MOVEMENTS OF TAGGED BLUE CRABS IN NORTH CAROLINA WATERS

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The infrequent exchange of crabs between estuarine systems or between widespread coastal areas shows that a commercial fishery for blue crabs in one area cannot depend on migration of commercial-size crabs from another area.

From 1957 to 1965, 17,237 female and 5,691 male adult blue crabs were tagged and released in North Carolina waters, including two rivers, two sounds, and two ocean areas. Total recoveries were 6,947 tags, or 30.3%. Most recoveries (90-95%) were made within 6 months--and 60-65% of these were recaptured within 3 months after release. Of crabs caught away from tagging sites, 83% of females and 80% of males were caught within 24 km. of release areas. Females moved from estuaries into high-salinity waters in warm weather and returned to estuaries in late fall and winter. Males displayed limited movement between estuary and ocean but generally remained in estuaries.

BLUE CRAB FISHERY

The blue crab, Callinectes sapidus, supports an important commercial fishery along the Atlantic coast from Delaware Bay south to Miami, Fla., and along the Gulf coast from Florida to Texas. Annual landing records of blue crabs over the years show large and sudden fluctuations in abundance that have caused serious economic problems for the industry. As a direct result of these fluctuations, the Atlantic States Marine Fisheries Commission inspired an investigation of the blue crab in the South Atlantic States by the National Marine Fisheries Service Biological Laboratory in Beaufort, N.C. This report resulted from the investigation.

Our article reports male and female crab movements within and between estuaries, between estuaries and the ocean, and movement in the ocean by summarizing recaptures from a large-scale tagging program in North Carolina coastal waters during 1957-65.

Data on seasonal movements of blue crabs are necessary to understand their life history and establish sound management practices. Therefore, the migrations and localized movements of this species have been emphasized in many blue crab studies. Investigations in Chesapeake Bay (Churchill, 1919; Fiedler, 1930; Truitt, 1939; Van Engel, 1958); in Texas (Daugherty, 1952); in Louisiana (Darnell, 1959); in South Carolina (Fiedler, 1962); and in Florida (Tagatz, 1965, 1968) indicated that crab movements were closely related to phases of the life cycle. In Delaware Bay (Cronin, 1954; Porter, 1956) and in Chincoteague Bay (Cargo, 1958) research indicated that crabs scatter widely within their respective habitats but show only limited movement to other inland and coastal waters.

Movements Related to Life Cycles

Generally, movements related to the life cycle are: Early stage immature crabs, after development from eggs hatched in the ocean, move to less saline waters of sounds and rivers, where they mature in approximately 1 year. After their last molt, crabs mate and females begin a gradual movement to high salinity waters for spawning (eggs passed

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from ovaries to abdominal appendage) and hatching their eggs. Since spawning occurs only during warm weather, the actual spawning process may occur from a few weeks to a few months after mating but, once spawning occurs, the eggs will hatch in about 2 weeks. After their eggs have hatched, adult females gradually move from the ocean back into lower salinity waters. In most waters, adult males generally remain in low salinities all year, but in South Carolina and Florida many males, as well as females, migrated to the ocean at spawning time.

MATERIALS, METHODS, & STUDY AREAS

From 1957 to 1965, we tagged and released 22,928 adult crabs obtained from commercial fishermen and from our own gear. Crabs were captured by crab pots, otter trawl, haul seine, and trot lines. A plastic carapace tag (Rounsefell and Everhart, 1953) was attached to each crab by slipping a preformed loop of stainless steel wire (0.4 mm.) over one lateral spine, drawing the wire and tag taut over the back and securely winding the other end of the wire around the opposite spine (fig. 1). The tag bore a serial number on one side, and the laboratory address and reward notice (25 cents) on the other. Display posters at crab dealers and processors and contact with individual crabbers publicized the tagging study. Tag-return data were obtained either by direct contact with the fisherman or by use of tag-return envelopes.

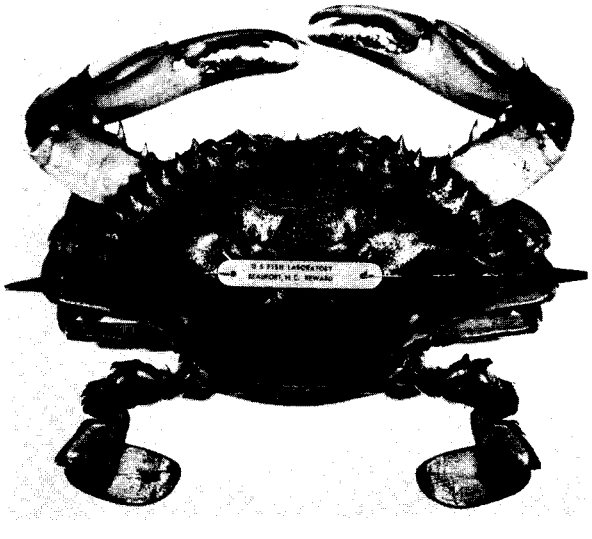

Fig. 1 - Tagged blue crab.

Crabs were tagged in the Newport and White Oak Rivers, Core and Bogue Sounds, and two ocean areas in the general vicinity of Beaufort and Oregon Inlets (fig. 2).

RESULTS

General

From the 17,237 female and 5,691 male crabs tagged, we recovered 6,947 tags (30.3% of total). Insufficient information accompanied 260 tags (3.7% of tags returned). Thus, 5,260 female returns (30.5% of females released) and 1,427 male returns (25.1% of males released) were used in the final analysis.

Release and recovery data for blue crabs (all female tag groups, and one male tag group) released in the Newport and White Oak Rivers, Core and Bogue Sounds, and Ocean Area #2 are shown in tables 1 and 2. (Due to very limited male-crab movement, data for males are shown in table form only for Newport River area.) Due to limited tagging and to small percent of tags returned, no table was prepared for crabs released in the Oregon Inlet area.

Although tag recovery is influenced by fishing intensity, it was beyond the scope of this study to deal with catch statistics. No tagging area had a uniform blue-crab fishery throughout the year. That our tag returns were dependent on fishing pressure was reflected by especially high and low recovery rates for some areas and times. Recovery rates were especially high in inside waters during winter and spring, and in the ocean during spring and summer when fishing effort was usually high in these areas (tables 1 and 2). Although fishing effort altered seasonal distribution of recoveries, we do not believe it materially affected conclusions regarding crab movement.

The percentage of tags returned varied widely with the area of release. The rate of tag returns was highest (51.4%) from White Oak River, and lowest (15.4%) from Oregon Inlet area.

Returns from tagging sites accounted for 77.2% of all recoveries (5,166 crabs). Tagging site, in this study, is defined as the river

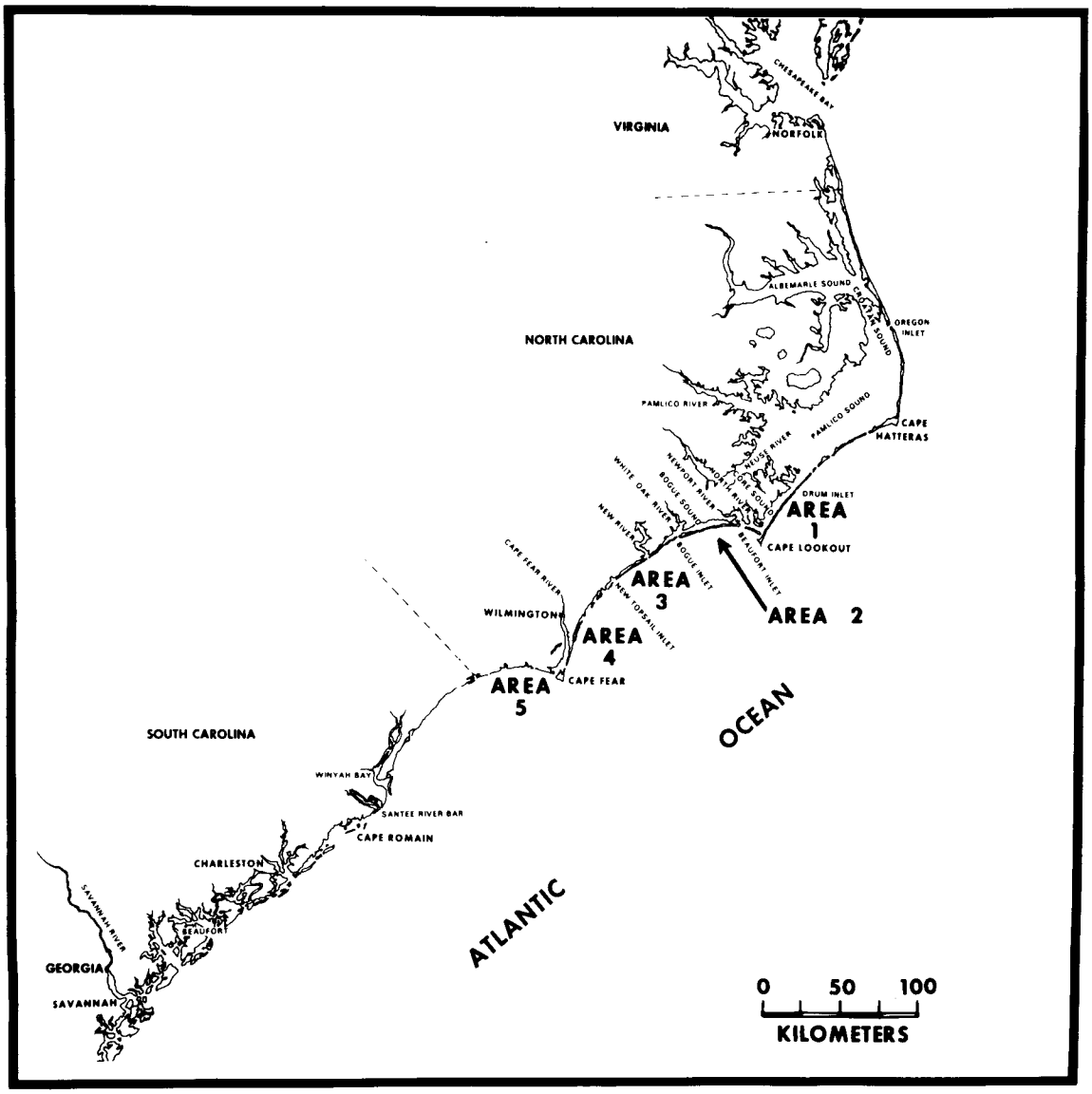

Fig. 2 - Atlantic coast, Chesapeake Bay to Savannah, showing areas where tagged blue crabs were released and captured.

Table 1 - Recovery of female blue crabs tagged in Newport and White Oak Rivers, Core and Bogue Sounds, and in the ocean off Beaufort, N.C., by quarters 1957-65

Released		Recovered										
Area	Number	Area recovered	Jan.-Feb.		Apr.-June		July-Sept.		Oct.-Dec.		Total recovered	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Newport River	6,814	Site.....	471	30.0	304	19.4	98	6.2	127	8.1	1,000	63.6
		Other rivers.....	6	.4	4	.3	3	.2	---	---	13	.8
		Sounds.....	45	2.9	35	2.2	11	.7	4	.3	95	6.0
		Ocean.....	2	.1	293	18.6	157	10.0	11	.7	463	29.5
											1,571	23.0 1/
White Oak River	2,699	Site.....	605	41.9	686	47.5	14	1.0	---	---	1,305	90.3
		Other rivers.....	---	---	20	1.4	---	---	---	---	20	1.4
		Sounds.....	12	.8	37	2.6	4	.3	---	---	53	3.7
		Ocean.....	---	---	43	3.0	23	1.6	1	.1	67	4.6
											1,445	53.5 1/
Core Sound	3,335	Site.....	202	24.0	268	31.8	56	6.6	115	13.6	641	76.0
		Other sounds.....	---	---	6	.7	2	.2	---	---	8	.9
		Rivers.....	5	.6	9	1.1	6	.7	---	---	20	2.4
		Ocean.....	3	.4	119	14.1	50	5.9	2	.2	174	20.6
											843	25.3 1/
Bogue Sound	1,583	Site.....	289	44.5	59	9.1	10	1.5	58	8.9	416	64.1
		Other sounds.....	1	.1	1	.1	3	.5	1	.1	6	.9
		Rivers.....	2	.3	10	1.5	9	1.4	---	---	21	3.2
		Ocean.....	1	.1	138	21.3	63	9.7	4	.6	206	31.7
											649	41.0 1/
Ocean (Off Beaufort, N.C.)	2,448	Site.....	7	1.0	183	26.3	302	43.3	23	3.3	515	73.9
		Other ocean areas	1	.1	14	2.0	4	.6	1	.1	20	2.9
		Sounds.....	57	8.2	31	4.4	10	1.4	21	3.0	119	17.1
		Rivers.....	14	2.0	22	3.2	5	.7	2	.3	43	6.2
											697	28.5 1/

1/ Percent based on number released in each area, other percentages based on total number recovered from each release area.

Table 2 - Recovery of male blue crabs tagged in Newport River, by quarters 1957-61

Released			Recovered									
Area	Number	Area recovered	Jan.-Feb.		Apr.-June		July-Sept.		Oct.-Dec.		Total recovered	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Newport River	4,290	Site.....	358	35.5	218	21.6	158	15.7	152	15.1	886	87.9
		Other rivers.....	2	.2	1	.1	2	.2	2	.2	7	.7
		Sounds.....	30	3.0	16	1.6	19	1.9	9	.9	74	7.3
		Ocean.....	1	.1	12	1.2	20	2.0	8	.8	41	4.1
											1,008	23.5[1/]

[1/] Percent based on number released in each area, other percentages based on total number recovered from each release area.

or sound where crabs were released or, in the ocean, within 24 km. from release area. We considered distance greater than 24 km. as showing more than just random movement. Recoveries at tagging sites accounted for 73.7% (3,877 crabs) of all female returns, and 90.3% (1,289 crabs) of all male returns. The difference between site recoveries of females and males was highly significant (X^2 = 39.7, P.01 = 6.63). No crabs tagged at Oregon Inlet were recovered there. In other areas, 63.6 to 90.3% of tagged females and 87.9 to 100% of males were recovered at tagging site. Site recoveries in rivers and sounds were higher during winter and spring, and in the ocean during spring and summer. The percent of on-site returns was consistently higher for males. The percent-return-by-area for females was altered greatly by their movement to and from the ocean.

Returns other than those at tagging sites indicated limited crab movement. Only 20 tags were recovered outside of North Carolina: 17 from Chesapeake Bay, 3 from South Carolina. All crabs recovered in the bay were released in Oregon Inlet area only a short distance from bay. Two of the 17 crabs recovered in Chesapeake Bay were males; all other recoveries from outside North Carolina were females.

MOVEMENT

Location and Distance

Crabs recovered away from their respective tagging sites were separated into two categories: Those caught within 24 km. of release, and those caught beyond 24 km. These two categories included 1,383 female and 138 male crabs. Those recovered within 24 km. of release accounted for 1,143 females (83% of nonsite recoveries) and 110 males (80%). Of these, 800 females and 42 males were recovered in ocean, and 343 females and 68 males in inside waters.

Crabs recovered more than 24 km. from release accounted for 240 females (17% of nonsite recoveries) and 28 males (20%). Ocean recoveries accounted for 135 females and one male. The male crab was recovered in Area 3, 56 km. from release site. Areas 2 and 3 had highest numbers (54 and 39) of females recovered in ocean. These crabs were at least 24 km.--but not more than 80 km.--from release sites. Other ocean recoveries included 26 crabs from Area 4, nine from Area 5, four from Area 1, and three from South Carolina waters. Crabs recovered in Area 4 were 40 to 160 km. from tagging sites; in Area 5, 120 to 210 km. away; in Area 1, 40 to 80 km. from release sites.

Of those caught in South Carolina waters, one was recovered in Winyah Bay, 298 km. away; another off Santee Bar, 314 km. distant; and another off Beaufort, S.C., 442 km. from tagging site. These three represented longest migrations during this study.

The few remaining crabs (105 females, 27 males) that moved more than 24 km. from release sites were recovered in inside waters. Crabs that moved from ocean to inside

waters included 59 females and 3 males. Fifteen of those females, and 2 of males, were released in Oregon Inlet area and recovered in Chesapeake Bay. These crabs were 65 to 205 km. from release site but not more than 48 to 65 km. inside bay. Other crabs had moved among various inland habitats. Over all, the distance from release to recovery for females recaptured in inside waters ranged from 40 to 258 km.; males 40 to 80 km.

Direction

Tagged crabs caught more than 24 km. from release areas were grouped by direction of movement. Of the 240 females, 84% (201 crabs) had moved south or southwest, and 16% (39 crabs) north or northeast. Movement of male crabs was opposite that of females. Of the 28 males, only 14% (4 crabs) had moved south or southwest, and 86% (24 crabs) north or northeast.

Speed

Crabs are capable of rapid movement. Knowing the time of release and recapture for recovered crabs--and the approximate distance of travel--allows an estimate of movement speed. Using only the earliest recoveries allows estimates of maximum speed.

Of crabs that traveled 16 to 24 km., the daily travel for the 100 earliest returns averaged 2.9 km. and ranged from 1.7 to 12.1 km. Four crabs averaged 8 km. per day. For travel greater than 24 km., we determined speed from the first recoveries at various distances from the release site. The most rapid movement was 11.6 km./day by a crab that traveled 314 km. (table 3).

Table 3 - Time-distance relationship for 8 blue crabs, Callinectes sapidus

Time out	Distance moved	Kilometers per day
Days	Kilometers	
4	32	8.0
5	40	8.0
33	80	2.4
31	105	3.4
34	121	3.5
39	137	3.5
42	153	3.6
27	314	11.6

LONGEVITY

Only 1.5% of the females (79 crabs) and 1.1% of the males (16 crabs) were recovered after 1 year at liberty. Eight of the females and three males were recaptured after 2, but less than 3, years. Greatest liberty periods were 940 and 1,058 days for recaptured females, and 540 and 769 days for males. These were all caught within 24 km. of their release sites.

CONCLUSIONS

In North Carolina, after the waters have warmed and during warm weather, female crabs move to high salinity for the purpose of spawning and hatching their eggs (Dudley and Judy, unpublished data). In late fall and winter, females move back into the estuaries. Only a few male crabs move from the rivers and sounds into the ocean. There was some movement by both male and female crabs between rivers and sounds; but males were less active than females and tended to remain in the area where they were tagged. Coastwise movement, mostly by females, was usually less than 80 km. and was generally south.

Commercial-size blue crabs in North Carolina do not engage in migrations that would make them available to a succession of fisheries along the coast. Thus, in North Carolina, the commercial fishery for blue crabs in any estuarine system is dependent on the number of crabs which reach maturity within that system. The population of blue crabs in one estuary, however, may be influenced by what happens in another estuary. Blue-crab larvae hatch and develop in the ocean and can be transported long distances from their point of origin (Nichols and Keney, 1963). So, even though the adults do not move up and down the coast, there is probably an interchange between estuaries as the result of larval transport.

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