

## Callinectid Crab Abundances, and Movements of Tagged Blue Crabs (*Callinectes sapidus*) in the Cape Fear River and Adjacent Waters, North Carolina

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### Abstract

A six year (1973-1978) 23 stations survey of the Cape Fear River and the adjacent waters was instituted to determine the effects of the CP&L (now Duke) Brunswick 1,979 MW nuclear power plant on the biota, especially crabs, frequenting the area. *Callinectes sapidus*, blue crabs, were the most abundant of the five Callinectid crabs collected. Only 180 or 0.5% of tagged *C. sapidus* were impinged of the power plant intake screens.

**Keywords:** *Callinectes sapidus*; Blue crabs; Tagging; Cape Fear River; Impinged

### Introduction

An intensive six year survey of the Cape Fear River and adjacent waters (1973-1978) was initiated to determine of the effects of the CP&L (now Duke) Brunswick 1,979 MW nuclear power plant, located four km north of Southport, North Carolina (Brunswick County) on the biota, especially crabs, of the area. Blue crabs, *Callinectes sapidus* Rathbun, 1869, are an important North Carolina resource for commercial fisherman and the public. Blue crabs are captured as hard and soft shell crabs using: dip nets, troll lines, baited crab pots, gill nets, pound nets, haul seines and otter trawls, sell for as much as \$55/dozen. Would the power plant manmade intake canal flow affect the blue crabs frequenting the Cape Fear River and adjacent waters? Would tagged blue crabs, by sex, stay in the river? What were their environmental conditions: water temperatures, oxygen contents, salinities they endured during the six year surveys?

### Study Area

Cape Fear River flowing southward of Wilmington, NC (New Hanover County) is a coastal, two-layered, 1.2-3.2 km wide estuary. It experiences 2 m tides, southeast and southwest winds, tropical storms and hurricanes. Its coffee brown waters exit into the Atlantic Ocean via Carolina Beach Inlet on the northeast, the ocean mouth at Southport and the CP&L power plant canal that passes around Southport and into the ocean west of Southport (Figure 1). Abundant precipitation of 127.5 cm/yr (43% is dissipated as runoff, 85 cm is lost to evaporation and transportation) produces flows of 258,000-7.2 million m<sup>3</sup>/month (Wheeler Pers. Obs.). East and west river shoal substrates are sandy to silty-sand, river navigation substrates are muddy and strewn throughout with water logged trees and stumps, and the substrate is rocky at buoy 18.

### Methods

Surface and bottom water samples were obtained using a three liter brass Kemmerer sampler. Water temperatures were recorded using hand held Taylor Mercury thermometers. Oxygen contents were determined using the Winkler titration methods. Salinities were determined by using A/O refractometers. Fourteen river channel (1973) and 23 river-shoal stations (1974-1978) stations were sampled using gill nets and semi-balloon otter trawls [1] (Table 1) Sampling was weekly and daily (five days per week) January-May, September-November, and one week during June, July, and August. The number of stations visited daily depended on available daylight.

Monofilament No. 208 nylon gill nets (91.4 m long, 65 meshes

deep, 89 cm stretch mesh) were set at 24 east and west river shoal stations. Soak time was one hour/set. A 6.1 m skiff towed a 9.2 m wide semiballoon otter trawl for 15 minutes at all shoal stations. Deep water, CBI and intake canal stations (Figure 1) were sampled by either the 13.3 m R/V Sara Helen or the 19.3 m R/V Machapunga towing a 12.5 or 15.5 m semi-balloon otter trawl.

Varied numbered and addressed, colored 6 × 24 mm plastic strap tags, held in place by wires wound around the lateral carapace spines, were attached across 120-170 mm crab carapaces. Tag number changed every 1,000 specimens. Most blue crabs were tagged during September-October of each year. A small reward was paid for the return recapture information, location, and date located on the numbered and addressed tags. Additionally, large number of fish and shrimp were tagged and recaptures analyzed [1].

Numbers of impinged tagged crabs were determined from sampling of screens from the inflow of river water in the intake canal (Figure 1) by the North Carolina State University concurrent study. Percentage impingement was determined by dividing the number impinged by the number tagged at various stations.

### Results

Surface river waters flowed faster than substrate waters (Pers. Obs.). Water temperatures were lowest in January (mean 4°C) with extreme lows in 1976-1977 that froze many shallow areas of the river, and highest in July and August (mean 23°C). Oxygen levels were highest in January (mean 12.2 ppm) lowest in July-August (mean 3.2 ppm). Salinities were 0-4 ppt at buoy 42 and increased to 32 ppt at the river mouth.

Overall, 429,497 fish, shrimp, and crabs were collected during this six year survey. Callinectid crabs accounted for 81,208 (Table 1): *Callinectes larvatus* (8), *Callinectes danae* (3) *C. ornatus* (436), *C. sapidus* (58,087), and *C. similis* (11,048). *C. sapidus* Rathbun 1869, the

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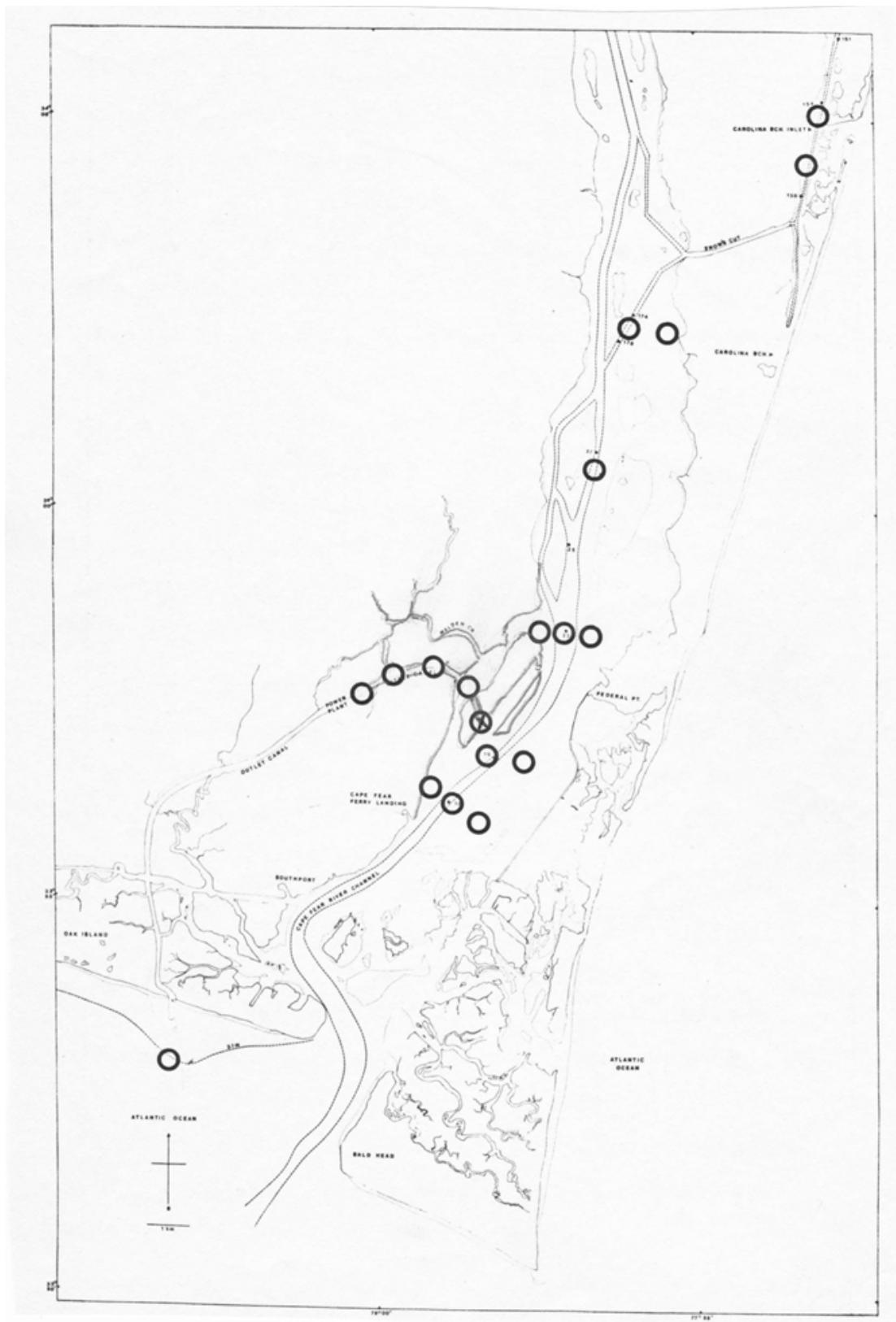


Figure 1: Stations in and near the lower Cape Fear River, North Carolina. Intake canal stations beginning with the circle X.

most abundant crab, occurred throughout the fresh water and saline river waters; and was especially caught at the canal mouth (5,048) CBI inlet (4,240) and buoy 19 (1,756) (Table 2). They tolerated water temperatures 4-32°C, oxygen 4-12 ppt, and salinities 0-32 ppt. *C. larvatus* Ordway 1863, *C. similis*, *C. danae*, and *C. ornatus* preferred higher saline waters south of buoy 18 and at CBI inlet (Figure 1 and Table 3).

Male *C. sapidus* preferred low level salinities (Table 2). Males moved throughout the river, mated, and wintered in the river substrates. A few moved into the Atlantic Ocean and moved north to Chesapeake Bay. Maximum distance of tag returns by males was short – 25.1-50.0 km, although one moved to Hoopersville, MD, 617 km (Table 4).

Female *C. sapidus* preferred higher saline river waters (Table 2), moved throughout the river system, mated, and exited the river via CBI and the river mouth into adjacent Atlantic Ocean to spawn and live for one or two years before returning to the river. Females traveled longer distances, up to 1,256 km (Table 4) to the Gulf of Mexico just west of Key West, Fl. The oddest female blue crab (No. 4326) was tagged near buoy 18, 13 May 1975 and was recaptured alive 2359 days later in the lower Cape Fear River 26 October 1985 [2]. That recapture established a new survival record, as the blue crab rarely live as long as 18 months.

Female catches and those tagged out numbered (25,330) males caught and tagged (9,198) (Table 5). Tagged blue crabs were released at their capture site. Blue crabs tagged with orange-colored plastic

Species	1973	1974	1975	1976	1977	1978	Totals
<i>Callinectes larvatus</i>					8		8
<i>Callinectes danae</i>					3		3
<i>Callinectes ornatus</i>	34	119	49	93	177	40	436
<i>Callinectes sapidus</i>	6657	3954	10449	11036	1302	24745	58087
<i>Callinectes similis</i>	887	697	3511	2828	4420	118	11048
Totals	7,544	4,760	13,983	13,957	4,721	24,851	69,582
Total Catch All Gears	32,279	35,279	57,996	85,642	1,07,906	1,10,395	4,29,497

Table 1: Total number of callinectes captured by species and year in the capefear river and adjacent waters 1973-1978 by gill nets, small and large trawls.

Station	1973		1974		1975		1976		1977		1978	
	Effort	Tagged	Effort	Tagged	Effort	Tagged	Effort	Tagged	Effort	Tagged	Effort	Tagged
42W							79	12	17	16	96	242
42							453	32	146	89	24	115
42E							0	0	38	32	94	94
CB	105	104	137	131	2	2	0	0	0	0	0	0
CBI-N	0	0	0	2	150	146	265	255	186	183	67	727
CBI-S	0	0	12	10	846	844	340	325	967	966	72	3513
174	1450	77	4095	220	3286	185	3068	390	2243	1069	49	1002
SC	151	151	284	111	150	93	62	33	61	61	96	604
27	564	19	1140	51	866	46	886	101	927	190	52	611
23E	74	74	298	181	213	148	118	88	75	61	97	512
23	413	7	1074	54	1855	50	615	171	1268	414	62	597
23W	96	96	367	213	170	114	87	54	79	71	98	490
19E	50	50	150	93	171	121	77	63	42	37	98	332
19	158	21	858	106	1788	396	1341	479	1199	326	75	1756
19W	148	135	770	297	1227	213	71	40	322	66	101	1634
CS	0	0	75	4	492	82	132	25	58	31	60	975
CB1	0	0	118	19	3351	269	2795	91	971	112	50	1175
CB2	0	0	0	0	82	32	203	36	360	100	54	744
CM	0	0	105	5	2063	259	2164	225	1154	266	47	5048
18E	111	110	1058	435	1108	558	623	428	598	138	112	2535
18	131	73	737	228	1280	279	799	493	277	61	67	1207
18W	226	190	296	221	152	138	51	17	16	14	91	501
OCEAN	533	12	1071	32	1719	77	1778	13	587	31	200	502
Total	4210	1119	12952	2413	20971	4052	16086	3387	11591	4334	1762	19223

Table 2: Total effort and number of blue crabs tagged by station and years, 1973-1978, in the Cape Fear River and adjacent areas.

Adjacent ocean	Lower river 1	Middle river 2	Upper river 3	Total
463	21,890	5,226	11,949	34,528

Table 3: Number of blue crabs tagged by major geographic areas of the Cape Fear River, 1973-1978.

Sex	1973	1974	1975	1976	1977	1978	Total
Males	478	1350	1742	931	1283	3414	9198
Females	641	1063	2310	2456	3051	15809	25330
Total	1119	2413	4052	3387	4334	19223	34528

Table 4: Male and female blue crabs tagged in the cape fear river, north Carolina.

	Distance (Km)						Totals
	0.0-2.0	2.1-10.0	10.1-25.0	25.1-50.0	50.1-75.0	75.1+	
1973							
Female	115	0	0	0	0	0	115
Male	71	0	0	0	0	0	71
1974							
Female	12	22	15	3	2	5	59
Male	46	111	39	1	0	0	197
1975							
Female	117	145	56	2	20	21	361
Male	101	137	41	6	0	0	285
1976							
Female	123	168	41	5	2	8	347
Male	55	67	18	1	0	2	143
1977							
Female	93	147	25	5	4	36	310
Male	71	148	17	2	0	1	239
1978							
Female	139	205	72	10	4	4	434
Male	105	126	11	0	0	1	243
Total of Females for 1974-1978							1626
Total of Males for 1974-1978							1178

Table 5: Blue Crab recapture by distance travelled after tagged during 1973-1978.

strap tags dominated the recaptures, 1,282, yellow were 492, red 593, and green 88. Tags of blue crabs were usually returned within one to three years; although tags shed, caught, or unearched following storms were periodically returned as late as 2011. Maximum recaptures of both males and females were between 2.1 and 10.0 km from the release points (Table 5). Blue crabs tagged in the CP&L power intake canal were rarely impinged (159, or 3.1% from 1973-1978) in the nearby screens. Only 180 of 34,528 (0.5%) total tagged blue crabs were impinged on the intake canal screens.

## Conclusions

Even though others have studied blue crab movements and abundance in North Carolina [3]; Eggleston et al. [4] Hill and Fowler 1989 [5]; Judy and Dudley [6]; Ramach et al. [7]; Schwartz [2]; Schwartz et al. [1]; Schwartz [8], their observations while similar to the Cape Fear River and adjacent waters study [8] did not address power plant intake effects. The low number impinged from this study from blue crabs tagged and released in the canal (3.1% from one of the major capture sites) and from total tagged in the Cape Fear River and adjacent waters (0.5%) indicates little impact from power plant canal screen impingement.

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