Chapter 8.6

Status of blue crab, *Callinectes sapidus*, populations in the Maryland Coastal Bays

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Abstract

The blue crab, *Callinectes sapidus*, is a valuable resource in the Coastal Bays, supporting a steady commercial and recreational fishery. Surveys suggest that blue crab abundance fluctuates without an apparent trend, yet there is still a successful annual commercial fishery that even attracts crabbers from the Chesapeake Bay. Since 1990, commercial landings for crabs have averaged from 0.5 to 1.5 million pounds. Commercial landings for 2003 were 1.17 million pounds. Unlike Chesapeake Bay landings data, these appear to fluctuate without trend. During 2003, the fishery independent trawl and seine survey caught a total of 6,754 blue crabs. An examination of 2,627 legal blue crabs taken by trawl net over a 13- year period indicates no decline in average size, suggesting minimal increases in fishing pressure. Like commercial landings, these catches have generally fluctuated without trend.

Environmental and hydrographic factors play a key role in blue crab recruitment (movement into the Coastal Bays). One factor that may affect blue crab populations is a parasite (*Hematodinium* sp.) that kills crabs in late summer and fall. Blue crabs may also be threatened by the presence of invasive species such as green and Asian shore crabs (*Carcinus maenas* and *Hemigrapsus sanguineus*).

A. Blue crab abundance

Introduction

The blue crab, *Callinectes sapidus*, is a valuable resource to the Coastal Bays ecosystem and the commercial and recreational efforts it supports. Since 1990, commercial landings for crabs have averaged from 0.5 to 1.5 million pounds annually. The Coastal Bays Fisheries project (CBFI) has conducted annual surveys of the Coastal Bays since 1972. Although blue crab monitoring is not an official component of the CBFI, some data is available through the CBFI and through reported catch data.

Management Objective: Maintain optimum sustainable blue crab populations (MCBP CCMP objective FW 1.4)

***Draft* Blue crab Indicator:** Abundance/ trends

Analyses

Abundance – commercial landings, independent trawl survey mean size comparison (Casey et al. 2001b).

Hematodinium – occurrence, relationship to salinity, temporal variability.

Status of blue crab abundance

Commercial landings from these bays for 2003 were 1,168,960 pounds. Unlike the Chesapeake Bay, these Coastal Bays landings appear to fluctuate without trend (table 8.6.1). During 2003, the fishery independent trawl and seine survey caught a total of 6,754 blue crabs. Like commercial landings, these catches have generally fluctuated without trend (Figure 8.6.1).

Table 8.6.1 Reported Landings of Hard, soft and peeler crabs (in Pounds) in Coastal Atlantic Waters under the jurisdiction of the State of Maryland.

Year	**Landings (Pounds)**
1997	1,146,487
1998	541,292
1999	561,216
2000	1,422,277
2001	1,881,068
2002	1,168,469
2003	1,168,960
AVERAGE	**1,165,824**

An examination of 2,627 legal blue crabs taken by trawl net over a 13 year period indicates no decline in the mean size (~140 mm), which might otherwise indicate increasing fishing pressure (Casey et al. 2001b). An examination of mean size from trawl caught blue crabs from 1991 through 2001 indicated a size variation from 137.6mm (5.42 inches) to 142.8mm (5.62 inches).

Indirect information suggests that spawning and recruitment of blue crabs in the Coastal Bays system may vary from that of the Chesapeake Bay. Water circulation is slow and, in many areas, larvae may be entrained in the bay system rather than being carried out on currents. At certain times of the year, megalops stage larvae of the blue crab were found to be abundant in the vicinity of the Chincoteague and Ocean City inlets. This, along with other factors, suggests that a substantial number of crabs may be recruited from other sources to these bays. This possibility should be examined further.

During the winters of 2000 and 2003, a total of 64 sites were examined to locate the overwintering sites of mature female blue crabs. Like female crabs in the Chesapeake, Coastal Bays females appear to seek out the deepest waters for overwintering, constituting the largest percentage by sex of crabs using these sites. In the northern bays of Assawoman, Isle of Wight and Sinepuxent, these areas are represented by the dredged navigation channels. However, in Newport and Chincoteague Bays to the south, no such dredged channels exist. Here, the mature female crabs appear to still seek the deeper water (7 to 9 feet), but are found intermixed with immature males and females as well as mature males (Casey 2004, in review).

B. Parasitic infection

General Introduction

Hematodinium sp. is a parasitic dinoflagellate that infects and kills blue crabs. Outbreaks of disease caused by *Hematodinium* sp. in blue crabs have been reported in several coastal states. In the laboratory, experimentally infected blue crabs suffer high mortality rates (>86%) to the resultant disease, a level seven to eight times higher than uninfected controls. Current models project crab abundance based on constant low levels of natural mortality. They do not consider the potential epizootics and resulting mortalities caused by *Hematodinium* sp. or other diseases.

Several commercially important crustaceans have been reported infected with *Hematodinium* spp. including the Tanner crab (*Chionoecetes bairdi*), the snow crab (*Chionoecetes opilo*), the Norway lobster (*Nephrops norvegicus*), the velvet swimming crab (*Necora puber*), and the blue crab (*Callinectes sapidus*) in the U.S.A. Other commercial species are also hosts to *Hematodinium* sp. infections, including 2 species of rock crabs (*Cancer irroratus* and *C. borealis)*, the Australian blue crab (*Portunus pelagicus*), and the mangrove crab (*Scylla serrata*). Infections also occur in lady crabs (*Ovalipes ocellatus*), obligate coral-dwelling crabs, and amphipods.

Hematodinium sp. in the Coastal Bays

In 1992 watermen from Maryland Coastal Bays reported crabs dying in their baited crab pots. Upon investigation, adult and juvenile blue crabs from Coastal Bays of Maryland, Delaware, and Virginia were found infected with *Hematodinium* sp., a parasitic dinoflagellate. Dinoflagellates were found in hemolymph and tissues of sick crabs where the parasite proliferates and causes mortalities. Studies conducted since 1992 have indicated that in coastal bays of the Delmarva region, prevalence of infected crabs follows a seasonal pattern with up to 90% of crabs infected during early winter. Heavy mortalities were reported by watermen during summer months.

Blue crabs infected with *Hematodinium* sp. have been reported in other areas along the Atlantic and Gulf Coasts (Newman & Johnson 1975, Couch & Martin 1982, Overstreet

1978). Prevalence of infected crabs varied depending upon location, and infections were found more often in shallow the Coastal Bays than in deeper, larger estuaries.

Crustaceans other than blue crabs are also affected by *Hematodinium* spp. dinoflagellates; these included amphipods, green crabs, Tanner crabs, and other commercially important species.

Prevalence of *Hematodinium* sp. infections in blue crabs is seasonal. The seasonal infection cycle and apparent salinity and temperature requirements for infections indicate that environmental factors influence the parasite's ability to proliferate within crab hemolymph. Additionally, host factors such as size influence the prevalence of infections. The prevalence and intensity of *Hematodinium* sp. in blue crabs are seasonal and peak in late autumn and early winter in Maryland coastal bays. The apparent 0% prevalence from late winter through spring in coastal bays of the Delmarva region (Messick 1994) is likely caused by low water temperature reducing *Hematodinium* sp. numbers to unobservable levels within the hemolymph. Winter temperatures appear to provide a refuge from infection for crabs overwintering in coastal bays of Delmarva.

Periodic outbreaks of dinoflagellate infections with subsequent high host mortalities prompted a study of the epizootiology and distribution of the crab pathogen beginning in 1992. Hemolymph samples from over 13,000 crabs were assessed for infections over eight years. Moderate to high prevalence were found at several locations along the Atlantic and Gulf coasts of the United States. In the Coastal Bays of Maryland and Virginia, prevalence followed a seasonal pattern with a sharp peak in late autumn. Infections were significantly more prevalent in crabs measuring less than 30 mm carapace width; host sex did not influence prevalence. Prevalences were highest in crabs collected from salinities of 26-30‰; no infected crabs were found in salinities below 11‰. Intensity of infection did not vary among crab sizes, molt stages, or sexes. Several other crustaceans, including gammaridean amphipods, xanthid (mud) crabs, and the green crab *Carcinus maenus,* were found with *Hematodinium*-like infections. Considering its widespread distribution and high pathogenicity, we suggest that *Hematodinium* sp. represents a significant threat to blue crab populations in high salinity estuaries along the Atlantic and Gulf coasts of the USA.

Blue crabs from the Coastal Bays had high prevalence of *Hematodinium* sp. infections, especially during autumn months. Within the Coastal Bays, the distribution of *Hematodinium* sp. was significantly associated with high salinities ($p<0.0001$). Prevalence was highest in the 26-30‰ salinity range with 38% infected ($n = 2,130$). No crabs collected from salinities <11‰ ($n = 45$) were found with infections. Prevalence of *Hematodinium* sp. varied significantly among 20 trawl stations ($p<0.0001$). Stations T01-T07, located north of Ocean City Inlet, were among the stations with the lowest prevalence. Additionally, stations T12 and T17 in the upper reaches of Newport Bay and Green Run Bay had relatively lower prevalence of infections than nearby stations (Figure 8.6.2). Average salinities at stations T05 and T12 were comparatively lower than nearby stations (Figure 8.6.2).

Hydrographic features may contribute to epizootics of *Hematodinium* sp. in blue crabs. In the Coastal Bays, the prevalence of *Hematodinium* sp. varied by location in relation to salinity, and to general drainage or flushing patterns. Stations with some of the lowest prevalence were located north of the ocean inlet, and in tributaries (Figure 8.6.2). The greatest drainage of this system is into the northern portions (Sieling 1960); i.e., increased flushing via this drainage pattern may partially explain the lower prevalence of infections in the northern Coastal Bays. Hydrographic conditions may contribute to high prevalence of infections in crabs from Chincoteague Bay, Wachapreague, Virginia, and Red Bank Creek, Virginia. Limited flow of water through these shallow, high salinity lagoons may focus or amplify the infectious stages of the parasites. The region includes relatively closed crab populations, based on low immigration and emigration rates of juveniles and adults, relatively high salinity with little water exchange between the open ocean and backwaters, and stressful conditions such as high temperatures and seasonal hypoxia. Similar conditions exist in many small estuaries along the mid-Atlantic and southeastern USA.

Management Objective: Maintain optimum sustainable blue crab populations (FW 1.4)

***Draft* Blue crab Indicator:** *Hematodinium* infection

Status of Hematodinium Infection

A. 2003 Field Studies

Crabs from Maryland Coastal Bays were sampled June 17-20, 2003. A total of 76 crabs were assayed for disease via a hemolymph smear. *Hematodinium* was present in 11% of assayed crabs. Average size of crabs was 66.4 mm carapace width.

Crabs were collected from Ed Lynch, a local waterman, on July 8th, 2004. He is a coastal bay waterman who was complaining of crabs dying in his pots and on the way to the market. Approximately 50% of crabs he selected as being sick had *Hematodinium* sp. in their hemolymph.

Crabs from Maryland Coastal Bays were sampled in July, August, and September. A total of 434 crabs were assayed for disease via hemolymph smears during this quarter. Results showed a 12 to 33% infection rate.

Table 8.6.2: Results of blue crabs assayed for *Hematodinium* prevalence in 2003.

Month	# Crabs sampled	% Prevalence of Hematodinium	Average crab size (mm)
July	319	23	92
August	33	0	79
September	82	12	102

B. Experimental Studies

Past Experimental Studies -*Hematodinium* sp. infections in blue crabs from the United States are widely distributed and prevalence is influenced by location, salinity, and host size (Messick 1994, Messick & Shields 2000). Seasonal infection cycle and apparent salinity and temperature requirements for infections in wild crab populations indicate that environmental factors influence the parasite's ability to proliferate within crab hemolymph. A series of experiments found that low water temperature and salinity limit the proliferation of *Hematodinium* sp. in blue crab hemolymph (Messick 1999; Jordan et al. 1999). Blue crabs that were experimentally infected with 10^3 or 10^5 cells of *Hematodinium* sp. began dying 14 days post injection with a median time to death of 30.3 ±1.5d (SE). Subsequent mortality rates were 86% in infected crabs as opposed to 20% in control animals (Shields and Squyars 2000).

Current Experimental Studies – Blue crab population models do not consider the effects of epizootics and resulting mortalities caused by *Hematodinium* sp. or other diseases in their projections of crab abundance (Lipcius & Van Engel 1990; Abbe and Stagg 1996; Rugolo et al. 1998). Mortality rates and time to death in infected blue crabs would give an estimate of mortality based on infection level. The goal of current research is to experimentally assay days to mortality in crabs experimentally infected with a known density of parasite. Shields and Squyers (2000) conducted similar experiments in crabs inoculated with known quantities of *Hematodinium* sp., but did not detect a significant variation in mortality between two parasite density inoculums. National Oceanic and Atmospheric Administration, NOAA, plans to assay mortality between two size categories in crabs inoculated with a known parasite density. This information will give blue crab fishery managers a better estimate of mortality in crab populations affected by the parasitic dinoflagellate, *Hematodinium* sp.

Overall Summary

Blue crab abundance is fluctuating without trend yet there is still a successful annual commercial fishery that even attracts crabbers from the Chesapeake Bay. Environmental/hydrographic factors play a key role in blue crab recruitment. One factor that may affect blue crab populations is a parasite that infects crabs and is believed to kill crabs in August. Blue crabs may also be threatened by the presence of invasive crabs such as the green crab and the Pacific Shore crab.

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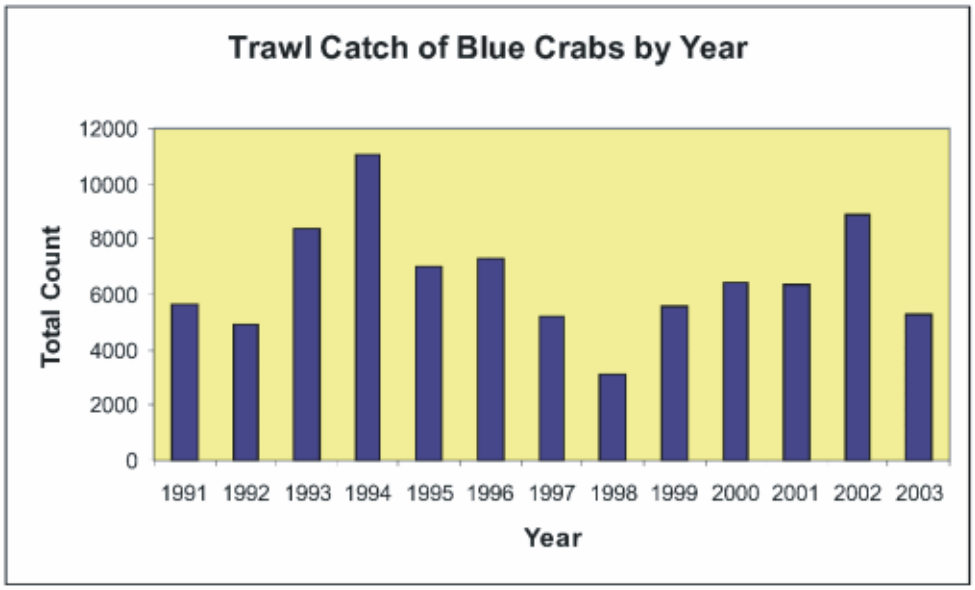

Figure 8.6.1: Annual blue crab landing during the DNR fisheries trawl survey.

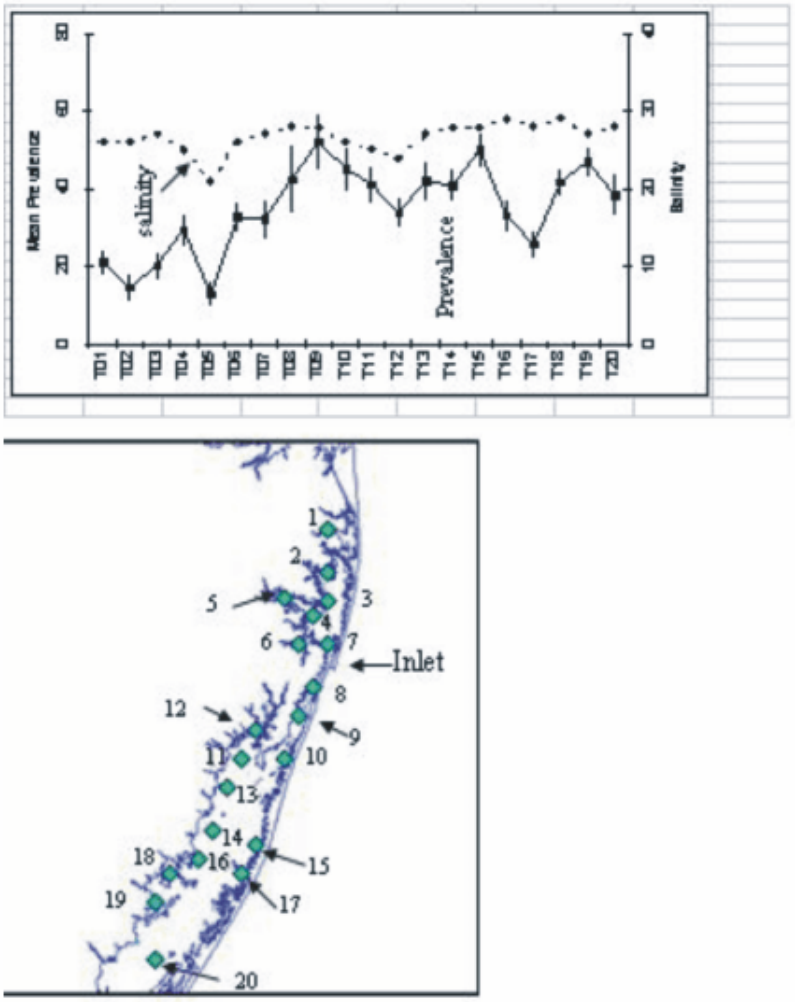

Figure 8.6.2: Prevalence of *Hematodinium spp*. parasite in blue crabs from Coastal Bays stations, 2003.

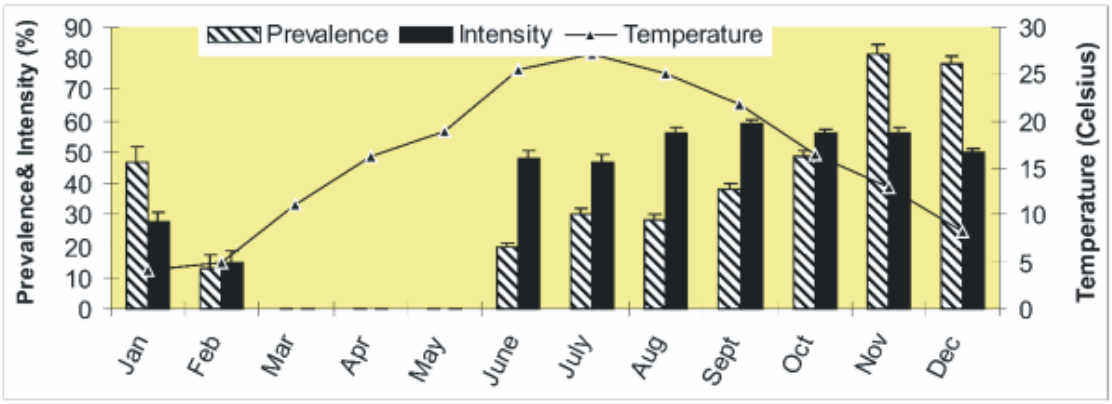

Figure 8.6.3: Prevalence and intensity of *Hematodinium* infection among months (2003).