GROWTH OF JUVENILE BLUE CRABS, *Callinectes sapidus* RATHBUN, IN THE ST. JOHNS RIVER, FLORIDA

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ABSTRACT

Relative growth was studied by holding juveniles (20–139 mm. wide) in anchored floats. The floats were at two locations—one in salt water and one in fresh water. Molt intervals were similar at both sites, but the average growth was generally more per molt in salt water. From April to mid-November, the mean molt interval was 11 days for crabs 20 to 29 mm. wide; it increased to 41 days for crabs of 130 to 139 mm. Frequency of molting decreased in winter, but most juveniles 20 to 59 mm. wide molted two or three times. Growth increments per molt varied from 7.8 to 50 percent. Mean increment, by 10-mm. width groups, was 20.9 to 34.2 percent. Estimates of increase in width with age indicate that most blue crabs in the St. Johns River reach harvestable size (width of 120 mm.) within 1 year after hatching.

This report presents the results of studies from April 1964 to March 1966 on growth increments, molt intervals, and the effects of salinity and temperature on growth of juvenile blue crabs, *Callinectes sapidus* Rathbun, in the St. Johns River, Fla. This information on growth is needed to estimate the time required for crabs of any particular size to reach harvestable size.

Because the juvenile (postlarval) crab has a rigid shell, it can grow only when it molts. The shell is composed of chitin strengthened by the deposition of calcium salts (Rees, 1963). Before molting, the crab forms a new exoskeleton inside the old shell, which then loosens. During molting, the carapace separates from the abdomen along the sides of the undersurface, and in a few minutes, the crab backs out of the old shell (fig. 1). Initially, the new shell is soft and wrinkled. Water, absorbed after molting, stretches the thin and elastic new cuticle and increases the size of the crab. Crabs grow from the first postlarval crab stages, about 2.5 mm. wide, to full size after 18 to 23 molts (Van Engel, 1958). In the St. Johns River, the width of fully grown blue crabs ranges from less than 100 mm. to more than 240 mm.

Few studies have been made on the rate of growth of juvenile blue crabs. Churchill (1919) used the limited number of molting records available at that time for Chesapeake Bay crabs and attempted to determine size at various instars and the frequency of molting from hatching to maturity. He found that time between molts was progressively longer with increase in size. The first few molts were a few days apart and the last at intervals of a month or more. He reported that growth ceases from October until late April or early May and that the animals probably do not molt at temperatures less than 60° F. (15.5° C.). Studies with blue crabs over 29 mm. wide by Gray and Newcombe (1938) and on smaller crabs by Newcombe, Sandoz, and Rogers-Talbert (1949) provide the best published data on growth. The mean increases in width of the various instars ranged from 15 to 48 percent; the mean was 25 percent for males and 27 percent for females. No information was obtained on molt intervals because the animals were held for only one molt.

Numerous reports of unusually large blue crabs in low-salinity waters and very small adult crabs in high-salinity waters suggest a possible negative correlation of size with salinity of the water in which growth occurs (Newcombe, 1945; Porter, 1956; Cargo, 1958; Fischler, 1959; Tagatz, 1965). Van Engel (1958) believed that crabs in low salinity absorb more water at the time of the molt and, thus, increase more in size than crabs that molt in water of higher salinity.

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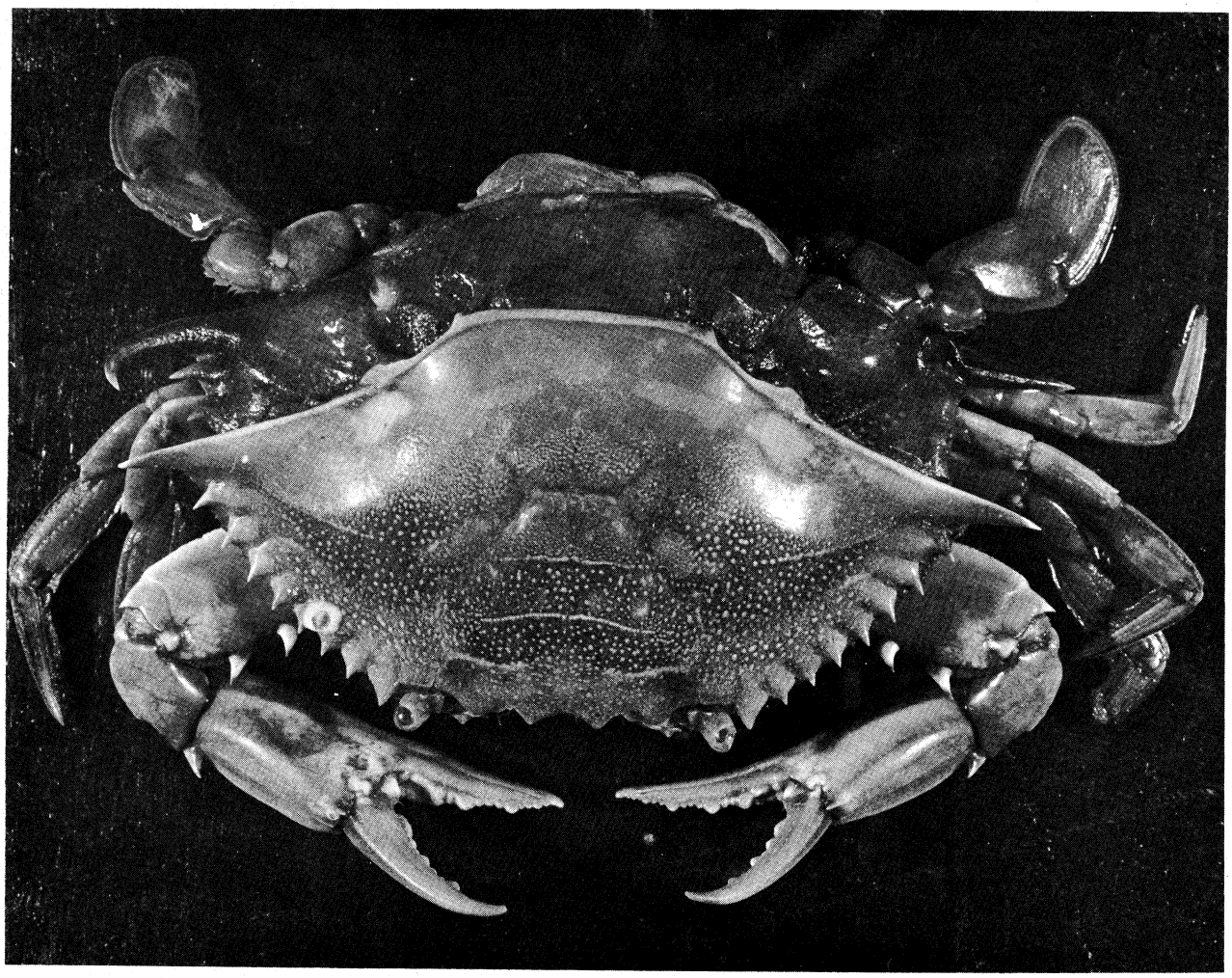

FIGURE 1.—A molting blue crab emerging from its old shell.

MATERIALS AND METHODS

Juvenile blue crabs, 20 to 139 mm. wide, were held in wooden floats in salt water (salinity greater than 5 p.p.t.—parts per thousand) from April 1964 to March 1965 and in fresh water (salinity less than 1 p.p.t.) from April 1965 to March 1966. Studies in salt water were in Cedar Point Creek, a tidal tributary of Clapboard Creek, which enters the St. Johns River 15 km. from the Atlantic Ocean. Studies in fresh water were in the St. Johns River near Green Cove Springs, 90 km. upstream from the mouth of the river. Both sites were natural habitats for crabs in the size range used.

Two hundred crabs in four floats were used at each location. The floats had hinged covers and were about 3 m. long, 1½ m. wide, and ½ m. deep. A 15-cm.-wide rim allowed three-fourths of the float to hang submerged. Each float had 50 compartments, 24 cm. by 24 cm. by 46 cm. deep, covered with 6.4-mm.-mesh hardware cloth.

Blue crabs were collected near the floats, and only one animal was put in each compartment (to prevent cannibalism). About 2,000 of those captured were measured for length-width ratio.

Three times each week crabs were fed, those that had molted were measured, and the dead ones were removed. The crabs normally were supplied with more cut fish than they would eat. I measured carapace width and length of each animal that had molted since the last observation; shell hardness indicated the day of ecdysis. Width

is the distance between the tips of the large lateral spines, and length the distance between the median anterior notch and the posterior margin. Measurements of crabs that died within a week after molting were not used in estimating growth. Except for length-width ratio, I discuss growth in terms of width.

Salinity and temperature were measured at each observation. Salinity determinations, obtained within 2 hours of low tide at Cedar Point Creek, probably were near minimum values for this site. Salinities at Green Cove Springs were always less than 1 p.p.t.—the lowest concentration detectable with the hydrometer. Blue crabs and other marine forms are able to live in the upper St. Johns River because it has a high concentration of calcium chloride and also localized areas of high sodium chloride (Odum, 1953).

I defined as summer studies those from early April to mid-November and as winter studies those from near the end of November through March. Summer work ended earlier in salt water because of damage to the floats from a September storm. During the summer, crabs were replaced (randomly collected near floats) when they died, escaped, attained maturity, or surpassed 139 mm. All new crabs were used at the start of winter, and none were replaced.

LENGTH-WIDTH RATIO

Length-width ratios were obtained for blue crabs 10 to 149 mm. wide captured in the St. Johns River (table 1). For comparison, I have included the data given by Newcombe et al. (1949) for Chesapeake Bay blue crabs. The two sets of data show similar changes in body form with growth. As size increases, the length-width ratio decreases. For St. Johns River crabs the ratio expressed as a percentage was 50 in juveniles 10 to 19 mm. wide and decreased to less than 42 in crabs over 119 mm. wide. In crabs over 69 mm. wide, males were proportionally longer than females.

The body proportions of blue crabs from the St. Johns River differed from those of crabs from the Chesapeake Bay. In every width class the Chesapeake Bay crabs had a greater mean length than the St. Johns River crabs. Geographic variation is to be expected in an animal as widely distributed as the blue crab.

TABLE 1.—*Length-width ratios of blue crabs from St. Johns River, Fla., and Chesapeake Bay*

Sex and width	St. Johns River				Chesapeake Bay [1]			
	Crabs	Mean width	Mean length	Length/width	Length/width	Mean length	Mean width	Crabs
Mm.	*Number*	*Mm.*	*Mm.*	*Percent*	*Percent*	*Mm.*	*Mm.*	*Number*
Males:								
10–19	10	16.8	8.4	50.0	53.2	9.2	17.3	13
20–29	67	25.4	12.5	49.2	53.3	13.6	25.5	17
30–39	130	34.7	16.4	47.3	49.7	17.7	35.6	16
40–49	122	44.1	20.7	46.9	49.4	22.4	45.3	27
50–59	88	54.4	25.3	46.5	48.6	26.5	54.5	32
60–69	69	63.9	29.3	45.8	48.5	31.7	65.4	35
70–79	69	74.7	34.6	46.3	47.5	35.3	74.3	31
80–89	93	83.8	37.7	45.0	46.9	40.1	85.4	37
90–99	65	94.4	42.2	44.7	47.2	44.2	93.7	39
100–109	54	103.8	45.3	43.6	46.2	48.3	104.6	38
110–119	52	114.9	49.4	43.0	45.7	52.7	115.3	37
120–129	52	124.2	51.5	41.5	46.2	57.9	125.3	32
130–139	46	133.8	54.3	40.6	44.8	60.2	134.4	35
140–149	22	145.0	59.0	40.7	44.9	65.4	145.7	42
Females:								
10–19	11	16.8	8.4	50.0	53.9	8.9	16.5	22
20–29	78	25.3	12.4	49.0	52.5	12.8	24.4	21
30–39	129	34.6	16.5	47.7	50.3	18.4	36.6	19
40–49	136	44.4	20.7	46.6	49.7	22.5	45.3	50
50–59	119	54.3	25.3	46.6	49.0	27.1	55.3	83
60–69	102	63.7	29.5	46.3	48.1	31.1	64.6	103
70–79	116	74.4	33.8	45.4	47.1	35.1	74.5	79
80–89	109	84.1	37.7	44.8	46.5	39.2	84.3	65
90–99	103	94.7	41.4	43.7	45.2	42.6	94.3	58
100–109	48	103.9	44.3	42.6	45.2	47.3	104.7	38
110–119	58	113.7	48.0	42.2	44.0	50.1	113.8	32
120–129	30	124.5	50.3	40.4	44.4	55.4	124.7	34
130–139	11	132.6	53.4	40.3	44.5	59.0	132.7	25
140–149	13	143.8	55.8	38.8	41.7	60.6	145.3	21

[1] Data from Newcombe et al. (1949).

RELATIVE GROWTH

Observations on growth were made during summer and winter.

SUMMER

I obtained data on 1,085 molts in salt water (April 1 to September 15, 1964) and on 1,152 in fresh water (April 24 to November 15, 1965).

Water temperatures were somewhat similar at the sites, but salinities differed by as much as about 26 p.p.t. The mean water temperature was 26.8° C. in salt water (range, 13.8°–32.1° C.) and 25.8° C. in fresh water (range, 16.2°–31.5° C.). Mean salinity (readings taken within 2 hours of low tide) at the Cedar Point Creek site was 18.8 p.p.t. (range, 7.5–25.8 p.p.t.); at Green Cove Springs, salinity was always less than 1 p.p.t.

Confinement did not appear to inhibit growth of blue crabs. The experimental animals ate readily, remained pugnacious, and many molted six or seven times. Growth increments of crabs that molted more than once in confinement averaged about the same as those for crabs of comparable size that molted only once.

Growth increments were highly variable in each size group, but no blue crab molted without some increase in size. The smallest increase in width was 7.8 percent; the largest, 50 percent. Mean percentage growth per molt by 10-mm.-width groups was 20.9 to 34.2 (table 2), and the groups averaged 26.7 for females, 23.9 for males, and 25.3 for females and males combined. Among larger crabs, females usually had greater width increments (at greater ages, they are relatively wider than male crabs). On the assumption of homogeneous variance about the regression of postmolt width on premolt width, an analysis of covariance indicated significant interaction of sex and salinity on growth ($P < 0.01$). Because of this interaction the separate effects of salinity on males and females were examined. Each sex showed significant differences in growth between fresh and salt water ($P < 0.05$). All crabs less than 80 mm. wide and many larger ones had greater average growth in salt water (fig. 2).

Some factor other than salinity appears to account for larger crabs in certain low-salinity waters. In the present experiments and in earlier ones on the terminal molt of female blue crabs (Haefner and Shuster, 1964), decrease in salinity did not produce increase in size.

Female blue crabs undergo a final molt at which they become sexually mature. This stage is easily recognizable because the abdomen changes shape from triangular to semicircular (the last stage of males cannot be determined from external appearance). In the St. Johns River, as in Chesapeake Bay (Tyler and Cargo, 1963), the sizes at the last two instars overlap widely. The smallest mature female measured was 99 mm. wide, and the largest immature female was 177 mm.

I obtained data on the terminal molt of 170 females (83–139 mm. wide)—85 at each site. Most growth generally took place at this molt. The mean increase in width was 34.4 percent (range, 19.6–50) in salt water and 30.2 percent (range, 20.5–47.4) in fresh water.

The variability of growth of juvenile crabs causes irregularity in the recruitment of harvestable crabs (larger than about 120 mm. wide) and in the time of crab maturity. For example, of two 21-mm.-wide males that molted seven times in salt water from May to August (in 101 days and 103 days), one attained 139 mm. and the other only 115 mm. The smaller crab would be more likely to escape the fishery to complete its life history (crabs smaller than 120 mm. made up less than 5 percent of the commercial catch). Another example is the difference in growth of two females in salt water that were 34 mm. wide in spring. One matured after four molts and 78 days (114 mm.); the other after seven molts and 179 days (175 mm.). The individual maturing at 114 mm. did not attain harvestable size and probably would have spawned in summer. The 175-mm. female was acceptable for market during its last two instars and had it escaped the fishery it probably would have spawned in fall.

TABLE 2.—*Relative growth of blue crabs, by 10-mm.-width groups and by sex, in salt (S) and fresh (F) water, St. Johns River, Fla., April 1 to November 15, 1964 and 1965*

Width and habitat	Males			Females		
	Crabs	Mean increase and standard deviation	Range	Crabs	Mean increase and standard deviation	Range
Mm.	*Number*	*Percent*	*Percent*	*Number*	*Percent*	*Percent*
20–29						
S	17	27.4±5.9	15.4–38.5	13	23.8±7.9	10.3–39.1
F	50	20.9±5.5	11.1–34.6	48	21.3±3.7	11.1–30.4
30–39						
S	39	23.3±7.1	10.2–37.8	42	24.7±6.8	12.8–35.9
F	93	22.3±5.4	10.8–33.3	108	21.8±5.0	10.8–33.3
40–49						
S	74	24.2±7.4	11.4–41.9	64	23.4±7.0	11.1–44.2
F	93	21.9±6.1	9.3–35.7	120	22.7±5.2	9.5–32.6
50–59						
S	73	24.4±6.9	11.9–40.0	77	24.2±5.7	11.5–40.0
F	70	21.0±6.0	7.8–36.5	85	23.2±6.8	8.5–34.0
60–69						
S	65	24.4±6.9	8.3–39.3	75	28.2±7.0	13.6–44.1
F	38	23.1±6.2	10.1–41.2	69	25.7±6.0	11.7–39.3
70–79						
S	66	26.2±7.1	8.1–39.7	62	27.0±8.1	13.5–43.0
F	32	24.4±5.5	14.7–35.1	62	26.3±6.8	7.9–40.3
80–89						
S	58	24.4±6.3	8.4–37.6	74	28.1±6.6	13.8–44.8
F	24	25.0±6.3	12.9–37.6	47	28.2±6.1	10.0–39.0
90–99						
S	52	25.9±6.9	12.6–41.0	55	28.2±8.5	11.7–48.9
F	22	24.7±5.8	14.3–36.4	47	28.9±7.3	14.3–47.4
100–109						
S	43	26.4±5.7	9.7–36.1	39	29.4±6.8	16.0–45.7
F	5	26.0±7.8	18.0–35.6	23	30.4±7.3	15.8–43.5
110–119						
S	30	24.4±4.7	13.4–30.4	30	34.2±9.3	14.8–50.0
F	13	24.6±4.2	19.8–31.8	35	28.5±5.4	13.4–39.6
120–129						
S	16	22.5±5.5	9.4–31.4	6	28.0±3.9	23.4–32.8
F	24	23.1±4.0	15.4–28.9	18	27.7±4.0	20.5–37.2
130–139						
S	13	21.6±5.1	14.1–33.6	2	30.2±2.0	28.8–31.6
F	16	22.7±3.4	16.9–28.5	10	26.9±4.4	22.3–35.8

WINTER

Blue crabs grow during the winter in the St. Johns River but more slowly than in summer. I observed 287 molts among crabs in salt water (November 20, 1964, to March 31, 1965) and 258 in fresh water (November 22, 1965, to March 31, 1966).

Water temperatures in winter averaged 11.8° C. lower in salt water and 13.5° C. lower in fresh

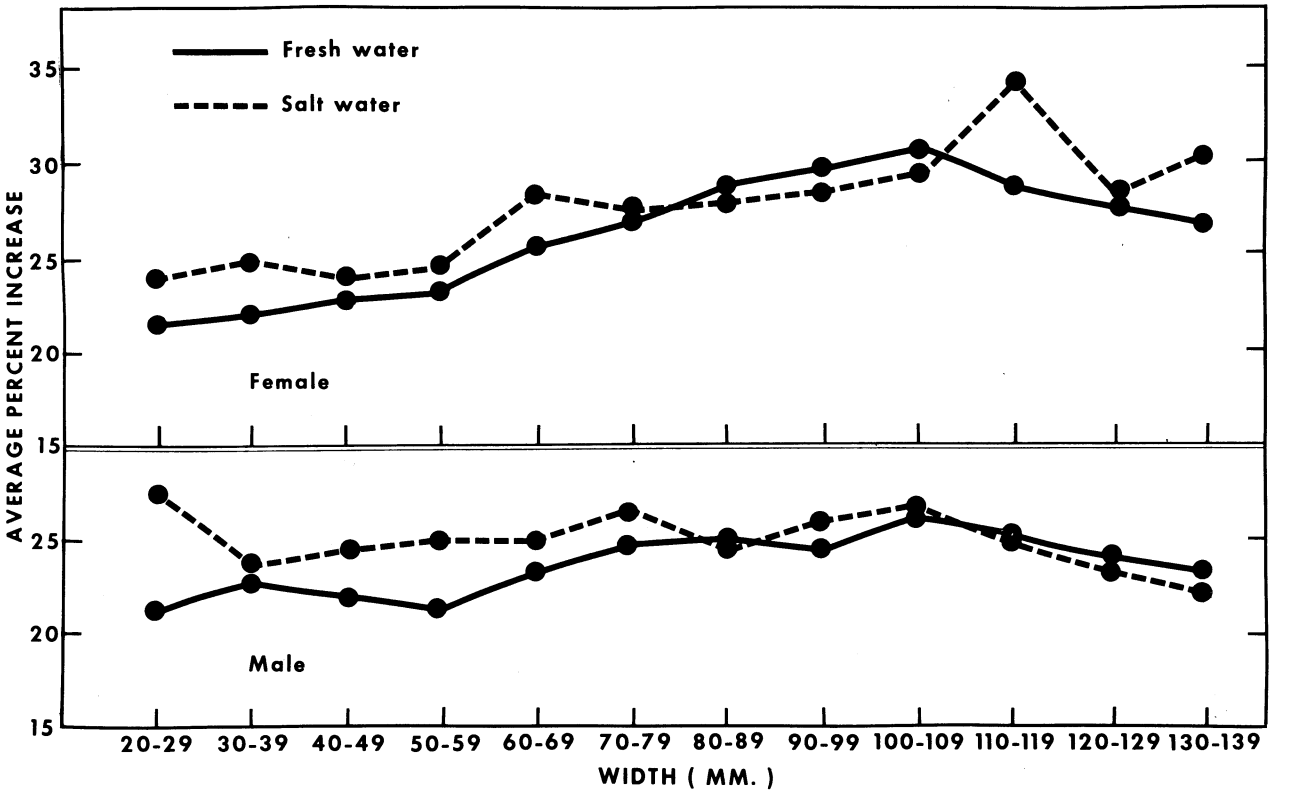

FIGURE 2.—Relative growth per molt of female and male blue crabs in fresh and salt water, St. Johns River, Fla., April 1 to November 15, 1964 and 1965.

water than in summer; salinities at the salt water station were 4.3 p.p.t. lower. Mean water temperature was 15° C. in salt water (range, 8.3°–22.9° C.) and 12.3° C. in fresh water (range, 3.8°–18.2° C.). Salinity at the Cedar Point Creek site averaged 14.5 p.p.t. (range, 6–23.3 p.p.t.).

Relative growth per molt in winter was similar to that in summer. Crabs were less active and consumed less food but generally were in good condition.

MOLT INTERVAL

Information was collected on molting in summer and winter.

SUMMER

More than one-half (1,256) of the molts in summer (April 1 to November 15) from crabs that molted more than once provided information on molt interval.

Molt intervals appeared to be affected by the size of crabs and by season but not by sex and salinity. I found little difference in molt interval between males and females or between salt and fresh water. The time between molts increased with increasing body size (table 3). The smallest crabs (20–29 mm. wide) molted after an average of 11 days, and those over 120 mm. wide after an average of 42 days. Molt intervals of crabs within each size group varied greatly but usually were shortest during the warmest months, June to September. Most juveniles 30 to 39 mm. wide in April reached harvestable size after 4 months, but crabs that had the same width in June were harvestable after 3 months with the same number of molts. Crabs that molted after particularly long periods grew little or died.

Information was obtained on the time needed for the terminal molt of 101 female blue crabs (83–139 mm. wide). The final molt interval for 85 percent of these crabs ranged from 25 to 50 days. Two females molted in as few as 18 days. Large crabs (above 110 mm. wide) averaged 5 days longer than smaller ones. In salt water (crabs averaged 106 mm. wide), the mean interval

TABLE 3.—*Molt interval in the blue crab, by 10-mm.-width groups, St. Johns River, Fla., April 1 to November 15, 1964 and 1965*

[Salt- and fresh-water data combined; ranges in parentheses]

Width group	Crabs		Mean molt interval, standard deviation, and range	
	Male	Female	Male	Female
Mm.	*Number*	*Number*	*Days*	*Days*
20–29	23	18	12±5.0 (7–25)	10±2.4 (7–17)
30–39	61	77	15±4.6 (7–34)	13±3.8 (6–27)
40–49	100	101	17±6.1 (8–38)	18±6.1 (9–42)
50–59	101	99	21±7.9 (9–51)	20±9.0 (9–49)
60–69	67	87	23±9.2 (11–54)	21±10.3 (9–68)
70–79	69	51	22±8.5 (11–64)	24±9.5 (11–59)
80–89	46	65	28±10.5 (16–68)	26±11.5 (14–77)
90–99	52	47	31±9.1 (20–64)	30±8.8 (17–60)
100–109	36	39	32±9.2 (21–65)	33±7.2 (20–52)
110–119	29	38	34±7.8 (19–53)	39±10.2 (18–61)
120–129	17	15	43±12.0 (22–68)	43±8.4 (26–59)
130–139	13	5	41±9.6 (27–56)	41±7.4 (35–54)

before the final molt was 38 days (range, 18–77 days); in fresh water (crabs averaged 117 mm.), it was 40 days (range, 18–61 days).

WINTER

Data on molt intervals (from animals that molted more than once in confinement) were obtained on 112 crabs in salt water and 96 in fresh water during winter (November 20 to March 31). The time between molts was three to four times as long in winter as in the rest of the year. The mean interval was 46 days for crabs 20 to 29 mm. wide and rose to 124 days for an individual 92 mm. wide (table 4). Most juveniles 20 to 59 mm. wide molted two or three times, but many of those larger than 99 mm. did not molt (table 5).

Temperature has a major influence on the molt interval. In Chesapeake Bay, growth of blue crabs usually ceases during the colder months from November to early April (Van Engel, 1958). In the St. Johns River, low temperatures delay but do not prevent molting. I observed crabs shedding their old shells at water temperatures as low as 3.8° C. Molting in winter was less frequent at the lower water temperatures. The numbers of molts were about the same in November and March (mean water temperature 16° C.) as during the 3 months, December–February (mean water temperature 12.5° C.). Extended observations in fresh water indicated that almost all of the crabs that did not grow in winter molted during the first 3 weeks of April (mean water temperature had risen to 18.2° C.).

TABLE 4.—*Molt interval in the blue crab, by 10-mm.-width groups, St. Johns River, Fla., November 20 to March 31, 1964–65 and 1965–66*

[Salt- and fresh-water data combined]

Width group [1]	Crabs	Molt interval	
		Mean and standard deviation	Range
Mm.	*Number*	*Days*	*Days*
20–29	16	46±25.8	21–96
30–39	48	47±15.8	20–100
40–49	49	59±17.8	22–94
50–59	35	72±17.3	28–101
60–69	37	79±18.1	46–118
70–79	18	91±19.4	69–123
80–89	4	106±17.0	81–120
90–99	1	124	----------

[1] Crabs wider than 99 mm. did not molt more than once.

ESTIMATE OF ABSOLUTE GROWTH

Mean percentage growth per molt (25.3) and mean molt interval per size group (for summer and winter) were used with relevant data from laboratory experiments on blue crabs less than 20 mm. to obtain gross estimates of increase in body size with age. Although the floats would not hold crabs smaller than 20 mm. wide, I have data on two individuals that reached this size when hatched and reared in the laboratory. After metamorphosis to the first crab stage, one of these crabs went through 10 molts in 68 days to reach 23 mm.; the other took nine molts and

TABLE 5.—*Frequency of molting of blue crabs, by 10-mm.-width groups, St. Johns River, Fla., November 20 to March 31, 1964–65 and 1965–66*

[Salt- and fresh-water data combined; no crabs molted more than three times]

Width group	Crabs	1 molt	2 molts	3 molts
Mm.	*Number* [1]	*Number*	*Number*	*Number*
20–29	40	40	39	22
30–39	43	43	40	14
40–49	58	58	46	2
50–59	46	46	33	0
60–69	37	37	10	0
70–79	31	31	1	0
80–89	41	40	0	0
90–99	24	19	0	0
100–109	12	7	0	0
110–119	25	14	0	0
120–129	27	3	0	0
130–139	6	0	0	0

[1] Not included are 10 crabs that died before molting once. Deaths after one molt: 1(20–29), 1(30–39), 1(40–49), and 1(60–69); after two molts, 1(40–49).

69 days to reach 20 mm. The mean percentage growth per molt was the same as in larger crabs. To estimate the time needed to attain harvestable size, I used 25.3 percent to calculate relative increases from the 1st crab stage (2.5 mm.) to a 19th crab stage (142 mm.), applied mean molt intervals, and allowed 1½ months for larval development (Costlow and Bookhout, 1959). These calculations indicate that most blue crabs in the St. Johns River reach harvestable size within 1 year after hatching (table 6).

TABLE 6.—*Estimated growth by month of St. Johns River, Fla., blue crabs hatched in April, July, and October.*

Month	Maximum width		
	Mm.	*Mm.*	*Mm.*
April	[1] 1		
May	5		
June	12		
July	23	[1] 1	
August	46	5	
September	58	12	
October	90	23	[1] 1
November	113	46	5
December	113	46	8
January	113	58	10
February	113	58	12
March	142	72	15
April		90	29
May		113	46
June		142	72
July			90
August			113
September			142

[1] Larvae.

MORTALITY OF EXPERIMENTAL ANIMALS

I recorded deaths of 94 blue crabs in salt water and 212 in fresh water during the summer. Mortality was 8 percent for crabs 20 to 79 mm. wide and 19 percent for those 80 to 139 mm. Most crabs that died were well past the average molt interval of their size group.

Only eight animals died in salt water (two after molting once) and seven in fresh water (three after molting once) during the winter—a mortality of 3 percent.

Year-round mortality at ecdysis was 36 crabs (salt water, 11; fresh water, 25) out of a total of 2,782 molts. The few deaths at ecdysis indicate that molting in itself may not be a critical source of mortality. In nature, however, crabs are easy prey immediately after they emerge from their shells.

SUMMARY

From April 1964 through March 1966, juvenile blue crabs (20–139 mm. wide) were held in floats in St. Johns River to determine growth increments, molt intervals, and the effects of salinity and temperature on growth.

Measurements of 2,000 blue crabs, 10 to 149 mm. wide, collected in the river indicated that the length-width ratio decreased as the animals grew. This decrease was less among males than females.

In salt water (salinity greater than 5 p.p.t.), data were obtained on 1,085 molts during the summer (April 1 to November 15) and on 287 during the winter (November 20 to March 31); in fresh water—on 1,152 molts in summer and 258 in winter.

Growth increments per molt varied from 7.8 to 50 percent in summer, and mean increment, by 10-mm.-width groups, was 20.9 to 34.2 percent. Among larger crabs, females usually had greater width increments than males. Percentage growth in the terminal molt of females averaged 34.4 in salt water and 30.2 in fresh water. Males and females showed significant difference in growth between fresh and salt water. Each sex generally averaged the most growth per molt in salt water.

Relative growth per molt in winter was similar to that in summer.

Molt intervals in the summer did not appear to be affected by the sex of the crab and the salinity of the water, but were affected by crab size and water temperature. The smallest crabs (20–29 mm. wide) molted after an average of 11 days and animals over 120 mm. wide after an average of 42 days. Molt intervals usually were shortest during the warmest months. The interval of the terminal molt of females averaged 38 days in salt water (mean width, 106 mm.) and 40 days in fresh water (mean width, 117 mm.).

The time between molts was three to four times as long in winter as in summer. Most juveniles 20–59 mm. wide molted two or three times, but many of those larger than 99 mm. did not molt.

Calculations based on the data presented indicate that most blue crabs in the St. Johns River reach harvestable size within 1 year after hatching.

Year-round mortality at ecdysis at both sites was only 36 crabs out of a total of 2,782 molts; other deaths totaled 285.

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