Annual Report on the Commercial Monitoring of the Hudson River Blue Crab Fishery

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Foreword

The Hudson River Estuary Action Plan has funded the Blue Crab Project as part of its commitment to conserve fish and crustaceans in the Hudson River Estuary. The goal of the Blue Crab Project is to sustain and enhance the blue crab fishery in the lower Hudson Estuary. The Hudson River Estuary Action Plan coordinates this project through the Hudson River Fisheries Unit of the New York State Department of Environmental Conservation (NYSDEC). The NYSDEC has contracted the New England Interstate Water Pollution Control Commission (NEIWPCC) to carry out their objectives.

The main objective of the project is onboard monitoring of the Hudson River blue crab fishery to determine catch rates, size, sex, composition, timing and location of catches. This report summarizes the commercial monitoring data collected in the year 2000 crab season. The Blue Crab Project will also obtain and summarize:

- Published scientific literature pertaining to blue crabs in the Hudson River Estuary.
- Unpublished data on distribution, size and relative abundance from various fisheries sample programs.
- Historical harvest data

Cover photo by M.R. Clancy

George E. Pataki, Governor
Erin M. Crotty, Commissioner

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Introduction

Blue crabs (*Callinectes sapidus*) are an important species in the Hudson River estuary because they provide a commercial and recreational fishery in the estuary and they may also function as a keystone predator species throughout their range (Hines et al., 1990). There is currently little published data about blue crabs in the Hudson River Estuary. There is no ongoing collection of biological data for blue crabs and harvest information is limited to catch reports turned in by fishers. This project has begun the collection of important biological information about blue crabs in the estuary.

Objectives

This report summarizes information collected while observing the commercial fishery for blue crabs in the Hudson River Estuary during the summer and fall of 2000. The four main objectives of the commercial monitoring effort are:

- To collect basic biological information about crabs captured in the pots of crab fishers: sex, carapace length, and weight.
- Determine the catch per unit of effort (CPUE) for commercial crab fishers in the estuary.
- Collect water quality information in the vicinity of crab pot locations including: temperature, salinity, dissolved oxygen and conductivity.
- Explore potential relationships between water quality information and CPUE.

Methods

Description of study area

The Hudson River Estuary (Figure 1) extends north approximately 246 km (153 mi) from the Battery at New York City, to the Federal Dam at Troy. Widths of the Estuary range from less than 0.5km (0.3 mi) near the Troy dam to more than 6 km (3.7 mi) in Haverstraw Bay below Peekskill (Kahnle and Stang, 1986). Depths generally range from 10 to 20 m (33 to 66 ft) with a channel maintained for shipping from the Atlantic Ocean to Albany. The location of the salt front varies seasonally with freshwater flow.

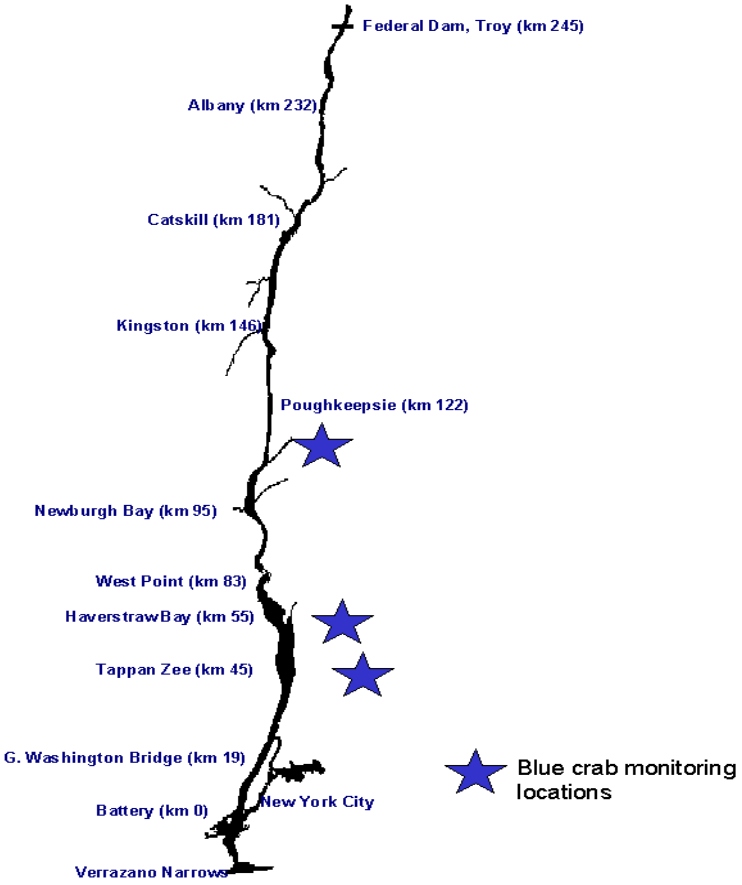
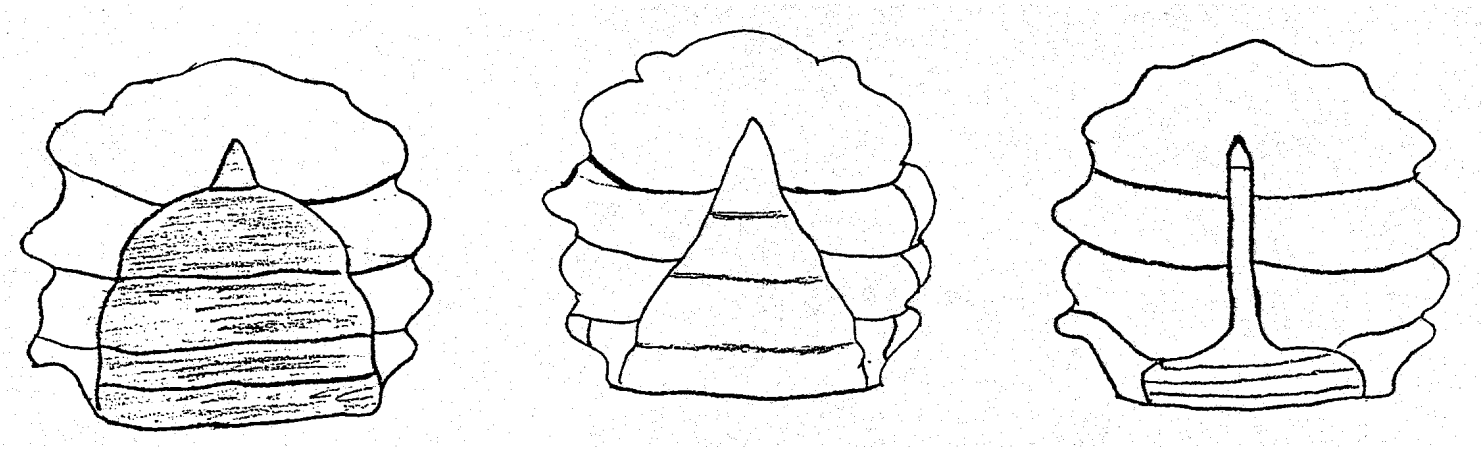


Figure 1. Important Blue Crab Project landmarks in the Hudson River Estuary

General Blue Crab biology

Little is known on the life history details of blue crabs in the Hudson River Estuary. Based on work done in the Chesapeake Bay, however, we can make some generalizations about the likely life history of blue crabs in the Hudson. The blue crab is a crustacean that inhabits the entire Hudson River Estuary. After hatching, their lives begin as zoea, a planktonic form, moving out of the estuary at the mercy of tides and wind to develop in the near shore ocean. After 10-12 molts, about two months, the larval form gradually assumes the shape of a crab. At this stage they begin to move back into the estuary. Juvenile crabs can be found throughout the estuary as they continue to molt and grow.

Female crabs are mature after 18 to 24 months, when they measure approximately five inches from point to point across the back (carapace length). Females undergo their final molt when sexually mature. It is at this final molt that the female undergoes her once in a lifetime mating event. The female then stores the sperm for future spawning events, which may occur three to four times annually over the course of her life. The eggs develop beneath her apron and she carries them until she spawns in the lower estuary in areas of high salinity. Higher salinity water has been found to be favorable for larval development (McClintock et al., 1993). Males continue to molt and grow throughout their lives. The shape of their aprons (Figure 2) can distinguish males and females.



MATURE FEMALE **IMMATURE FEMALE** **MALE**

Figure 2. Shape differences in blue crab aprons

Once mature the blue crab is a dominant benthic predator. Its powerful claws allow it to lay in wait to ambush small fish that pass by. It also preys upon other crabs, bivalves and dead organisms on the river bottom. The blue crab has strong back appendages it can use as paddles to propel itself through the water. The use of these "paddles" probably inspired the crabs Greek name *Callinectes*, meaning beautiful swimmer.

Hudson River Blue Crab fishery

The blue crab fishery in the Hudson River Estuary is typically a summer and fall endeavor. Many of the participants were also shad fishers who began crabbing shortly after the shad fishing ended. All of the fishers used crab pots to capture the crabs. These pots are made of 1 ½ inch meshed plastic coated chicken wire that measure eight cubic feet and had holes on four sides for the crabs to enter. The crabs were coaxed into the pot by a container in the center that holds bait. Baits used in the Hudson River included Atlantic menhaden (*Brevoortia tyrannus)* and chicken. The crabs enter the pots and are trapped by a design that takes advantage of their instincts to rise when they feel trapped.

There are approximately 705 people that hold crab permits in the State of New York. A moratorium on new crab permit holders has been in place since 1999. Of those 705 crab permit holders in the state, twelve are known or suspected to crab in the Hudson River Estuary. We monitored the tending of pots with three fishers in the year 2000. One fisherman refused permission to monitor his efforts and several fishers did not actively fish in the 2000 season.

It is important to note that the crabs that were counted and measured by the on-board monitor were selected from all crabs caught, including those that were returned to the estuary. Generally, all of the fishers voluntarily returned female crabs and crabs less than 5 inches in carapace length to the estuary. There is currently no regulation that requires this practice. Current law requires only those crabs bearing eggs, or "sponge crabs," be returned to the estuary. There are currently no size or harvest limits on commercial harvest of blue crabs in the Hudson River estuary. Blue crabs offered for sale are often divided into two size categories. "Number ones" include all crabs over 5.5 inches and command a premium price. "Number twos" are the smaller crabs between 5 and 5.5 inches.

Data Collection

All of the information collected on blue crab catches in the commercial blue crab fishery was obtained through direct observation. Contact was made with these crabbers and permission was asked to monitor their catch. The fishers that consented were observed while they emptied or checked their crab pots. Data on river mile location, location relative to the channel, number of pots checked, time fished (in hours), bait used, water temperature, percent of dissolved oxygen, dissolved oxygen, conductivity, specific conductance, and salinity were collected for each trip. Water quality data were taken with a YSI model 85 handheld digital meter. The wire of the unit was marked off at foot intervals and a weight was attached to the end ensuring that the probe was at the desired depth. Data were collected at a depth of 1.5m (5ft) at each set location. Water quality profiles were taken at selected locations throughout the season.

The total blue crab catch for the trip was recorded in either number of crabs or number of bushels of crabs caught. A representative sample of total catch were measured, 10 males and up to 10 females per trip. The crabs were measured from point to point on the carapace to the nearest millimeter and weighed to the closest gram.

Results

The Hudson River blue crab monitoring effort resulted in twenty-five trips with fishers in the estuary. Length and weight data for both males and females were taken on a representative sample of crabs from each trip (Table 1, Figures 3 and 4).

Table 1. Length-frequency data for blue crabs measured in 2000, with average lengths and standard deviation.

	June		July		August		September		October	
Carapace width	male	female	male	female	male	female	male	female	male	female
90-94	0	0	0	0	0	0	0	0	0	0
95-99	0	0	0	0	0	0	0	1	0	0
100-104	0	0	0	1	0	2	0	0	0	1
105-109	0	0	0	2	0	7	0	0	0	0
110-114	0	0	0	2	2	3	1	0	0	1
115-119	0	0	0	3	0	4	1	0	0	0
120-124	0	0	0	1	1	2	4	4	1	0
125-129	2	0	0	2	3	3	6	4	1	0
130-134	1	0	3	1	7	2	5	3	2	0
135-139	1	0	5	1	10	3	14	4	3	2
140-144	2	0	6	0	6	2	13	13	3	1
145-149	1	0	4	5	2	3	13	11	4	1
150-154	2	0	6	2	4	5	11	13	2	6
155-159	0	0	8	1	6	4	16	10	3	5
160-164	1	0	3	1	2	1	9	12	0	0
165-169	0	0	4	0	8	1	9	6	1	3
170-174	0	0	5	0	2	0	4	2	0	0
175-179	0	0	1	0	3	1	3	0	0	0
>180	0	0	5	0	3	0	0	1	0	0
TOTAL	**10**	**0**	**50**	**22**	**59**	**43**	**109**	**84**	**20**	**20**
Average Length	143	0	156	131	144	132	148	149	144	149
STD	11.1		15.2	17.9	19.0	20.7	14.2	13.8	11.3	16.2

Figure 3. Mean length of blue crabs collected by Hudson River fishermen, year 2000

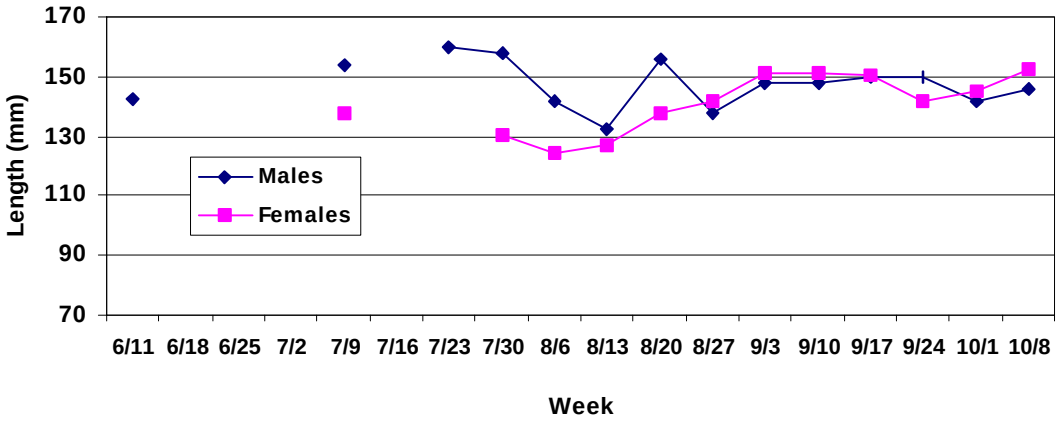
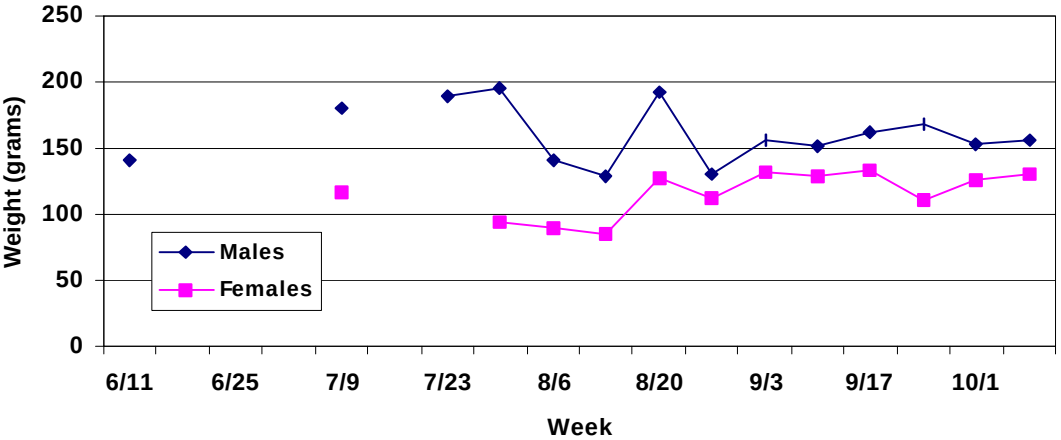
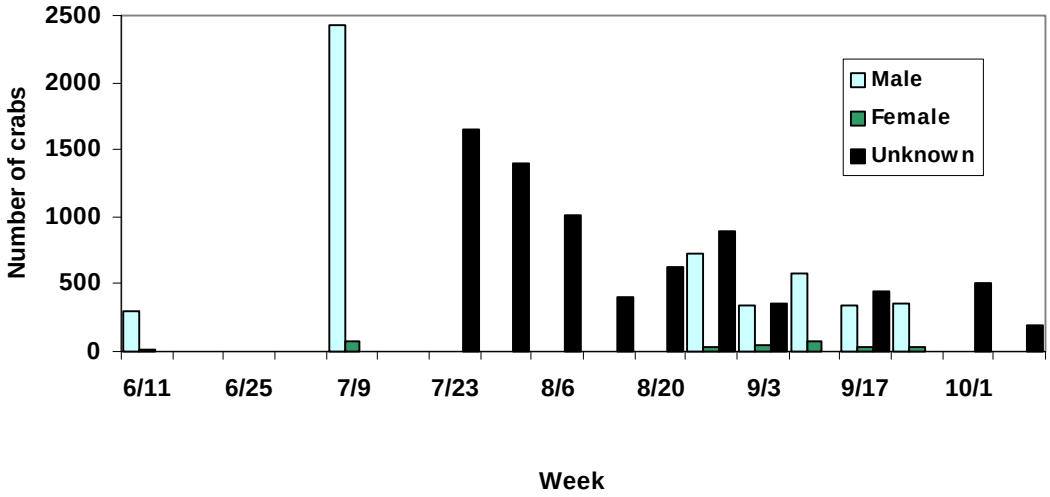


Figure 4. Mean weight of blue crabs captured in Hudson River Estuary, year 2000



Observed fishing activity was distributed around three major areas: Poughkeepsie (RM 72), Stony Point (RM 39) and the Tappan Zee bridge (RM 27)(Figure 1). The total number of crabs caught during monitored trips was estimated from the number of bushels caught by the fishers and the average number of crabs per bushel. The total weekly catch observed by all fishers is summarized in Figure 5.

Figure 5. Observed blue crab catch by Hudson River Estuary blue crab fisherman, year 2000



While this gives us a raw number of crabs caught it does little to estimate catch rates because the number of trips with an on-board monitor varied each week and the amount of effort put in by each fisherman varied with each trip. A summary of the number and duration of crab pots fished by each fisher is summarized in Table 2.

Table 2. Average number of pots fished (with standard deviation) and average duration (with standard deviation) of soak time over the course of the 2000 season.

ID	average # pots	STD	average duration (hrs)	STD
83	35.0	23.4	168.0	n=1
246	90.9	36.7	79.0	44.0
2337	41.6	4.2	84.0	22.6

In order to standardize catch rates we calculated a catch per unit of effort for each trip. This allows us to compare the success of different trips within the season. This standardized catch rate is determined by dividing the total catch by the effort. The total catch is simply the number of crabs brought on deck. The amount of effort is equal to the product of the number of pots fished and the number of hours the pots were fished (Figure 6).

$$\text{Catch per Unit Effort (CPUE) per trip} = \frac{\text{Total number of crabs caught}}{(\text{Number of pots}) \times (\text{Duration (hrs)})}$$

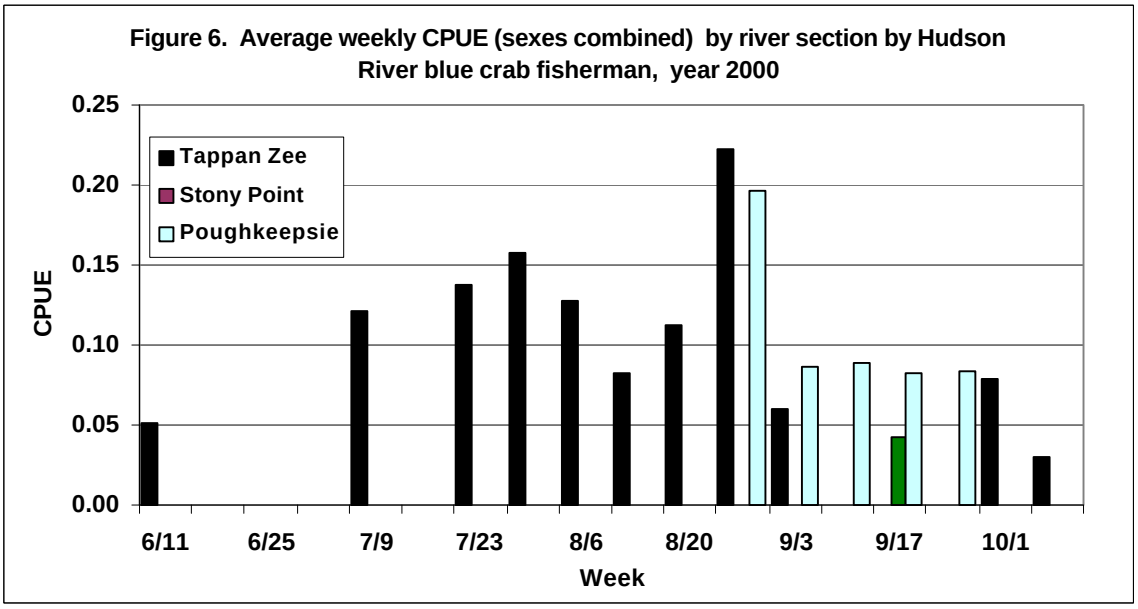
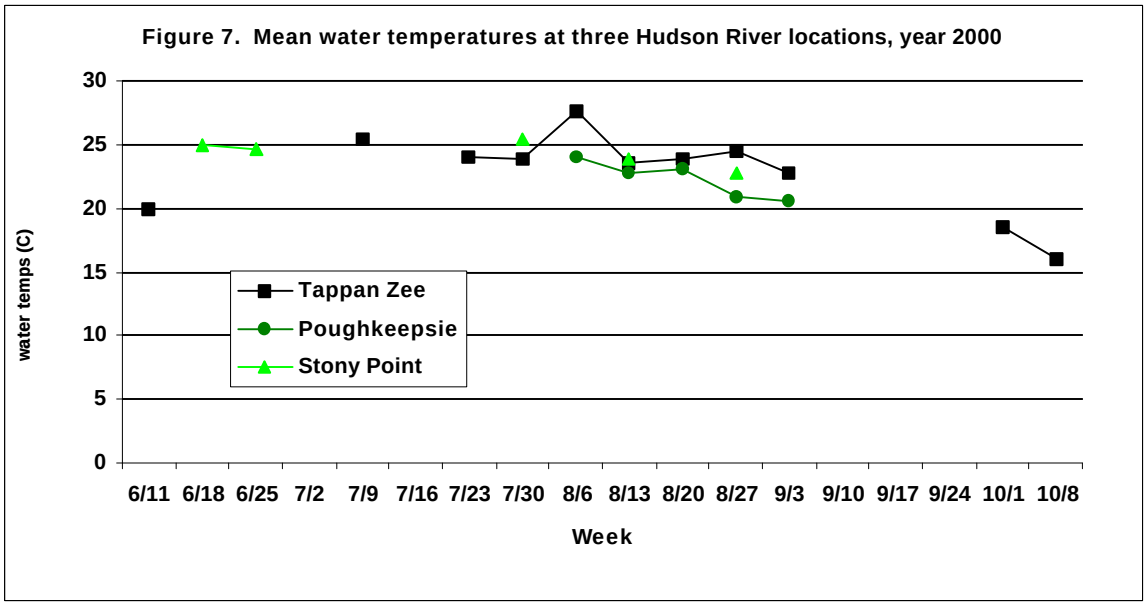
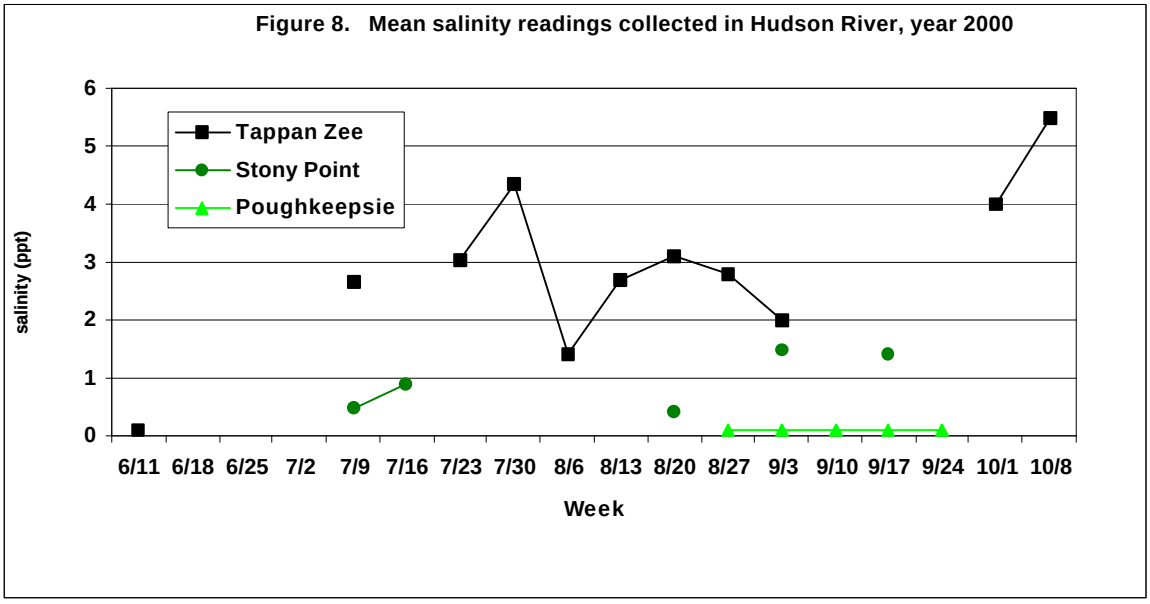


Figure 6. Average weekly CPUE (sexes combined) by river section by Hudson River blue crab fisherman, year 2000

Water quality data were taken at all sites throughout the crabbing season. Water temperature and salinity reading for all three areas are displayed in Figures 7 and 8.





Discussion

Total observed catch of blue crabs per week varied depending on the number of trips taken by observers and the amount of effort put forth by the observed fishers. We determined a standardized per trip unit, CPUE, to express the relative success of each trip. The 2000 season started late due to extended rains and high water into June (See Appendix 1). Most fishers did not start crabbing in earnest until the end of July. Above average rainfall throughout the season kept salinity levels relatively low. With the ongoing monitoring of this fishery we will more easily be able to document how these variables affect the harvest of blue crabs.

Crabbing in the Hudson River Estuary tends to catch many more males than females. We believe this is because of the different behavior exhibited by male and female blue crabs. While this is yet to be confirmed in the Hudson River, studies of blue crabs in the Chesapeake Bay show that blue crabs mate in brackish water. Males then move to areas of fresher water and females move to areas of higher salinity. The fishers that we monitored were fishing in areas that seem to have been fresher than is preferred for breeding, resulting in the catch of a disproportionate number of male crabs. In the 2001 field season the number of “couplers”, a female crab in the grasp of a male crab, will be recorded. This behavior occurs before mating and may allow us to evaluate the potential relationship between salinity and mating in blue crabs in the Estuary.

The mean length patterns collected in the 2000 season shows some interesting trends. The female crabs appear to get bigger throughout the year. This is what one would expect for juvenile female crabs, but once female crabs mature they cease molting. Therefore, we would expect mature female crabs to reach a peak size at some point during the season. The 2001 field season will include the notation of whether or not female crabs are mature. This will allow us to better analyze the trends in female crab growth.

The mean length of male crabs throughout the 2000 season does not seem to show a trend. It goes up and down but does not seem to increase or decrease over the course of the season. This is interesting because if the percentage of kept males increases throughout the season and the size of the male crabs does not, the data would imply either an effect of fishing or pot selectivity. In the year 2000 only catch data was regularly collected, so the percentage of males kept cannot be determined. In future seasons we will collect information on whether or not all crabs were kept or released.

We also identified a potential source of bias in the selection of crabs to be measured. The sample was potentially biased towards crabs that were to be returned to the river, as opposed to those that were to be kept, at one of the fishing locations. We will randomly select crabs from all size classes for the 2001 field season.

Another priority that has emerged from the analysis of the data is the need to have data on Hudson River Estuary crabs that is unbiased by any potential pot selectivity effect. The State of Maryland conducts a survey using a dredge to collect overwintering blue crabs (Glen Davis, personal communication). This survey uses a dredge to dislodge blue crabs by scraping along the bottom of a body of water with a bar or toothed scrape. A bag, attached slightly behind the bar, then collects the blue crabs that are disturbed in the sediment. This collection method is referred to as “dredging.” Dredging is not permitted as a commercial collection practice in the Hudson River Estuary, so we would be unable to collect information by using crabs collected by commercial dredge operators. We intend to outfit a small trawling vessel with a dredge to collect blue crabs in the winter of 2001-2002. This will allow us to collect biological information on blue crabs that is not biased by any effects of crab pot fishing. Size data from crabs caught in pots can then be compared to size data from crabs caught in a dredge.

After just one season of field collection broad generalizations about how water temperature and salinity affect CPUE are premature. There does seem to be some connection between CPUE (Figure 6), salinity (Figure 8) and temperature (Figure 7) in the Tappan Zee area. The two peaks of CPUE occur in the weeks of July 30th and August 27th . These relate very well with the two peaks of salinity. Heavy rain events (Appendix 1) caused the salinity and CPUE to markedly decrease shortly after these peaks. We can also see that salinity is not the only factor affecting CPUE. In late September and early October salinity in the Tappan Zee area was higher than it had been all season. The temperature, however, had dipped below 20 degrees Celsius for the first time since early June and CPUE did not increase with salinity. Additional data will allow us to expand this analysis.

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Appendix 1

Historical and year 2000 streamflow data for major Hudson River tributaries unaffected by dam activity. (Courtesy United States Geological Service)