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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

Occurrence of Larval, Juvenile, and Mature Crabs in the Vicinity of Beaufort Inlet, North Carolina

DONNIE L. DUDLEY AND MAYO H. JUDY

Marine Biological Laboratory
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Occurrence of Larval, Juvenile, and Mature Crabs in the Vicinity of Beaufort Inlet, North Carolina

By

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ABSTRACT

Monthly samples from 13 ocean stations near Beaufort Inlet, N.C., were examined for the occurrence of crab larvae in 1962. Larval collections were supplemented by sampling with a bottom trawl for juveniles and adults in 1962 and 1963. Trawling was restricted to a small area near the sea buoy at the Inlet. Larvae of 27 species of crabs were taken during the study and were most abundant during the summer and fall. Adults of 13 species of crabs occurred in the collections, with *Callinectes sapidus*, *C. similis*, *Portunus gibbesii*, *Ovalipes ocellatus*, and *Hepatus epheliticus* being the more prevalent.

INTRODUCTION

During 1962 and 1963, as a part of the blue crab studies at the National Marine Fisheries Service Laboratory, Beaufort, N.C., plankton samplers and bottom trawls were fished offshore to determine the seasonal distribution and abundance of various crab stages. Plankton stations were sampled twice a month from May through November 1962, and bottom trawl samples for juvenile and adult crabs were taken twice a month from June 1962 through December 1963. The study provided information on the species present and their time of spawning. Also, our knowledge of the size of the crab populations was increased.

SAMPLING STATIONS AND TECHNIQUES

Larvae were collected in the ocean at 13 plankton stations in an area extending approximately 8 km east and west of the Beaufort

Inlet and 13 km offshore (Figure 1). Stations 1, 2, 5, 6, 9, and 10 were approximately 1.6 km offshore and stations 3, 4, 7, 8, and 11 were approximately 6.5 km offshore. Stations 12 and 13 were 10 and 13 km offshore, respectively. Stations were located about 4 km apart on an east-west axis. Two samples were collected twice a month at each station, one at 1 m and the other at 8 m below the surface. Two 127-mm diameter Clark-Bumpus plankton samplers, equipped with nylon net with 526- μ mesh openings and a cap with 390- μ mesh openings, were used for sampling. Samples were collected by fishing the two samplers simultaneously for 10 min. The samples were preserved in 2% formaldehyde in 120-ml jars. Three 4-ml aliquots of each sample were examined for crab larvae.

Two 30-min hauls with a 8.5-m otter trawl were made twice a month near the sea buoy (Figure 1, station 3) in 11 to 14 m of water. The trawl was constructed of nylon netting with 22-mm mesh (bar measure) in the body

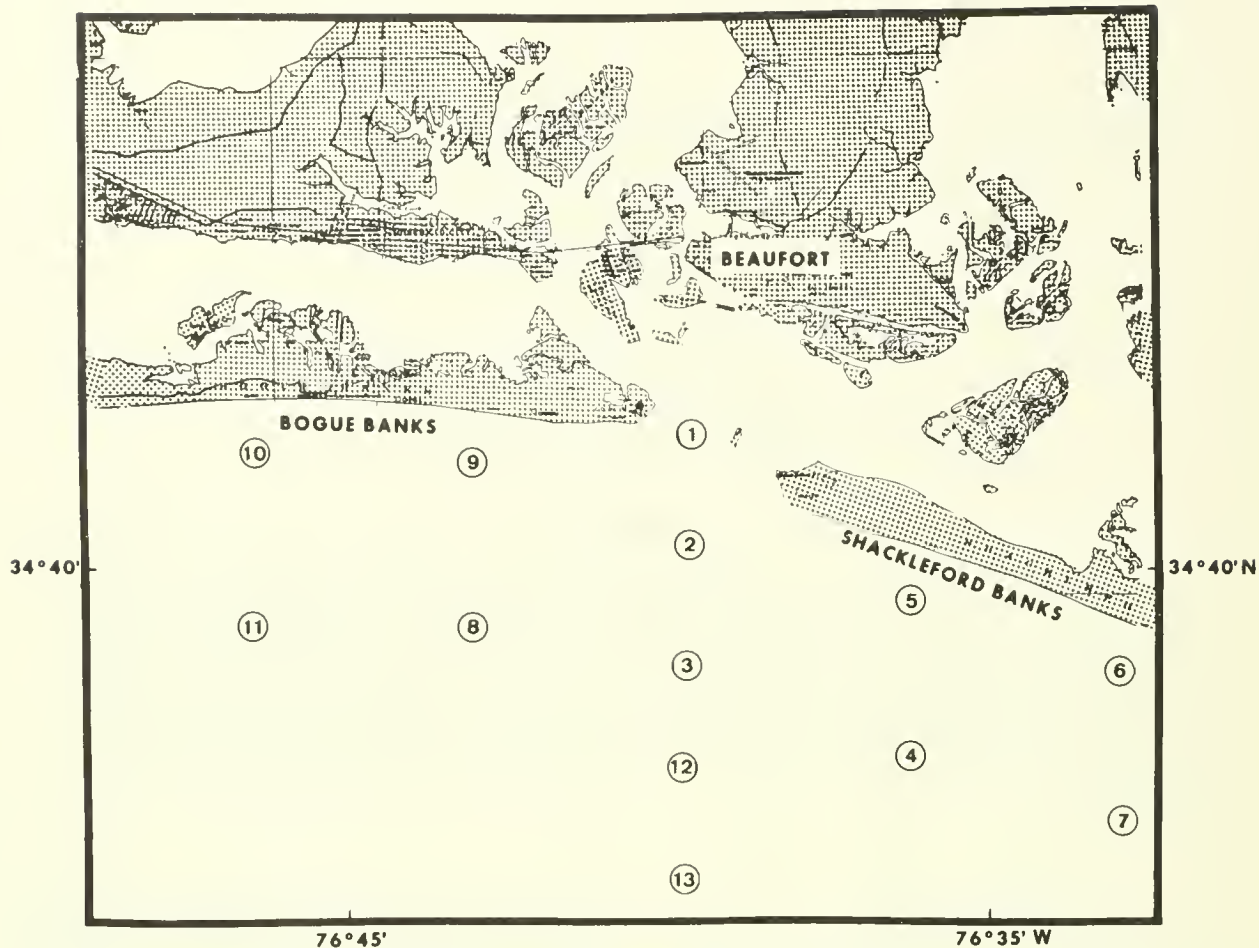


Figure 1.—Plankton sampling stations in vicinity of Beaufort Inlet, Beaufort, N.C.

and 13-mm mesh in the cod end. Relative abundance, size, sex, and stage of sexual maturity of the females were obtained for each species present. The egg mass or sponge, if present, was recorded either as orange, first laid eggs, or as black, mature eggs ready to hatch.

SEASONAL OCCURRENCE OF LARVAL, JUVENILE, AND ADULT CRABS

Larval Crabs

Plankton collections contained 27 different types of crab larvae. *Callinectes* spp. were identified as to larval and megalops stages. Other crabs were identified only as to genus or species (Tables 1, 2, and 3). The most abundant genus was *Callinectes* which oc-

curred during all months sampled (May through November) with the highest catches in June, July, and August. *Callinectes* spp. larvae were taken at all stations but greater concentrations were found at the offshore stations and generally were caught near the surface. Of special interest was the presence of *Callinectes* (stages 2 and 3) at offshore stations 12 and 13. Nichols and Keney (1963) found the more advanced stages of *Callinectes* 64 to 97 km offshore in plankton collections from the *Theodore N. Gill* cruises. In our samples megalops larvae (last larval stage) were collected only occasionally and then only in small numbers.

One of the more abundant genera, *Uca*, was prevalent from May through August but not after September. This genus was well represented in the collections at most stations but

Table 1.—Mean number of larval crabs per 20 cubic meters of water collected from May through November 1962 at inshore stations 1, 2, 5, 6, 9, and 10.

Species	May		June		July		Aug.		Sept.		Oct.		Nov.		References
	Depth		Depth		Depth		Depth		Depth		Depth		Depth		
	1 m	8 m	1 m	8 m	1 m	8 m	1 m	8 m	1 m	8 m	1 m	8 m	1 m	8 m	
<i>Callinectes</i> spp.	81	62	430	287	303	243	88	80	46	23	50	50	2	--	6, 21
Stage 1	--	--	--	--	20	--	2	4	5	--	5	4	--	--	--
Stage 2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Stage 3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Stage 4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Stage 5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<i>Dissodactylus mellittae</i>	4	4	--	2	1	6	--	8	2	4	2	6	--	--	16
<i>Emerita talpoida</i>	10	8	--	2	2	21	3	19	2	3	--	--	--	--	25
<i>Eurypanopeus depressus</i>	--	--	14	46	4	7	13	24	--	--	4	--	--	--	8, 17, 18, 26
<i>Hepatus epheliticus</i>	--	--	10	4	64	13	5	2	40	7	5	7	--	--	10
<i>Leucosiidae</i>	--	--	--	19	48	14	3	26	7	15	6	--	--	--	1, 2, 3
<i>Libinia</i> spp.	--	2	--	--	--	3	--	2	--	--	--	--	--	--	23
<i>Menippe mercenaria</i>	--	10	10	7	6	10	7	20	--	--	--	--	--	--	17, 18, 20, 27
<i>Neopanope texana sayi</i>	12	41	34	285	13	36	16	69	27	19	--	2	--	--	5, 17, 18, 26
<i>Pachygrapsus transversus</i>	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16
<i>Panopeus herbstii</i>	8	20	27	106	10	65	23	133	2	2	3	8	50	38	9, 17, 18, 26
<i>Pilumnus</i> spp.	--	--	--	2	1	7	5	11	4	--	--	--	--	--	17, 18, 26
<i>Pinnixa</i> spp.	49	39	39	206	9	98	40	272	100	71	75	367	--	--	15
<i>Pinnotheres maculatus</i>	--	2	--	2	4	5	8	20	16	--	4	13	--	--	15
<i>Pinnotheres ostreum</i>	--	--	--	7	--	1	5	8	4	7	--	5	--	--	15
<i>Polyonyx gibbesii</i>	5	3	3	18	12	48	--	2	8	6	15	14	3	13	4, 12
<i>Portunus gibbesii</i>	116	44	23	114	122	20	24	3	11	4	--	--	--	2	24
<i>Portunus sayi</i>	13	8	--	11	--	--	--	--	30	6	9	5	15	18	24
<i>Sesarma</i> spp.	--	--	2	78	3	17	8	106	--	--	--	--	--	--	7, 11, 16
<i>Uca</i> spp.	40	60	657	1,347	459	70	515	792	31	20	--	--	--	--	14
Unknown zoae ¹	A5	--	A14	A7	A2	--	A5	A10	C32	C16	C4	C52	--	C4	--
Unknown ²	--	--	D8	D3	--	--	D2	D3	D5	D2	D7	D2	--	--	--
Megalops:															
<i>Callinectes</i> spp.	--	--	--	--	--	--	--	--	2	--	2	3	--	--	6
<i>Eurypanopeus</i> spp.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8, 17, 18, 26
<i>Neopanope</i> spp.	--	--	--	2	--	--	--	--	--	--	--	--	--	--	5, 17, 18, 26
<i>Panopeus</i> spp.	--	--	--	--	--	--	--	--	9	4	--	2	--	--	8, 17, 18, 26
<i>Uca</i> spp.	--	13	--	--	--	10	3	38	4	1	--	--	--	--	14

¹ Zoecae raised from known crab, unpublished data Duke University Marine Laboratory, Beaufort, N.C.

² Zoecae raised from known crab, unpublished data National Marine Fisheries Service, Beaufort, N.C.

³ The letters represent the larvae type, the number accompanying the letter is the mean number of crabs of that type in the sample.

Table 2.—Mean number of larval crabs per 20 cubic meters of water collected from May through November 1962 at offshore stations 3, 4, 7, 8, and 11.

Species	May		June		July		Aug.		Sept.		Oct.		Nov.		References
	Depth		Depth		Depth		Depth		Depth		Depth		Depth		
	1 m	8 m	1 m	8 m	1 m	8 m	1 m	8 m	1 m	8 m	1 m	8 m	1 m	8 m	
<i>Callinectes</i> spp.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6, 21
Stage 1	97	493	525	1,061	3,955	879	595	257	26	50	56	76	--	--	--
Stage 2	--	--	43	91	64	17	124	21	--	--	10	4	4	4	--
Stage 3	--	--	--	4	2	--	14	--	--	--	--	--	4	4	--
Stage 4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Stage 5	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--
<i>Dissodactylus mellitae</i>	--	--	--	--	10	2	3	10	2	2	--	7	--	--	16
<i>Emerita talpoida</i>	4	90	--	4	5	11	--	99	2	2	--	3	--	--	25
<i>Eurypanopeus depressus</i>	--	9	4	14	2	10	--	5	--	2	2	3	--	--	8, 17, 18, 26
<i>Hepatus epheliticus</i>	--	4	4	8	157	17	109	29	51	18	11	7	2	--	10
<i>Leucosiidae</i>	--	--	11	27	71	29	19	39	2	--	2	13	2	6	1, 2, 3
<i>Libinia</i> spp.	--	--	--	--	--	2	--	--	--	--	--	--	--	--	23
<i>Menippe mercenaria</i>	--	10	4	23	8	2	13	3	--	--	--	--	--	--	17, 18, 20, 27
<i>Neopanopeo terana sayi</i>	10	27	70	130	16	45	11	40	5	--	--	5	--	2	5, 17, 18, 26
<i>Pachygrapsus transversus</i>	--	4	--	--	--	--	--	--	--	--	--	--	--	--	16
<i>Panopeus herbstii</i>	5	14	18	63	5	33	23	48	--	5	--	--	--	--	9, 17, 18, 26
<i>Pilumnus</i> spp.	--	--	--	8	--	5	3	23	--	--	--	--	--	--	17, 18, 26
<i>Pinnixa</i> spp.	48	92	26	48	11	19	23	199	44	107	80	730	68	175	15
<i>Pinnotheres maculatus</i>	--	--	--	--	--	--	--	5	--	9	5	7	2	--	15
<i>Pinnotheres ostreum</i>	--	--	--	3	--	3	--	4	--	5	--	7	--	--	15
<i>Polyonyx gibbesi</i>	--	3	--	4	16	3	--	15	2	9	5	30	6	29	4, 12
<i>Portunus gibbesii</i>	242	90	58	88	292	37	156	38	28	5	12	5	--	2	24
<i>Portunus sayi</i>	68	54	--	--	--	--	--	--	12	2	13	4	24	58	24
<i>Sesarma</i> spp.	--	--	63	10	--	5	5	13	--	3	--	--	--	--	7, 11, 16
<i>Uca</i> spp.	56	185	857	372	444	239	448	223	7	14	--	--	--	--	14
Unknown zoecae ³	A6	3	D7	B2	A2	F3	A5	C22	C26	C3	C15	C25	25	A4	
Unknown ³	D9	--	A7	--	F9	B2	D5	B3	D5	--	--	--	G4	C6	
							D5	D5	--	--	--	--	D4	D4	
Megalops:															
<i>Callinectes</i> spp.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6
<i>Eurypanopeus</i> spp.	--	--	4	--	--	--	--	--	--	--	--	--	--	--	8, 17, 18, 26
<i>Neopanope</i> spp.	--	--	--	--	--	--	--	2	2	--	--	--	--	--	5, 17, 18, 26
<i>Panopeus</i> spp.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8, 17, 18, 26
<i>Uca</i> spp.	--	--	4	--	--	3	--	8	--	--	--	--	--	--	14

¹ Zoecae raised from known crab, unpublished data Duke University Marine Laboratory, Beaufort, N.C.

² Zoecae raised from known crab, unpublished data National Marine Fisheries Service, Beaufort, N.C.

³ The letters represent the larvae type, the number accompanying the letter is the mean number of crabs of that type in the sample.

Table 3.—Mean number of larval crabs per 20 cubic meters of water collected from May through November 1962 at offshore stations 12 and 13.

Species	May		June		July		Aug.		Sept.		Oct.		Nov.		References
	Depth		Depth		Depth		Depth		Depth		Depth		Depth		
	1 m	8 m	1 m	8 m	1 m	8 m	1 m	8 m	1 m	8 m	1 m	8 m	1 m	8 m	
<i>Callinectes</i> spp.	36	342	48	1,505	436	586	1,283	810	118	107	--	53	--	--	6, 21
Stage 1	--	43	--	736	88	28	755	126	--	5	14	--	--	--	--
Stage 2	--	--	--	8	--	--	345	165	--	--	--	--	--	--	--
Stage 3	--	--	--	--	--	--	--	35	--	--	--	--	--	--	--
Stage 4	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--
Stage 5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<i>Dissodactylus mellitae</i>	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16
<i>Emerita tulpoida</i>	--	--	--	25	--	63	17	--	--	22	--	6	--	--	25
<i>Eurypanopeus depressus</i>	--	--	--	25	--	20	--	--	--	--	--	--	--	--	8, 17, 18, 26
<i>Hepatus epheliticus</i>	--	--	--	--	229	9	70	7	48	26	--	--	--	--	10
<i>Leucosiidae</i>	--	--	--	25	--	41	26	15	--	4	--	13	--	--	12, 1, 2, 3
<i>Libinia</i> spp.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	23
<i>Menippe mercenaria</i>	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17, 18, 20, 27
<i>Neopanope terana sayi</i>	--	--	--	8	--	15	--	--	--	5	--	--	--	--	5, 17, 18, 26
<i>Pachygrapsus transversus</i>	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16
<i>Panopeus herbstii</i>	--	--	--	--	5	72	--	17	--	--	--	--	--	--	9, 17, 18, 26
<i>Pilumnus</i> spp.	21	--	--	--	--	--	--	--	--	--	--	--	5	--	17, 18, 26
<i>Pinnixa</i> spp.	21	--	16	--	--	--	--	27	10	11	19	520	7	207	15
<i>Pinnotheres maculatus</i>	--	--	--	--	--	--	--	--	--	--	--	6	11	--	15
<i>Pinnotheres ostreum</i>	--	--	--	--	--	--	--	--	--	--	--	7	--	--	15
<i>Polyonyx gibbesii</i>	--	--	--	5	--	5	--	--	--	16	--	13	--	32	4, 12
<i>Portunus gibbesii</i>	149	267	524	87	85	634	51	54	50	50	34	26	--	--	24
<i>Portunus sayi</i>	43	--	--	--	--	61	--	--	12	10	169	104	35	73	24
<i>Sesarma</i> spp.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7, 11, 16
<i>Uca</i> spp.	64	19	33	33	23	199	22	14	5	16	--	--	--	--	14
Unknown zoae ¹	--	--	B50	--	--	B26	D88	D12	D5	C5	--	C7	C34	C54	--
Unknown ²	--	--	--	--	--	A10	--	B4	--	D4	--	D14	D5	--	--
Megalops:															
<i>Callinectes</i> spp.	--	--	--	--	--	--	9	--	--	--	--	--	7	--	--
<i>Eurypanopeus</i> spp.	--	--	--	8	--	--	--	--	--	--	--	--	--	--	8, 17, 18, 26
<i>Neopanope</i> spp.	--	--	--	8	--	--	--	--	--	--	--	--	--	--	5, 17, 18, 26
<i>Panopeus</i> spp.	--	--	--	--	--	--	--	--	--	--	--	6	--	--	8, 17, 18, 26
<i>Uca</i> spp.	--	--	--	--	--	--	9	--	--	30	--	12	--	--	14

¹ Zoeae raised from known crab, unpublished data Duke University Marine Laboratory, Beaufort, N.C.

² Zoeae raised from known crab, unpublished data National Marine Fisheries Service, Beaufort, N.C.

³ The letters represent the larvae type, the number accompanying the letter is the mean number of crabs of that type in the sample.

only a few were taken at the offshore stations (12 and 13). *Uca* spp. larvae were taken in equal numbers at both the 1-m and the 8-m depths. The megalops stages were collected only during August, September, and October.

Neopanope spp. occurred from May through November and were most numerous at the 8-m depth and inshore stations. This genus was found only four times at stations 12 and 13, and only at the 8-m depth.

Pinnixa spp. occurred at all stations and during all months of sampling, May through November. Occurrence was greatest at the 8-m depth.

Portunus gibbesii occurred in relatively large numbers at all stations from May through November. More were taken at the 1-m depth and higher concentrations occurred from May through August. The offshore stations were more productive.

Hepatus spp. occurred in relatively large numbers during July, August, and September; best catches were near the surface at offshore stations.

Juvenile and Adult Crabs

One of the more abundant species collected with the bottom trawl was the blue crab, *Callinectes sapidus* (Table 4). Adults were quite common from June through September, and immature forms were more abundant during June and July. The adult population was almost 95% females. Male crabs are generally found in the lower saline waters of this area, primarily in the upper Newport River, Neuse River, etc. More than 50% of the females caught during June, July, and August had a sponge (egg mass on the abdomen). The blue crabs caught during January and February 1963 were taken in an area where clam dredges were operating. Blue crabs normally are buried in the soft bottom and are not available to trawl gear at this time. Trawl samples in areas away from the dredge areas did not contain blue crabs.

Callinectes similis also were common and occurred during most months but were most abundant during July and August. Peak

spawning (black sponges observed) of *C. similis* occurred during September and October, while peak spawning of *C. sapidus* occurred during June, July, and August. Even though some overlap in spawning occurred, this time difference in "prime hatching periods" could serve as a guide in separating the larvae of the two forms.

Portunus gibbesii are year round inhabitants of this area occurring in greater numbers during June, July, and August. Females bearing egg masses were found principally during May and June.

Ovalipes ocellatus were numerous during June and July and probably are winter spawners because only four were taken with sponge, two in October, one in December, and one in February. The larvae were not identified in our plankton collections but could have been one of the unknowns.

Portunus spinimanus were most abundant from July through October. Only a few sponge females were taken, mostly in June. The larvae were not identified in our plankton collections.

SUMMARY

Larval, juvenile, and adult forms of 11 families and some 28 species were collected in the vicinity of Beaufort Inlet. Several other unidentified larval crab species were also collected during the study. Most species occurred in greatest numbers during summer and early fall. Generally only first and second stage *Callinectes* larvae were collected; other species were not identified as to stage. The megalops stage of only five genera were collected and in relatively small numbers.

Trawl studies indicated when different crab species were most prevalent and when larvae might be present by noting females with egg mass. Sex ratios were approximately the same for most species except *Callinectes sapidus*, which were predominantly female both as immatures and as matures.

Larval, juvenile, and adult crabs collected in the Beaufort Inlet area during 1962 and 1963 are shown in Table 5.

Table 4.—Species composition of crabs in the area of Beaufort Inlet, North Carolina.

Species	1962												1963												Total
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.						
<i>Arenaeus cribrarius</i>																									
Males	--	--	--	--	1	--	--	16	--	--	--	--	--	--	--	--	--	--	--	17					
Females	--	--	--	1	2	--	10	68-128	--	--	--	--	--	--	--	--	--	1	--	14					
Size range (mm) ¹	--	--	--	104	54-115	--	--	--	--	--	--	--	--	--	--	--	--	51	--	--					
<i>Callinectes flammica</i>																									
Males	--	--	--	2	3	--	--	--	--	--	--	--	--	--	--	--	3	--	--	8					
Females	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	4	--	--	5					
Size range (mm)	--	--	--	120-134	108-140	--	--	--	--	--	--	--	--	--	--	67-113	--	--	--	--					
<i>Callinectes sapidus</i>																									
Immature males	25	250	8	2	1	--	--	9	5	2	--	1	1	1	--	--	--	--	--	304					
Immature females	57	795	16	11	1	--	16	17	17	2	1	3	7	5	--	--	--	--	--	931					
Size range (mm) ²	38-88	84-109	92-112	44-45	--	--	--	33-109	--	34-102	59	60-80	50-43	--	--	--	--	--	--	--					
Males	73	121	28	18	12	3	2	3	3	--	--	--	2	10	--	--	3	1	--	279					
Females	496	4,995	690	216	123	57	42	381	111	9	183	171	325	410	--	59	9	9	--	8,277					
Without sponge	201	3,279	367	68	72	54	42	381	111	9	126	104	143	160	--	33	8	8	--	--					
Orange sponge	164	1,252	172	107	41	3	--	--	--	--	31	34	35	158	--	13	--	--	--	--					
Black sponge	131	474	151	41	10	--	--	--	--	--	26	33	147	92	--	13	1	--	--	--					
<i>Callinectes similis</i>																									
Males	60	1,421	292	120	497	39	--	5	--	--	--	69	1,127	1,480	--	208	83	1	--	5,402					
Females	80	1,245	269	250	666	34	--	1	--	--	--	20	678	1,562	--	407	86	--	--	5,299					
Without sponge	80	1,246	269	236	632	33	--	1	--	--	--	20	678	1,542	--	350	85	--	--	--					
Orange sponge	--	--	--	14	34	1	--	--	--	--	--	--	--	20	--	38	1	--	--	--					
Black sponge	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--					
Size range (mm)	34-56	28-77	34-96	37-94	38-108	36-104	--	50-95	--	--	--	33-59	42-98	35-97	--	35-102	38-106	46	--	--					
<i>Cancer borealis</i>																									
Males	--	--	--	--	--	--	--	--	1	1	1	--	--	--	--	--	--	--	--	3					
Females	--	--	--	--	--	--	--	1	4	3	2	--	1	--	--	--	--	--	--	11					
Size range (mm)	--	--	--	--	--	--	--	37	30-58	29-58	26-35	--	31	--	--	--	--	--	--	--					
<i>Hepatus ephippitius</i>																									
Males	--	--	9	10	81	16	1	9	4	2	3	20	8	84	--	12	4	2	--	265					
Females	10	1	34	20	98	26	--	16	3	7	3	12	3	36	--	22	5	--	--	296					
Without sponge	10	1	33	17	95	26	--	16	3	7	2	8	2	26	--	22	5	--	--	--					
Orange sponge	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--					
Black sponge	--	1	1	3	3	--	--	--	--	--	1	4	1	8	--	--	--	--	--	--					
Size range (mm)	42-77	46	49-77	40-90	42-83	41-84	63	33-80	33-77	27-80	60-85	22-82	35-80	33-86	--	52-82	44-67	42-73	--	--					
<i>Libinia dubia</i>																									
Males	--	--	--	--	--	--	--	--	--	--	--	--	1	4	--	--	--	--	--	5					
Females	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	2					
Size range (mm)	--	--	--	--	--	--	--	--	--	--	--	--	30	27-38	--	--	--	--	--	--					

Table 4.—Species composition of crabs in the area of Beaufort Inlet, North Carolina.—Continued.

Species	1962												1963												Total
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.						
<i>Libinia emarginata</i>																									
Males	2	16	2	--	6	11	2	23	15	--	10	8	31	19	14	--	--	--	1	160					
Females	3	10	11	1	6	2	5	16	7	--	5	5	39	23	27	--	1	1	1	163					
Without sponge	3	10	11	1	6	2	5	16	7	--	5	5	32	23	20	--	1	1	1	--					
Orange sponge	--	--	--	--	--	--	--	--	--	--	--	--	4	--	4	--	--	--	--	--					
Black sponge	--	--	--	--	--	--	--	--	--	--	--	--	3	--	3	--	--	--	--	--					
Size range (mm)	22-46	24-45	32-75	60	40-83	27-55	32-50	14-94	22-67	--	18-92	18-60	18-88	27-90	26-70	--	63	66	22-76	--					
<i>Ovalipes ocellatus</i>																									
Males	1,960	101	73	1	2	--	1	--	1	--	6	70	431	510	200	--	2	--	--	3,358					
Females	1,763	121	82	7	5	--	2	1	2	--	2	40	331	491	276	--	6	--	--	3,129					
Without sponge	1,763	121	82	7	4	--	1	1	1	--	2	40	331	491	276	--	5	--	--	--					
Orange sponge	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	1	--					
Black sponge	--	--	--	--	1	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--					
Size range (mm)	22-60	35-62	31-65	48-55	44-62	--	46-52	52	44-45	--	19-26	21-51	22-53	22-70	35-60	--	44-60	--	--	--					
<i>Ovalipes quadrupennis</i>																									
Males	803	113	178	14	2	--	3	1	--	--	--	41	116	195	32	--	--	--	--	1,498					
Females	758	--	158	12	--	--	--	1	--	--	1	23	70	168	18	--	--	--	--	1,209					
Size range (mm)	23-45	25-55	23-53	26-40	33-44	--	35-52	37-41	--	--	57	19-52	23-52	22-47	27-40	--	--	--	--	--					
<i>Persephona punctata</i>																									
Males	11	5	25	6	13	1	--	1	--	--	3	1	8	9	42	--	1	--	--	131					
Females	--	7	20	4	20	--	--	2	1	--	8	1	2	7	26	--	2	--	1	101					
Without sponge	--	--	7	4	20	--	--	2	1	--	8	1	1	6	20	--	2	--	1	101					
Orange sponge	--	--	--	--	--	--	--	--	--	--	--	--	1	1	4	--	--	--	--	--					
Black sponge	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--					
Size range (mm)	25-39	20-37	21-48	21-43	20-40	24	25-27	23-62	30-56	--	22-32	30-36	22-40	25-43	23-37	--	27-33	--	--	28					
<i>Portunus gibbesii</i>																									
Males	720	1,050	192	33	84	33	3	39	13	--	71	89	141	169	232	--	26	15	8	2,948					
Females	825	891	245	37	129	13	1	37	18	--	81	125	215	152	158	--	47	14	12	3,000					
Without sponge	673	891	245	37	129	13	1	37	18	--	81	90	151	147	154	--	47	14	12	--					
Orange sponge	119	--	--	--	--	--	--	--	--	--	--	--	58	5	4	--	--	--	--	--					
Black sponge	33	--	--	--	--	--	--	--	--	--	--	--	14	6	--	--	--	--	--	--					
Size range (mm)	23-70	24-51	30-55	35-63	25-62	35-76	26-76	23-62	30-56	--	31-65	38-70	28-67	30-95	28-63	--	34-60	38-60	35-49	--					
<i>Portunus spinimanus</i>																									
Males	72	280	156	72	144	56	1	8	--	--	3	2	11	53	152	--	41	22	--	1,073					
Females	99	270	112	60	148	54	--	5	--	--	6	10	28	53	178	--	28	21	--	1,072					
Without sponge	59	270	112	60	142	54	--	5	--	--	6	7	19	53	176	--	28	21	--	--					
Orange sponge	20	--	--	--	3	--	--	--	--	--	--	3	6	--	2	--	--	--	--	--					
Black sponge	20	--	--	--	3	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--					
Size range (mm)	34-79	24-69	26-77	30-65	33-77	37-93	52	28-55	--	--	35-65	52-68	32-75	28-65	27-60	--	33-78	32-85	--	--					

¹ Size range include both sexes of all species.

² Mature *Callinectes sapidus* were not measured.

Table 5.—Checklist of larval, juvenile, and adult crabs collected Beaufort Inlet area, N.C., during 1962 and 1963.

Scientific name	Common name
PORCELLANIDAE	
<i>Polyonyx gibbesi</i> Haig	
HIPPIDAE	
<i>Emerita talpoida</i> (Say)	Mole crab
LEUCOSIIDAE	
<i>Persephona punctata</i> Rathbun	Purse crab
CALAPPIDAE	
<i>Calappa flammea</i> (Herbst)	Box crab
<i>Hepatus epheliticus</i> (Linnaeus)	Calico crab
PORTUNIDAE	
<i>Ovalipes ocellatus</i> (Herbst)	Spotted lady crab
<i>Ovalipes quadulpensis</i> (Saussure)	Lady crab
<i>Portunas sayi</i> (Gibbes)	
<i>Portunas gibbesii</i> (Stimpson)	
<i>Portunus spinimanus</i> Latreille	
<i>Callinectes sapidus</i> Rathbun	Blue crab ¹
<i>Callinectes similis</i> Ordway ¹	
<i>Arenaeus cribrarius</i> (Lamarck)	Speckled crab
CANCRIDAE	
<i>Cancer borealis</i> Stimpson	Jonah crab
XANTHIDAE	
<i>Pilumnus</i> spp.	
<i>Menippe mercenaria</i> (Say)	Stone crab
<i>Neopanope texana sayi</i> (Smith)	
<i>Eurypanopeus depressus</i> (Smith)	Flat mud crab
<i>Panopeus herbstii</i>	
H. Milne-Edwards	Common mud crab
PINNOTHERIDAE	
<i>Pinnotheres ostreum</i> Say	Oyster crab
<i>Pinnotheres maculatus</i> Say	Mussel crab
<i>Dissodactylus mellitae</i> Rathbun	
<i>Pinnixa</i> spp.	
GRAPSIDAE	
<i>Paehygrapsus transversus</i>	
(Gibbes)	Mottled shore crab
<i>Sesarma</i> spp.	
OCYPODIDAE	
<i>Uca</i> spp.	Fiddler crab
MAJIDAE	
<i>Libinia emarginata</i> Leach	Spider crab
<i>Libinia dubia</i> H. Milne-Edwards	Spider crab

¹ Only juvenile and adult form of *Callinectes similis* were identified.

LITERATURE CITED

(Citations have been numbered to permit easy reference in tables)

1. AIKAWA, HIROAKI.
1929. On larval forms of some Brachyura. Rec. Oceanogr. Works Jap. 2: 17-55.
2. 1933. On larval forms of some Brachyura, Paper II; a note on indeterminate zoeas. Rec. Oceanogr. Works Jap. 5: 124-254.
3. 1937. Further notes on Brachyuran larvae. Rec. Oceanogr. Works Jap. 9: 87-162.
4. BROOKS, W. K., and E. B. WILSON.
1883. The first zoea of Porcellana. Stud. Biol. Lab., Johns Hopkins Univ. 2: 58-64.
5. CHAMBERLAIN, N. A.
1961. Studies on the larval development of *Neopanope texana sayi* (Smith) and other crabs of the family Xanthidae (Brachyura). Chesapeake Bay Inst., Johns Hopkins Univ., Tech. Rep. 22, 35 p.
6. COSTLOW, JOHN D., JR., and C. G. BOOKHOUT.
1959. The larval development of *Callinectes sapidus* Rathbun reared in the laboratory. Biol. Bull. (Woods Hole) 116: 376-396.
7. 1960. The complete larval development of *Sesarma cinereum* (Bosc) reared in the laboratory. Biol. Bull. (Woods Hole) 118: 203-214.
8. 1961. The larval development of *Eurypanopeus depressus* (Smith) under laboratory conditions. Crustaceana 2: 6-15.
9. 1961. The larval stages of *Panopeus herbstii* Milne-Edwards reared in the laboratory. J. Elisha Mitchill Sci. Soc. 77: 33-42.
10. 1962. The larval development of *Hepatus epheliticus* (L.) under laboratory conditions. J. Elisha Mitchill Sci. Soc. 78: 113-125.
11. 1962. The larval development of *Sesarma reticulatum* Say reared in the laboratory. Crustaceana 4: 281-294.
12. HARDY, ALISTER C.
1956. The planktonic crustacea. In Alister C. Hardy, The open sea, its natural history: The world of plankton, p. 156-177. Houghton Mifflin Co., Boston.
13. HAY, W. P., and C. A. SHORE.
1918. The decapod crustaceans of Beaufort, N.C., and the surrounding region. [U.S.] Bull. Bur. Fish. 35: 369-475.
14. HYMAN, O. W.
1920. The development of *Gelasimus* after hatching. J. Morphol. 33: 485-501.
15. 1925. Studies on larvae of crabs of the family Pinnotheridae. Proc. U.S. Nat. Mus. 64(2497): 1-9.
16. 1925. Studies on larvae of crabs of the family Grapsidae. Proc. U.S. Nat. Mus. 65(2532): 1-8.
17. 1926. Studies on the larvae of crabs of the family Xanthidae. Proc. U.S. Nat. Mus. 67(2575): 1-22.

18. LUNZ, G. ROBERT, JR.
1937. Xanthidae (mud crabs) of the Carolinas. Charleston Mus. Leaf. 9: 9-28.
19. NICHOLS, PAUL R., and PEGGY M. KENEY.
1963. Crab larvae (*Callinectes*), in plankton collections from cruises of M/V *Theodore N. Gill*, South Atlantic coast of the United States, 1953-54. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 448, 14 p.
20. PORTER, HUGH J.
1960. Zoal stages of the stone crab, *Menippe mercenaria* Say. Chesapeake Sci. 1: 168-177.
21. RATHBUN, MARY J.
1896. The genus *Callinectes*. Proc. U.S. Nat. Mus. 18(1070): 349-375.
22. 1918. The grapsoid crabs of America. Bull. U.S. Nat. Mus. 97, 461 p.
23. 1925. The spider crabs of America. Bull. U.S. Nat. Mus. 129, 613 p.
24. 1930. The cancrioid crabs of America of the families Euryalidae, Portunidae, Atelocyclusidae, Cancridae and Xanthidae. Bull. U.S. Nat. Mus., 609 p.
25. REES, GEORGE H.
1959. Larval development of the sand crab *Emerita talpoida* (Say) in the laboratory. Biol. Bull (Woods Hole) 117: 356-370.
26. RYAN, EDWARD PARSONS.
1956. Observations on the life histories and the distributions of the Xanthidae (mud crabs) of Chesapeake Bay. Amer. Midland Natur. 56: 138-162.
27. WILLIAMS, AUSTIN B.
1965. Marine decapod crustaceans of the Carolinas. U.S. Fish Wildl. Serv., Fish. Bull. 65: 1-298.

- salmon (models I and II), by Daniel W. Bates and John G. Vanderwalker, pp. 1-5, 6 figs., 1 table; 2d paper, Design and operation of a cantilevered traveling fish screen (model V), by Daniel W. Bates, Ernest W. Murphey, and Earl F. Prentice, 10 figs., 1 table.
609. Annotated bibliography of zooplankton sampling devices. By Jack W. Jossi. July 1970, iii + 90 pp.
610. Limnological study of lower Columbia River, 1967-68. By Shirley M. Clark and George R. Snyder. July 1970, iii + 14 pp., 15 figs., 11 tables.
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612. The Trade Wind Zone Oceanography Pilot Study. Part VIII: Sea-level meteorological properties and heat exchange processes, July 1963 to June 1965. By Gunter R. Seckel. June 1970, iv + 129 pp., 6 figs., 8 tables.
613. Sea-bottom photographs and macrobenthos collections from the Continental Shelf off Massachusetts. By Roland L. Wigley and Roger B. Theroux. August 1970, iii + 12 pp., 8 figs., 2 tables.
614. A sled-mounted suction sampler for benthic organisms. By Donald M. Allen and J. Harold Hudson. August 1970, iii + 5 pp., 5 figs., 1 table.
615. Distribution of fishing effort and catches of skipjack tuna, *Katsuwonus pelamis*, in Hawaiian waters, by quarters of the year, 1948-65. By Richard N. Uchida. June 1970, iv + 37 pp., 6 figs., 22 tables.
616. Effect of quality of the spawning bed on growth and development of pink salmon embryos and alevins. By Ralph A. Wells and William J. McNeil. August 1970, iii + 6 pp., 4 tables.
617. Fur seal investigations, 1968. By NMFS, Marine Mammal Biological Laboratory. December 1970, iii + 69 pp., 68 tables.
618. Spawning areas and abundance of steelhead trout and coho, sockeye, and chum salmon in the Columbia River Basin - past and present. By Leonard A. Fulton. December 1970, iii + 37 pp., 6 figs., 11 maps, 9 tables.
619. Macrozooplankton and small nekton in the coastal waters off Vancouver Island (Canada) and Washington, spring and fall of 1963. By Donald S. Day, January 1971, iii + 94 pp., 19 figs., 13 tables.
620. The Trade Wind Zone Oceanography Pilot Study. Part IX: The sea-level wind field and wind stress values, July 1963 to June 1965. By Gunter R. Seckel. June 1970, iii + 66 pp., 5 figs.
621. Predation by sculpins on fall chinook salmon, *Oncorhynchus tshawytscha*, fry of hatchery origin. By Benjamin G. Patten. February 1971, iii + 14 pp., 6 figs., 9 tables.
622. Number and lengths, by season, of fishes caught with an otter trawl near Woods Hole, Massachusetts, September 1961 to December 1962. By F. E. Lux and F. E. Nichy. February 1971, iii + 15 pp., 3 figs., 19 tables.
623. Apparent abundance, distribution, and migrations of albacore, *Thunnus alabunga*, on the North Pacific longline grounds. By Brian J. Rothschild and Marian Y. Y. Yong. September 1970, v + 37 pp., 19 figs., 5 tables.
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625. Distribution of salmon and related oceanographic features in the North Pacific Ocean, spring 1968. By Robert R. French, Richard G. Bakkala, Masanao Osako, and Jun Ito. March 1971, iii + 22 pp., 19 figs., 3 tables.
626. Commercial fishery and biology of the freshwater shrimp, *Macrobrachium*, in the Lower St. Paul River, Liberia, 1952-53. By George C. Miller. February 1971, iii + 13 pp., 8 figs., 7 tables.
629. Analysis of the operations of seven Hawaiian skipjack tuna fishing vessels, June-August 1967. By Richard N. Uchida and Ray F. Sumida. March 1971, v + 25 pp., 14 figs., 21 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 - 35 cents.
633. Blueing of processed crab meat. II. Identification of some factors involved in the blue discoloration of canned crab meat (*Callinectes sapidus*). By Melvin E. Waters. May 1971, iii + 7 pp., 1 fig., 3 tables.
636. Oil pollution on Wake Island from the tanker *R. C. Stoner*. By Reginald M. Gooding. May 1971, iii + 12 pp., 8 figs., 2 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 - Price 25 cents.

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