*. This species is often caught by the fishermen working in the lagoon region; however, this species was not used economically until 1991. It occupies a secondary importance level for the income of local fishermen.

12 - Hisarönü Bay (Figures 1 and 6): Some body parts of the species were found on the beach. A new population has developed since 1989 in the large fish culture installations near Subucak. This area was a small swamp with fresh water input, which later dried and stabilized. However, until 1990 there was no economic activity.

Occurrence of blue crab, *Callinectes sapidus* (RATHBUN, 1896) (Crustacea, Brachyura) on the Turkish Mediterranean and the adjacent Aegean coast and its size distribution in the Bay of Iskenderun

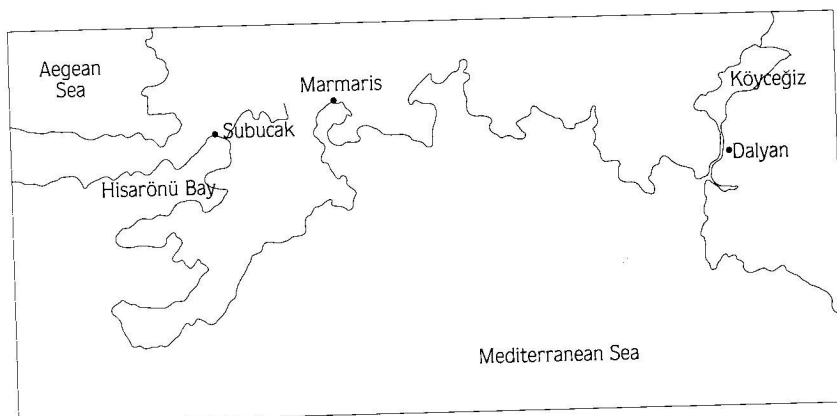


Figure 6. Lagoon area of Dalyan.

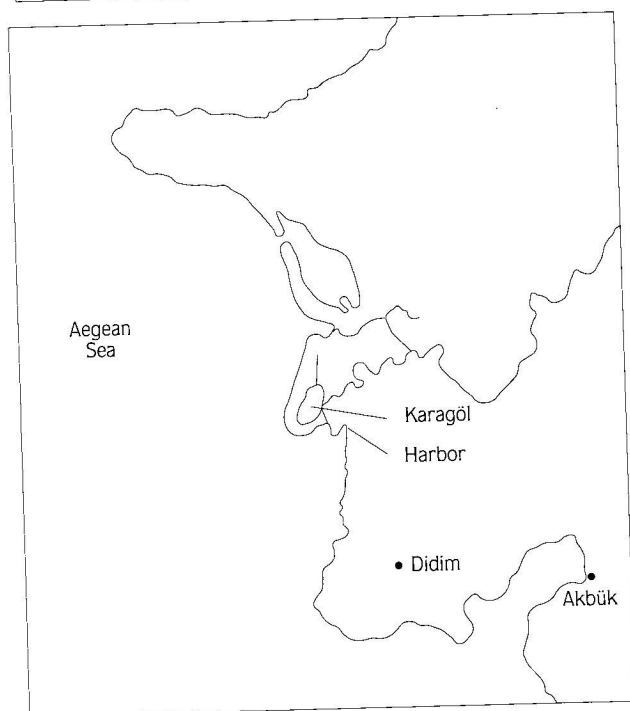


Figure 7. Estuary region of Menderes river.

13 - Akbük (Figures 1 and 7): In the shallow bay of Akbük single specimens were found under stones near the shoreline.

14 - Lagoon region until Akköy harbor (Figures 1 and 7): Because of strong erosion from the periphery, the area is growing more and more shallow and hence the population is displaced towards the deeper water. Since 1989 the water depth in some areas has been only a few centimeters.

15 - Menderes estuary (Figures 1 and 7): According to information obtained from the local fishermen and the fishermen's cooperative, a well developed *C. sapidus* population exists especially in the Karagöl area.

Size distribution

A size frequency distribution of the carapace width (Figure 2) of all measured individuals is presented in Figure 8. The histogram clearly indicates that the sample individuals consisted of at least two size groups of juveniles and adults the minimum being 108 mm and the maximum being 151 mm).

Location	1985	1987	1988	1989	1990	1991	1994	1995
01-Iskenderun	xx	x	x	x	0	x	0	0
02-Burnaz	0	0	0	0	xx	xx	xx	xx
03-Deveciüşi	0	0	0	xxx	xxx	xxx	xxx	xxx
04-Akyatan lagoon	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
05-Tuzla	0	x	x	xx	xx	0	xx	xx
06-Silifke region	0	xx	xx	x	xx	0	xx	xx
07-Anamur	x	x	x	x	x	0	x	x
08-Finike	0	x	x	x	0	0	0	0
09-Bemelek lagoon	0	xxx	xxx	0	xxx	0	0	0
10-Fethiye Bay	x	x	x	x	0	0	x	0
11-Dalyandere	0	0	xx	xx	0	0	xx	0
12-Hisarönü Bay	0	0	0	x	xx	0	xx	0
13-Akbük	0	x	x	x	0	0	0	0
14-Lagoon area of Akköy	x	x	x	*	*	0	*	0
15-Menderes estuary	(xx)	(xx)	(xx)	(xx)	(xx)	0	(xx)	(0)

x = little

xx = a lot

xxx = mass occurrence

0 = not visited

* = population does not exist any more

() = information obtained from fishermen

Table 2. Estimate of the *C. sapidus* abundance in the study area.

a of Dalyan.

A comparison of the measurements revealed that all (Figure 9) are linearly correlated among males, females and juveniles (Figure 10). No significant difference existed among the slopes of total carapace length- anterolateral length for either males or females ($F_{0.05} = 3.92 \ll 43$).

Table 3. Frequency of occurrence of the black spot disease in the eastern Mediterranean coast of Turkey. Ten individuals, each randomly taken from the net at each location, were examined (naked eye observations).

Location	%	0-7	8-15	>15
1) Burnaz	2	1	1	-
2) Deveciüşi	3	2	1	-
3) Akyatan lagoon mouth	6	1	2	3
4) Tuzla region	3	1	2	-
5) Silifke region	7	-	2	5

and 7): According to local fishermen, the developed *C. sapidus* area.

carapace width is presented in that the same size groups of 108 mm and

the *C. sapidus* study area.

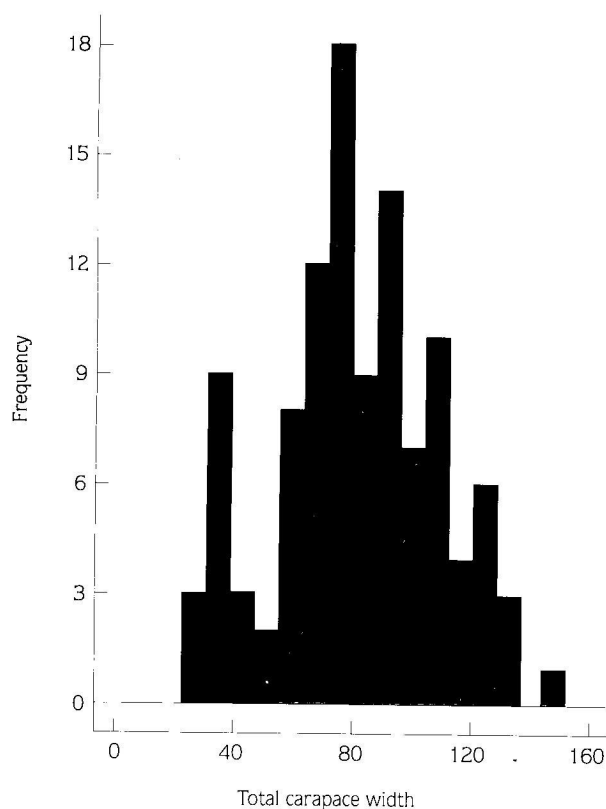


Figure 8. Size frequency distribution of all individuals measured.

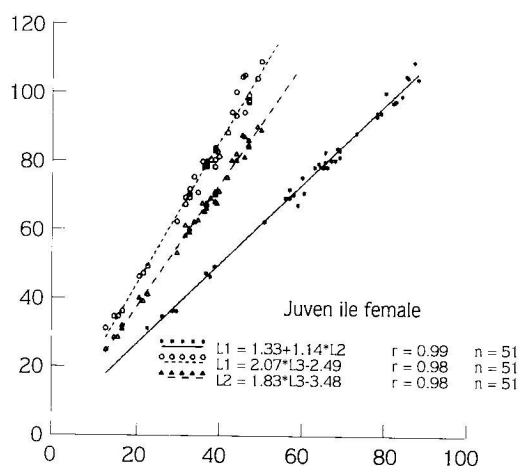
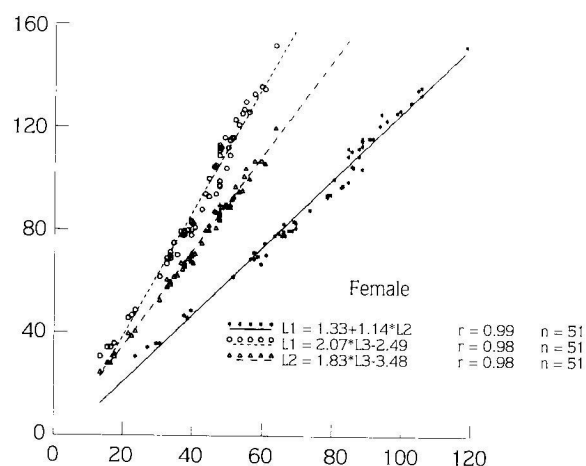
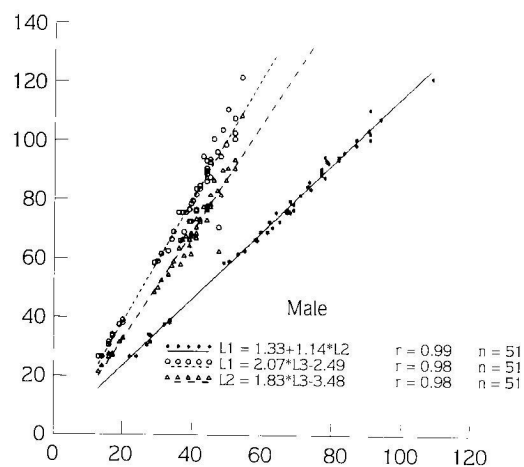


Figure 9. Linear relations of size measurements.
L1 = Total carapace width (mm)
L2 = Carapace width (mm)
L3 = Carapace length (mm)

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Plate 1. Juvenile female individuals (Photo: Harling, Stuttgart).

a) Carapace width 74 mm

Carapace length 37 mm

b) Carapace width 67 mm

Carapace length 34 mm

c) Carapace width 40 mm

Carapace length 21 mm

Furtherm
he female
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ave abdom
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Plate 2.

Furthermore, the size measurements indicated that the female specimen attained sexual maturity with a carapace length of about 108 mm (Table 1). The concave abdomen of the young female is first similar to that of the juvenile males. With increasing age and sloughing this become convex and gets a rounded form and the bristles develop, as can be seen in the adults (Plates 1 and 2).

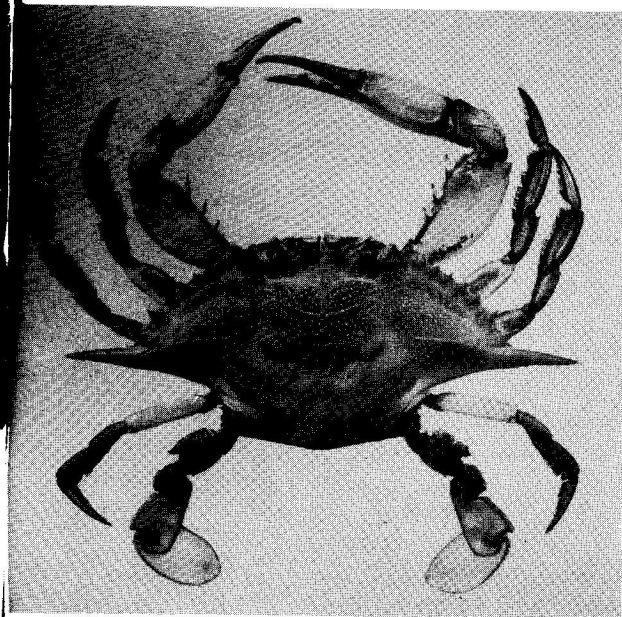
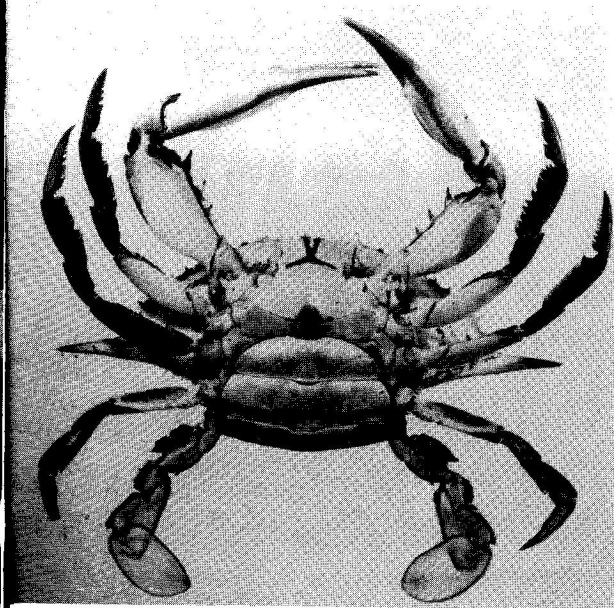


Plate 2. Dorsal and ventral view of an adult female specimen (Photo: Lumpe, Stuttgart). Carapace length 67 mm.

Addendum

During the excursion carried out in spring, 1995, a new development was observed that is worth mentioning.

In the region between Burnaz (area 02) and Silifke (area 06, Table 3) it was observed that *C. sapidus* shells were infected (Plate 3). This "black spot disease" was first reported on the Atlantic coast by Cook and Lefton (13). A description and occurrence of this disease in the North Sea was summarized by Knust (14).

The reason for the occurrence of the disease, observed here only in the adult individuals, is not exactly known. Usually the disease is related to pollution, especially from chloroparaffins, which are used as a softening agent in synthetics and varnish for vessel coating (for extended discussion see Knust, 14).

In contrast to earlier observations made (pers. comm. L. B. Holthuis 15), no parasiting *Sacculina* species were detected during the study period.



Plate 3. Spots of "black spot disease" of the blue-crab (Photo: Fiedler, Chemnitz.)

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