BLUE CRAB (CALLINECTES SAPIDUS) DISTRIBUTION AND HABITAT UTILIZATION IN THE LOWER HUDSON RIVER AND TRIBUTARIES

A Report of the 1991 Polgar Fellowship Program

by

Jeremy J. Stein

Polgar Fellow

Advisor

Dr. Kim A. Wilson

Department of Biological Sciences

Copernicus Hall

Central Connecticut State University

New Britain, CT 06050

ABSTRACT

Blue crab (Callinectes sapidus) sampling was conducted from June to September 1991 to determine aspects of its distribution and habitat utilization in the lower Hudson River and some of the Hudson's tributaries. Paired sites in the areas of Croton Bay, Haverstraw Bay, and Wappingers Creek were sampled with commercial crab pots for comparisons of numbers, size, sex, molt stage, and evidence of burn spot disease of blue crabs in the river and tributaries. Blue crab numbers fluctuated among river and tributary locations. The size ranges varied also, most noticeably in the Wappingers area where the mean carapace width in the river site was 143.9 mm compared to 131.5 mm in the tributary site. Percentage of premolt crabs in all tributary sites was higher than in the main stem. Burn spot disease was only found in the Croton and Haverstraw samples where the water was brackish (>1 ppt). Because more small and premolt crabs were collected in most of the tributary locations, we believe these more vulnerable crabs may seek vegetated tributaries as a refuge.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

The blue crab, Callinectes sapidus, is of great commercial and recreational value. A large crab fishery extends through the south Atlantic states and along most of the eastern coast of the United States (Van den Avyle and Fowler 1984). Blue crabs occur in estuarine waters of the east coast from New England, inland in the Hudson River, through Chesapeake Bay and the Carolinas, to south Florida and the Gulf of Mexico.

Because of the blue crab's commercial and recreational importance, they have been the subject of considerable research in many areas such as Chesapeake Bay. In the Hudson River, however, virtually nothing is known about their habitat utilization and ecology. Moreover, the data collected from locations in Florida, the Carolinas, and Chesapeake Bay may not be applicable in the Hudson River because of differences in physical environmental characteristics. In contrast to the expansive and shallow Chesapeake Bay, the Hudson River is relatively narrow with water depths ranging from less than one meter in a few marshes and embayments to near 61 meters close to West Point. The Hudson River and Chesapeake Bay also differ in salinity, temperature range, and types of submerged vegetation. This study sought to determine the blue crab's distribution and habitat utilization in the lower Hudson River, and compare these data to previous studies at other locations including Chesapeake Bay.

Wilson, et al. (1990) found that juvenile blue crabs inhabit marsh creeks, eelgrass, and macroalgae in shallow back-bay estuaries of southern New Jersey. In the Chesapeake Bay area, juveniles use seagrass beds as nursery areas (Orth and Van Montfrans 1987) and molting crabs occur frequently in salt marsh creeks (Hines et al. 1987; Ryer et al. 1990). In all of these cases, juvenile and molting crabs seem to be seeking shallow water refuges. We do not know if this is also the case in the lower Hudson River with its limited shallow water habitats and species of vegetation different from those in New Jersey and Chesapeake Bay.

In this study a comparison is made between catches of adult and juvenile blue crabs in the lower Hudson River and three of its tributaries. We attempted to determine differences in numbers, size, sex, molt stage, and occurrences of burn spot disease of blue crabs collected by crab pots in paired river and tributary sites.

METHODS

<u>Sampling sites</u>

Blue crab sampling was conducted in Croton Bay, Haverstraw Bay, and Wappingers Creek along the Hudson River (Figure 1). Two habitats were sampled at each of these areas: one in the Hudson River and the other in a nearby tributary. The paired sites were Croton River and Croton Bay, the upper east side of Haverstraw Bay and at the mouth of Furnace Brook (a nearby creek), and in and outside the mouth of Wappingers Creek. Adult blue crab pots were constructed of wire mesh (4.5 cm) to dimensions 0.61 m x 0.61 m x 0.61 m. Cylindrical eel pots (0.76 m long and 0.25 m diameter) made with a smaller mesh (1.5 cm) were used to catch juvenile crabs

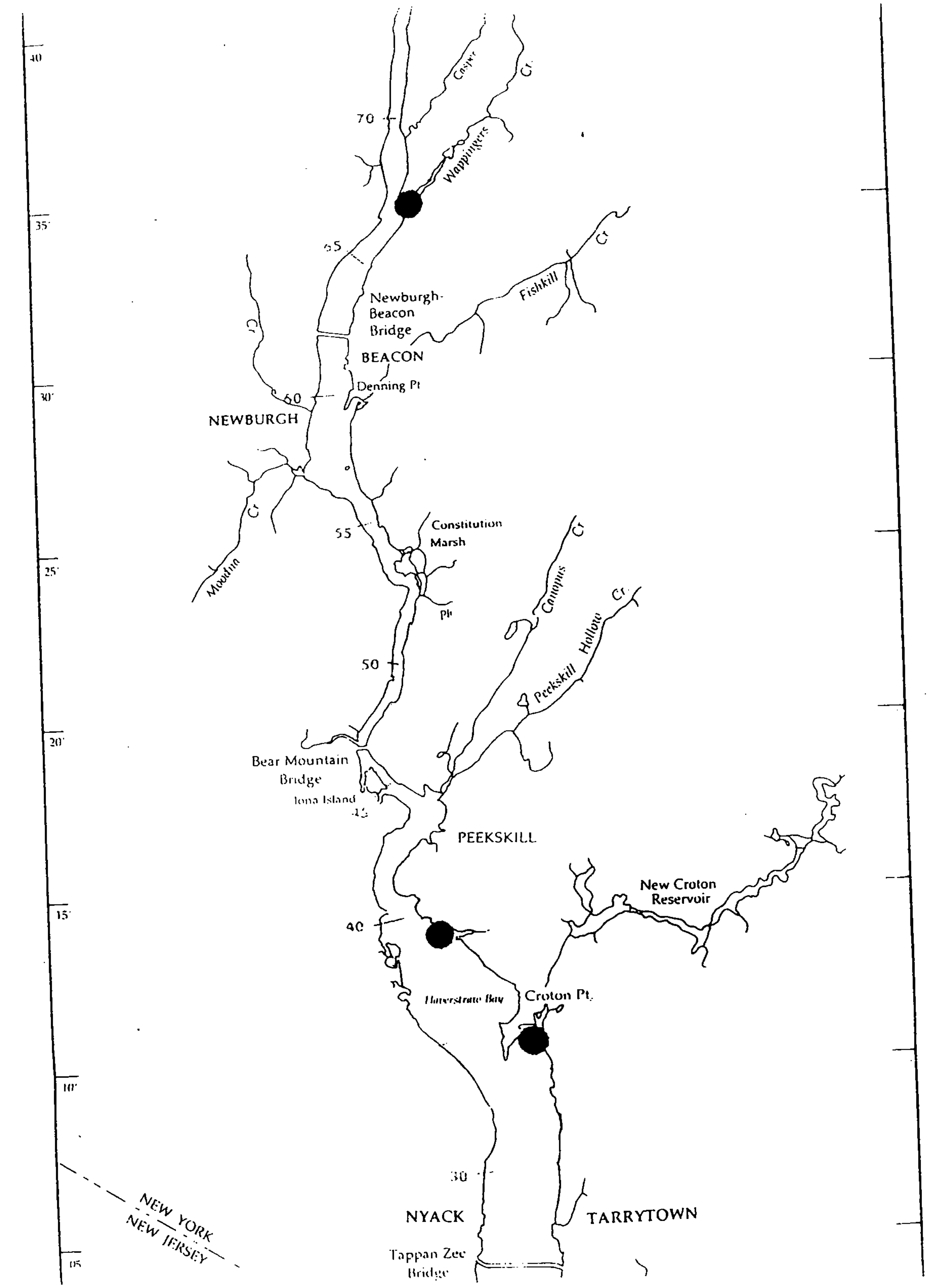


Figure 1. Map of research areas.

(< 40 mm CW). Two lines of adult pots were assembled. Each line had six pots attached at 3 m intervals. An identical set up was arranged for the juvenile pots. Each set of pots had a floating marker attached to allow for easy recovery.

To compare adult and juvenile numbers between Hudson River and tributary sites, one line of adult pots and one line of juvenile pots were set in paired habitats at each site. The pots were baited with either menhaden (bunker) or herring, set in the water, and recovered 24 hours later. The type of bait used did not appear to affect the numbers of crabs caught. All crabs were counted, and carapace width (CW), sex, molt stage, and evidence of burn spot disease were determined. Molt stage was identified by examining the dactyl of the swimming legs for color patterns. Crabs with either a white, pink, or red line on the outer edge of the dactyl were considered to be in the premolt stage (Van Engel 1958). Intermolt crabs exhibit little color variation. Temperature, salinity, conductivity, and dissolved oxygen were recorded at each crab collection site using YSI meters.

Each area was sampled at least twice (Table 1) with a variable number of pots (Table 2), and sampling at each of the three areas was conducted at different times within a 10-week period. Tide stage at the locations varied as well.

RESULTS

A total of 318 crabs was collected from all locations (Table 1), including 6 juveniles (< 75 mm CW) and 312 adults. Six

Table 1. Total crab catch and number of trials.

SITE	TRIALS	TOTAL CATCH
Haverstraw Bay	4	62
Haverstraw Bridge	2	20
Croton Bay	3	25
Croton River	3	83
Wappingers Bay	3	91
Wappingers Creek	3	37
		318

TABLE 2. Sampling dates and number of replicates.

SAMPLING DATE	LOCATION	NUMBER OF POTS
7/28/91	Haverstraw Bay	6
7/25/91	Haverstraw Bay	6
7/26/91	Croton Bay and Croton River	6,6
8/6/91	Croton Bay and Croton River	3,6
8/7/91	Croton Bay and Croton River	3,6
8/8/91	Hav. Bay and Furnace Brook	6,4
8/9/91	Hav. Bay and Furnace Brook	6,4
8/16/91	Wapp. Bay and Wapp. Creek	6,4
8/17/91	Wappingers Bay	6
8/20/91	Wappingers Creek	4
8/21/91	Wappingers Creek	4
8/22/91	Wappingers Bay	4

juvenile crabs were caught in a total of 108 pot sets. The mean number of crabs per pot was highest in the areas of Croton River and outside Wappingers Creek (Figure 2). A t-test was applied to each of the three paired locations and showed that there were significant differences in the mean number of crabs caught between the river and tributary sites of the Croton and Wappingers areas ($P<0.001$ and $P<0.002$, respectively).

In the Croton and Wappingers areas, temperature and salinity values were slightly lower in the tributary locations (Figure 3). The salinity in both the river and tributary sites in the Wappingers area measured less than 1 ppt. Average dissolved oxygen values among all sites ranged from 4.9-8.6 ppm (Table 3). Dissolved oxygen was higher at the surface of the water at all locations.

Crabs ranged in size from 200 mm CW to 32 mm CW (Figure 4). At most sites, a few small crabs (<75 mm CW) were caught, but these constituted less than 5% of the total catch in each case. A Kolmogorov-Smirnov (KS) test was performed on the distribution of crab sizes for each of the sites and showed a significant difference ($P<0.001$) between the size distribution of the crabs in Wappingers Bay and Wappingers Creek. The crabs averaged 143.9 mm in the bay compared to 131.5 mm in the creek. In Haverstraw Bay and Croton Bay, however, the distribution of sizes showed no significant differences ($P>0.10$) among the river and tributary locations.

At each area, the tributary site had a higher percentage of

Figure 2. Mean number of crabs per pot.

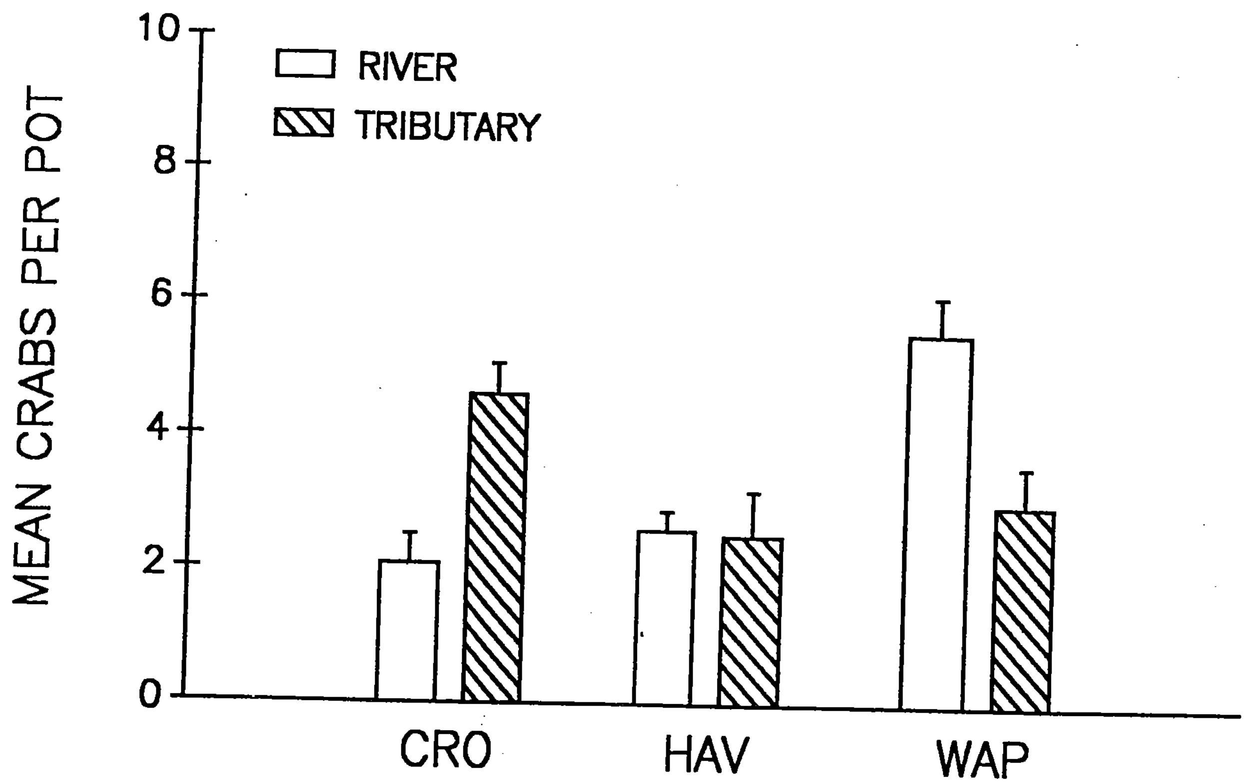


Figure 3. Average temperature and salinity measurements.

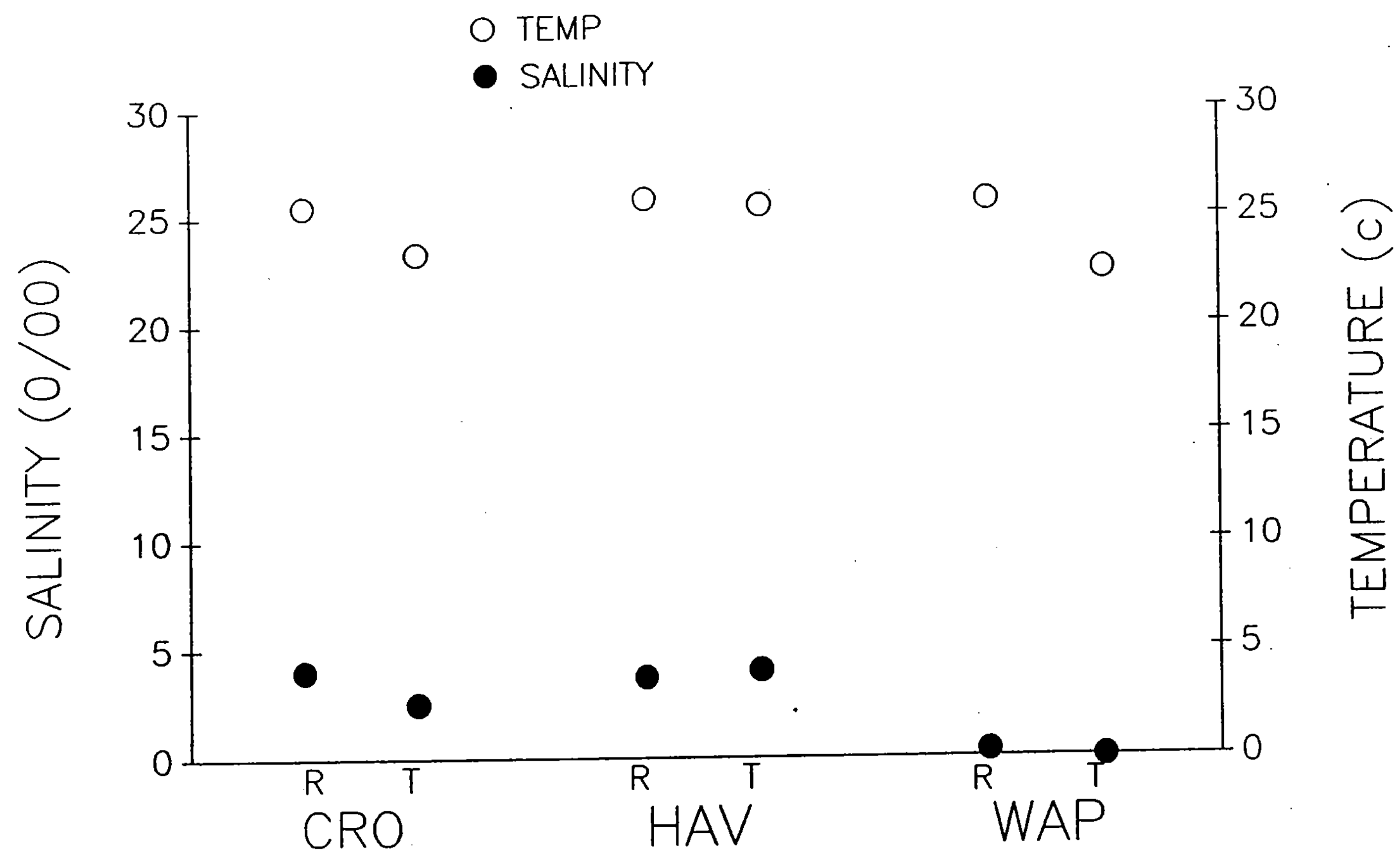
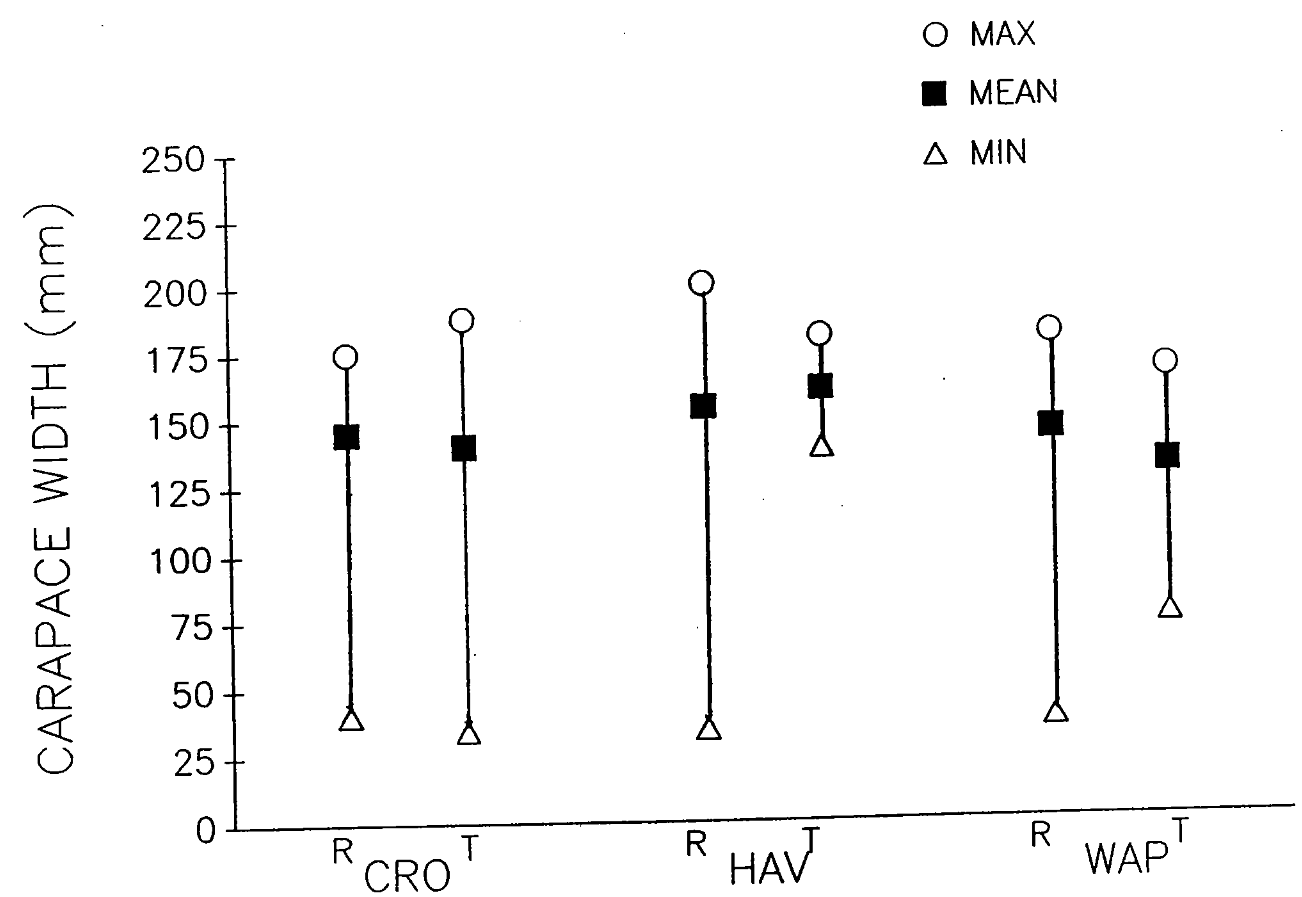


Table 3. Average dissolved oxygen values.

Average Dissolved Oxygen (ppm)		
Research Site	Surface	Bottom
Croton Bay	7.53	4.93
Croton River	7.17	6.10
Haverstraw Bay	7.67	6.40
Furnace Brook	8.60	8.20
Wappingers Bay	6.80	6.30
Wappingers Creek	6.07	5.33

Figure 4. Blue crab size ranges.



premolt crabs (Figure 5). The greatest difference occurred in the Wappingers area where 18.9% of the crabs were in the premolt stage inside the creek compared to 9.9% outside. A t-test performed on the premolt stage data showed no statistically significant differences among the river and tributary sites for the three paired locations.

Evidence of burn spot disease was found in the Croton and Haverstraw areas (Figure 6). In both locations, a higher percentage of burn spot disease occurred in the tributary sites (10.8% compared to 4.0% in the Croton area and 15.8% to 8.1% in Haverstraw). A t-test was applied which showed the differences between river and tributary were not significant ($p>0.10$). No evidence of the disease was found at the Wappingers location.

DISCUSSION

The number of blue crabs collected showed no patterns among river and tributary locations. However, blue crab size varied among and within river and tributary sites. These differences were most pronounced in the Wappingers Creek area where significantly smaller crabs were found in the tributary site. Wappingers Creek was found to be very dense with water chestnut and had very low salinities and small crabs may have sought the creek as a refuge to escape predation. Eelgrass has been found to reduce predator foraging success of adult and juvenile blue crabs (Orth and van Montfrans 1982; Wilson et al. 1990) and so perhaps water chestnut is equally effective. In addition, Holland et al. (1971)

Figure 5. Percentage of premolt crabs.

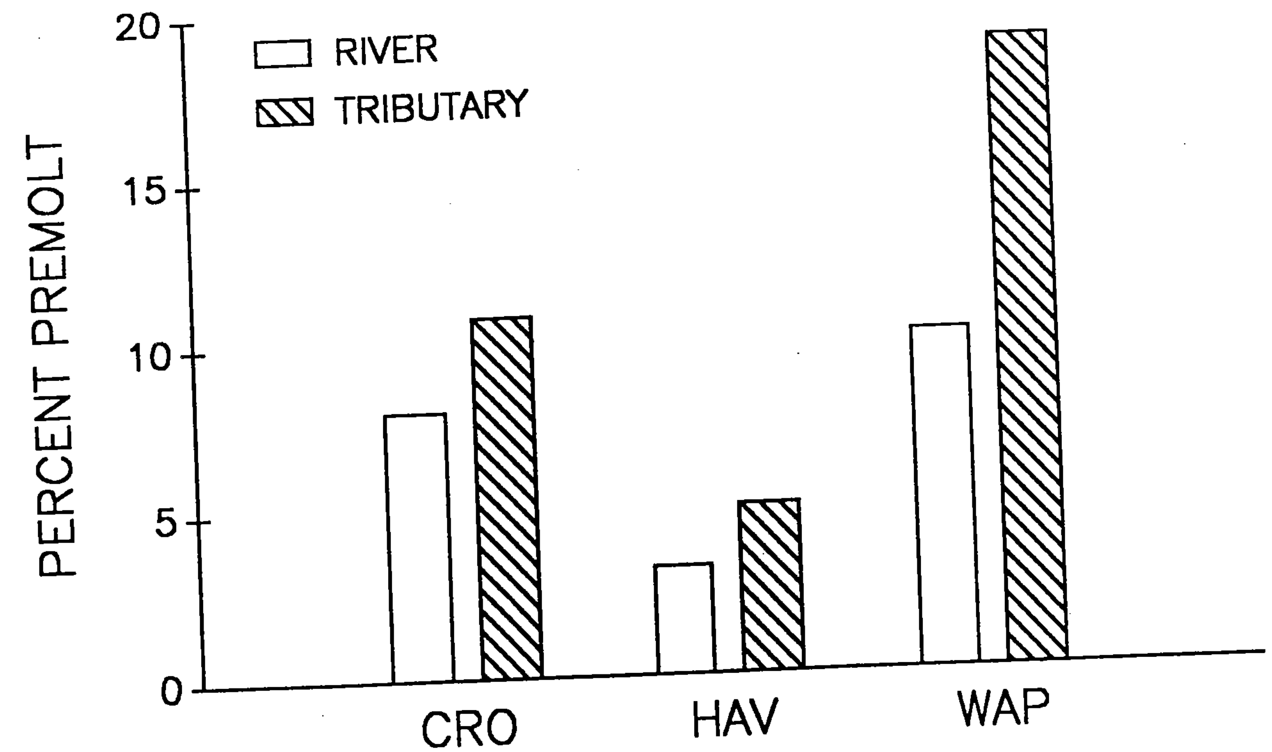
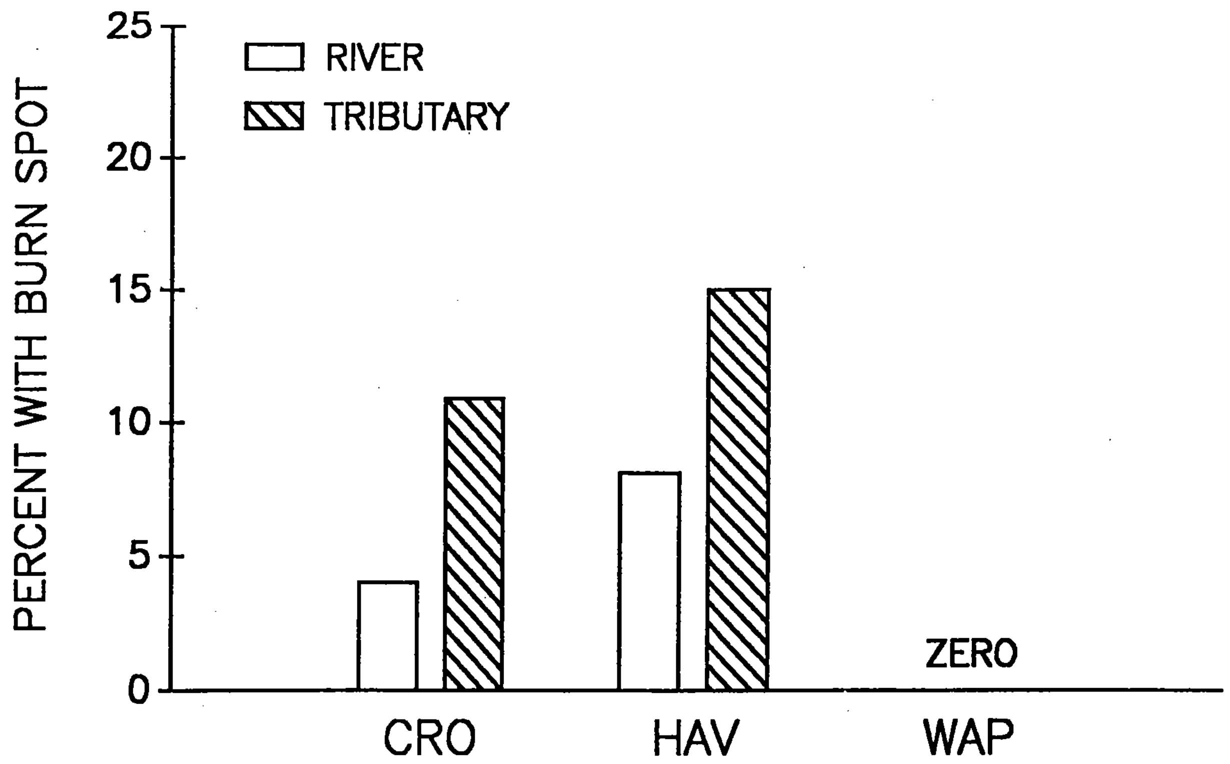


Figure 6. Percentage of crabs with burn-spot disease.



found that blue crab growth rate increased within the range of 27°C to 30°C compared to temperatures below 27°C. The mouth of Wappingers Creek had an average temperature of 27.1°C where the larger crabs were found. The small number of juveniles collected may be explained by another sampling study conducted in the fall of 1990 that found low blue crab recruitment in the Hudson River (K. Wilson, pers. comm.).

At all locations, premolt crabs showed a trend toward greater numbers in tributary sites. These crabs are nearing a very vulnerable stage where they must molt the protective exoskeleton, and then slowly harden the new exoskeleton. Smaller crabs molt more frequently than larger crabs (Van Engel 1958), thus increasing their susceptibility to predation. Molting crabs have been found to occur frequently in salt marsh creeks of the Chesapeake Bay (Hines et al. 1987; Ryer et al. 1990). In general, benthic prey experience lower mortality in vegetated, as opposed to unvegetated habitats, in both laboratory (Heck and Thoman 1981) and field tethering (with blue crabs) studies (Heck and Wilson 1987; Wilson et al., 1987). Perhaps tributaries are more favorable to these vulnerable crabs in the Hudson River.

Leffler (1972) found the growth rate per ecdysis (increase in carapace width) was directly related to temperature, suggesting that high temperatures produce larger crabs at maturity than at lower temperatures. A higher average temperature outside Wappingers Creek (27.1°C compared to 22.5°C inside the creek) was accompanied by significantly larger crabs outside the creek. Quite possibly the higher temperatures increased the growth rate of the blue crab outside Wappingers Creek and contributed to the significant differences in crab size.

Evidence of burn spot disease was found in the Croton and Haverstraw areas where the water salinity was greater than 1 ppt, but no evidence of the disease was discovered in the freshwater Wappingers area. This supports the observation that the disease only occurs in high salinity waters (K. Wilson, pers. comm.).

The higher percentage of premolt crabs in the tributaries suggest these areas may be utilized as a refuge from predation. Smaller blue crabs in the tributary site of Wappingers Creek suggest they are also seeking refuge. We propose tributaries may serve as nurseries for vulnerable blue crabs.

ACKNOWLEDGEMENTS

I deeply thank the Hudson River Foundation and the New York State Department of Environmental Conservation, Hudson River National Estuarine Research Reserve for the opportunity and funding of this research. Special thanks to John Waldman, Betsy Blair, and Stuart Findlay. Last, but certainly not least, I would like to express my gratitude to my advisor, Dr. Kim Wilson, who made all of this possible.

REFERENCES

Heck, K.L. and T.A. Thoman. 1981. Experiments of predator-prey interactions in vegetated aquatic habitats. J. Exp. Mar. Biol. Ecol. 53: 125-134.

Heck, K.L. and K.A. Wilson. 1987. Predation rates on decapod crustaceans in latitudinally separated seagrass communities: a study of spatial and temporal variation using tethering techniques. J. Exp. Mar. Biol. Ecol. 107: 87-100.

Hines, A.H., R.N. Lipcius and A.M. Haddon. 1987. Population dynamics and habitat partitioning by size, sex, and molt stage of blue crabs Callinectes sapidus in a subestuary of central Chesapeake Bay. Mar. Ecol. Prog. Ser. 36: 55-64.

Holland, J.S., D.V. Aldrich and K. Strawn. 1971. Effects of temperature and salinity on growth, food conversion, survival, and temperature resistance of juvenile blue crabs, Callinectes sapidus Rathbun. Sea Grant Program Publication SG-71-222.

Leffler, C.W. 1972. Some effects of temperature on the growth and metabolic rate of juvenile blue crab, Callinectes sapidus, in the laboratory. Mar. Biol. 14: 104-100.

Orth, R.J. and J. van Montfrans. 1982. Predator-prey interactions in a Zostera marina (eelgrass) ecosystem in the lower Chesapeake Bay, Virginia. In: Interactions of Resident Consumers in a Temperate Estuarine Community: Vaucluse Shores, Virginia, R.J. Orth and J. van Montfrans (eds.) VIMS SRAMSOE 267: 81-94.

Orth, R.J. and J. van Montfrans. 1987. Utilization of a seagrass meadow and tidal marsh creek by blue crabs Callinectes sapidus. I. Seasonal and annual variations in abundance with emphasis on post-settlement juveniles. Mar. Ecol. Prog. Ser. 41: 283-294.

Ryer, C.H., J. van Montfrans and R.J. Orth. 1990. Utilization of a seagrass meadow and tidal marsh creek by blue crabs Callinectes sapidus. II. Spatial and temporal patterns of molting. Bull. Mar. Sci. 46: 95-104.

Van den Avyle, M.J. and D.L. Fowler. 1984. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic)--blue crab. U.S. Fish Wildl. Serv. FWS/OBS-82/11.19. U.S. Army Corps of Engineers, TR EL-82-4.: 1-16.

Van Engel, W.A. 1958. The blue crab and its fishery in Chesapeake Bay. Comm. Fish. Rev. 20(6): 6-17.

Wilson, K.A., K.W. Able and K.L. Heck, Jr. 1990. Habitat use by juvenile blue crabs: a comparison among habitats in southern New Jersey. Bull. Mar. Sci. 46: 105-114.