Massachusetts
Division of Marine Fisheries

Massachusetts 2009 Compliance Report to the Atlantic States Marine Fisheries Commission – Horseshoe Crab

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I. Introduction

a. Summary of the year highlighting significant changes in monitoring, regulations or harvest.

Reported bait harvest to date is 98,279 crabs, down 5% from last year. Spawning surveys were continued for the second year following the protocol of Delaware Bay surveys, as described in the 2008 report. Two new areas – Martha's Vineyard and Nantucket - were added. A total of 26 beaches in MA were surveyed by over 200 volunteers and staff from 13 agencies and institutions. Efforts were coordinated with RI, CT, NH, and NY. It is anticipated that this will be an annual survey.

II. *de minimis* status – not applicable

III. Previous calendar year's fishery and management program

a. Activity and results of fishery dependent monitoring.

Massachusetts requires any person harvesting more than six crabs per day to have a regulated fishery permit and to report landings monthly. Monthly catch reports developed in 2008 continue to be used. These reports must include the date of harvest, trip start time and duration, port, gear type, disposition, the gender of the crabs, harvest location, and harvest method. If the crabs are sold, the harvester must identify the dealer or person purchasing the crabs. All scientific and research institutes and the single biomedical company must file monthly catch reports listing the names of individuals they purchased crabs from, in-state and out-of-state, the number of crabs purchased and how the crabs were used. Bait dealers are required to file electronic reports weekly under the SAFIS (Standard Atlantic Fisheries Information System) system. The biomedical company, Associates of Cape Cod (ACC), must also report the number of crabs received dead or rejected and the number of dead crabs returned to the biomedical fishermen. The biomedical fishermen must report monthly the number of dead crabs from the time of harvest to the time the crabs were returned to the water.

In 2009, Massachusetts issued 273 horseshoe crab bait permits and 19 horseshoe crab biomedical permits. With most reporting complete at this time, 82 bait permit holders reported harvesting 98,279 horseshoe crabs (Figure 1). Breakdown by sex was as follows:

<u>Bait:</u>
Female: 48,040 (49%)
Male: 42,343 (43%)
Unclassified: 7,896 (8%)

<u>Biomedical:</u> (numbers cannot be provided due to confidentiality)
Female: 60%
Male: 40%
Unclassified: <1%

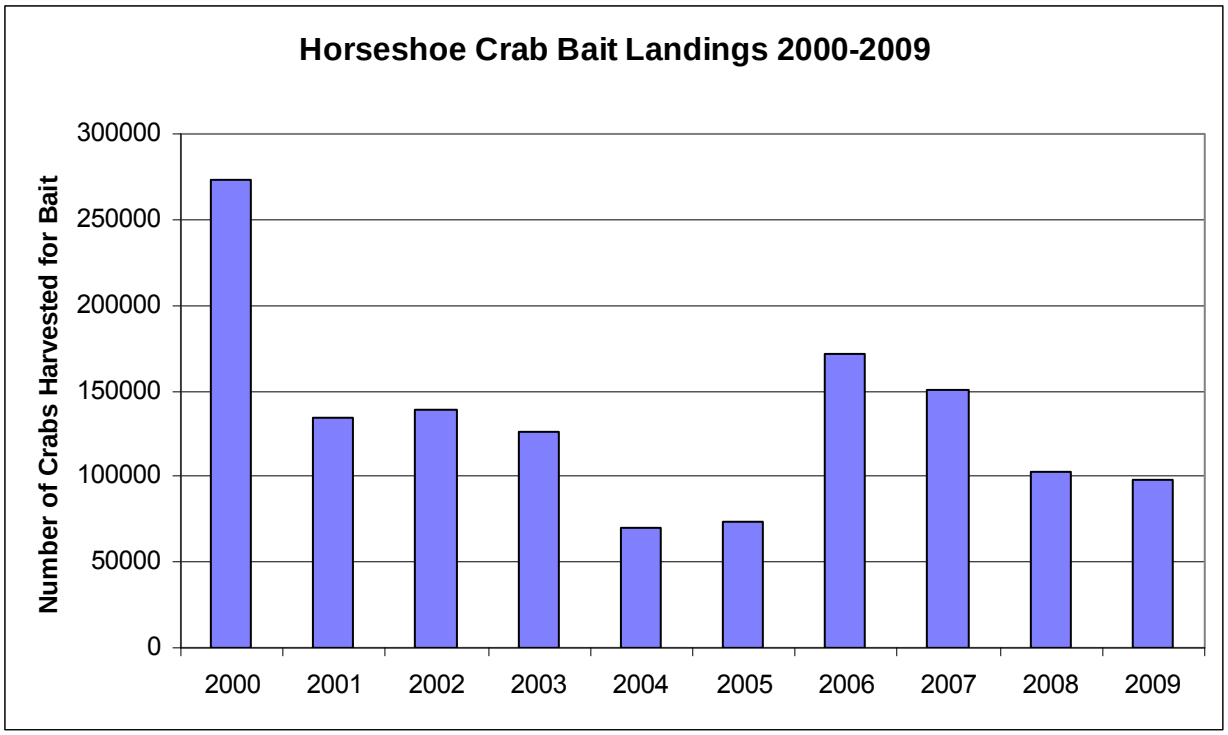


Figure 1. Massachusetts Horseshoe Crab Bait Landings 2000-2009 (2009 is year-to-date)

Approximately 80% (78,862) of the crabs were reportedly taken off spawning beaches by hand or rake harvest while draggers and dredge boats landed approximately 20% (19,597).

The breakdown by disposition is as follows:
Bait Not Sold from Fisher Reporting (personal use): 19,517
Total crabs used for bait: 98,093

Bait Sold from Fisher Reporting: 78,576
Bait from Dealer Reporting: 94,744
Unknown disposition from Dealer Reporting: None

Scientific and research facilities reported purchasing under 1,000 male horseshoe crabs from fishermen. None of these crabs were returned to water.

As the biomedical permit holders who collected crabs in 2009 sell to the Commonwealth's single biomedical dealer, their harvest numbers cannot be released. Massachusetts General Laws, Chapter 130, §21 protects the confidentiality of any person or business who submits such statistics.

All crab harvesters are required to identify beaches and embayments on the monthly catch reports. Most harvest was limited to the beaches on Cape Cod, Buzzards Bay, Mount Hope Bay and Martha's Vineyard. Only 1,138 crabs were reported harvested from areas north of the Cape Cod Canal to the Massachusetts/New Hampshire state line (Duxbury, and Plymouth).

MarineFisheries continues to characterize the commercial harvest of the crabs. Horseshoe crabs at local dealers were sampled to collect information on sex composition and prosomal width. Results are detailed in Section V.

b. Activity and results of fishery independent monitoring.

<u>Resource Assessment Project</u>

MarineFisheries' Resource Assessment Project has conducted seasonal spring (May) and fall (September) bottom trawl surveys in state waters since 1978. Approximately 100 tows are made in five bio-geographic areas, following a stratified random sampling design, with 22 total strata. The net's design, (¾-sized two seam 39' x 51' otter trawl with 3 ½" cookies on a chain sweep) is appropriate for sampling horseshoe crabs, however, the vessel size precludes towing inside most embayments or in water depths less than approximately 8 m. As a result, few horseshoe crabs are caught during these surveys. Nevertheless, due to the long time series these data are useful to illustrate trends over time (Figures 2 & 3).

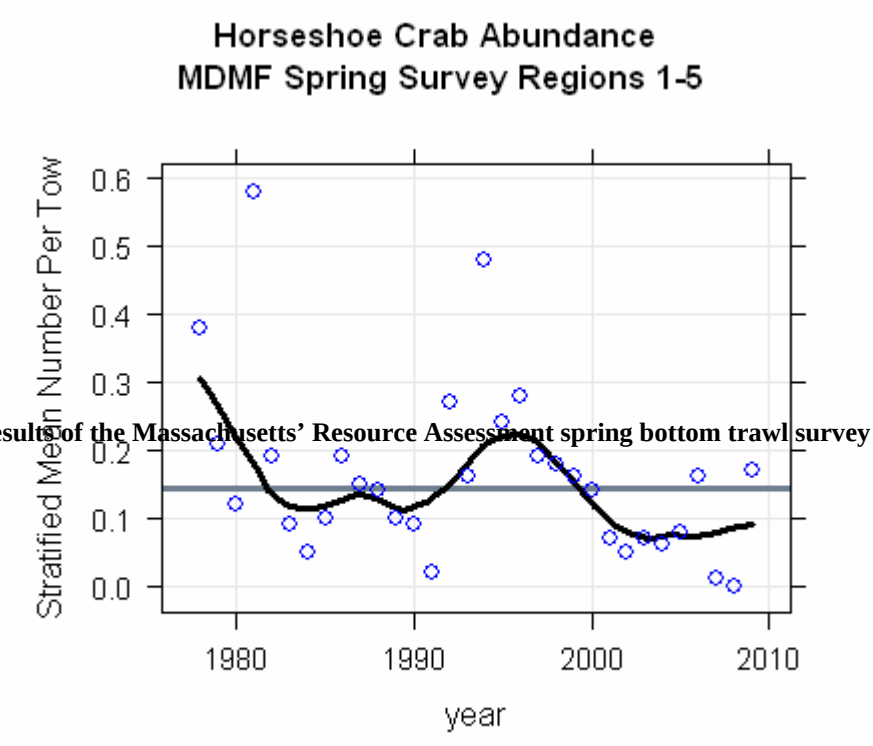


Figure 2. Results of the Massachusetts' Resource Assessment spring bottom trawl survey for 1978-2009.

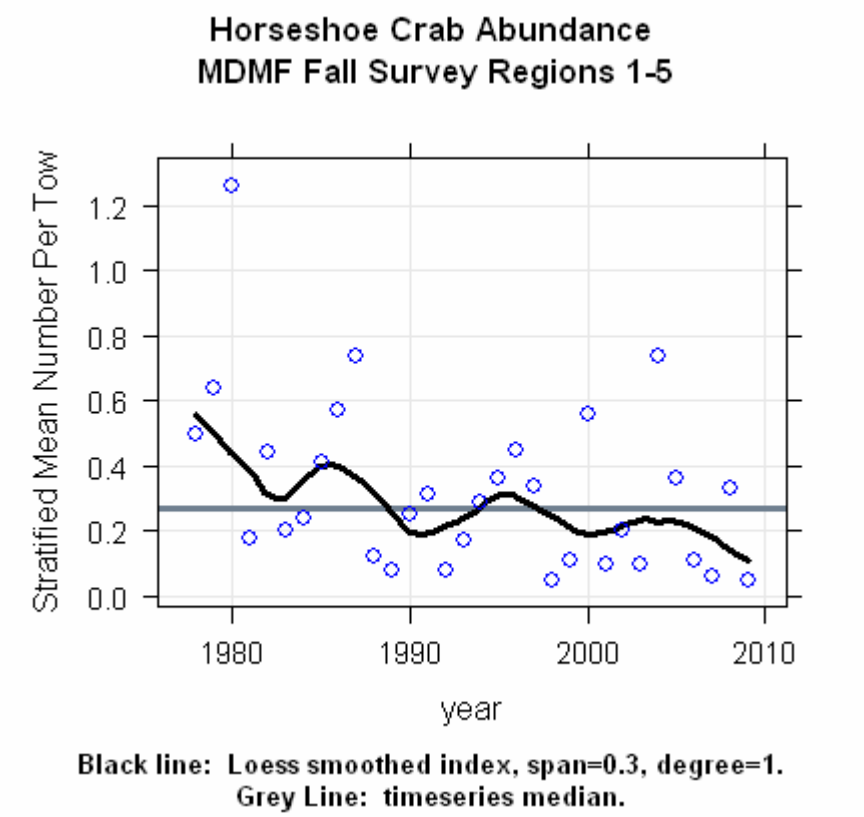


Figure 3. Results of the Resource Assessment fall bottom trawl surveys Massachusetts 1978-2009.

A Loess smoothed index of stratified mean number crabs per tow for both spring and fall surveys indicate a trend of generally decreasing abundance over time. Although there appears to be a slight uptick in the spring 2009 survey, 8 of the last 10 years indices were below the time-series median in spring, as were 6 of the last 10 fall indices.

Spawning surveys

A total of 358 surveys were conducted by almost 300 volunteers and 75 staff from 13 federal and state agencies, organizations, and universities. Spawning indices (SI = number of females per 25 m^2) were relatively low in all areas (Figure 4) compared to landings and anecdotal reports.

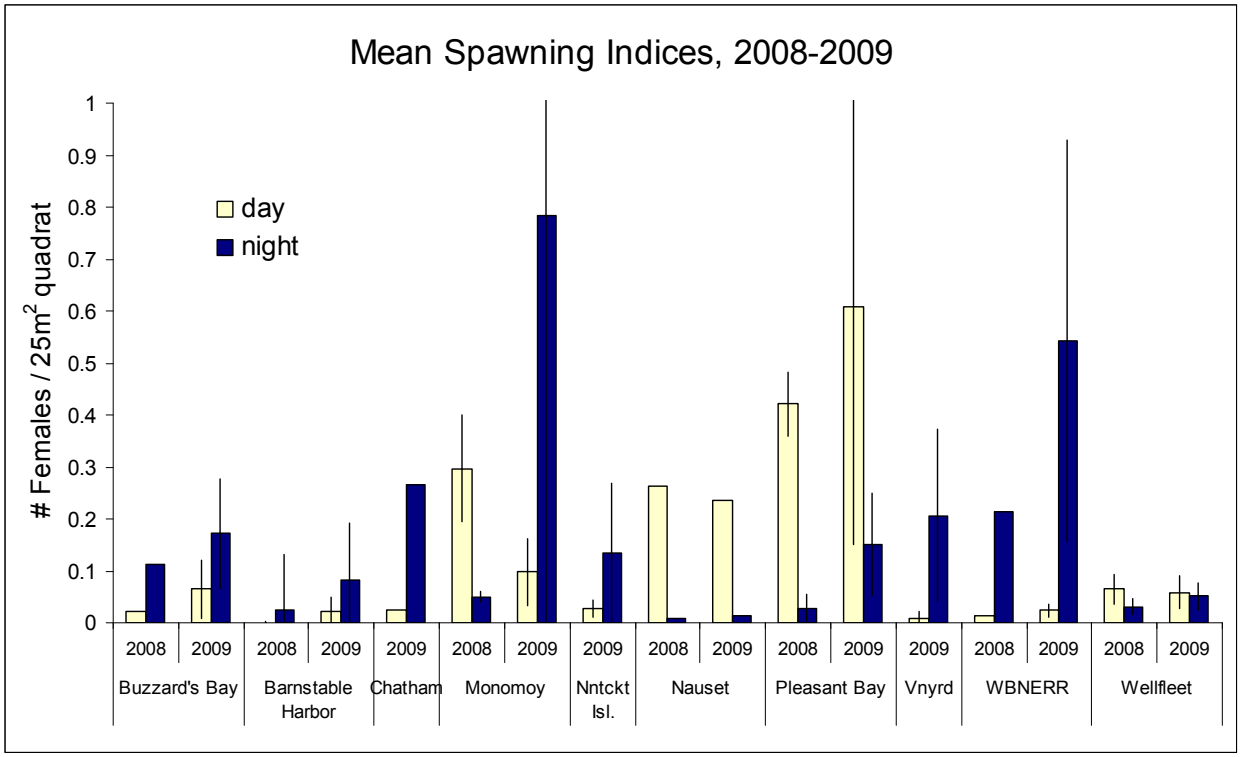


Figure 4. Spawning index (number females per 25 m^2 quadrat) ± SE in MA areas, 2008-2009. Data are combined from all beaches in each area, averaged across all moons. SEs cannot be calculated where only one beach in an area was surveyed in any given year.

Thirty-two percent of surveys had no crabs at all and ninety-eight percent had a SI < 1. It should be noted that many of the crabs counted in the surveys were subsequently harvested by fishermen and removed from the population.

Table 1: Percent of surveys with associated summary data

Total # surveys	358
Percent of surveys with:	
no crabs	32%
no females	38%
≤ 1 female	53%
≤ 2 females	61%
SI = 0	39%
SI < 1	98%
SI >2	0.006%
density ≤ 3	97%
≥ 1 sg F	20%
≥ 1 sg F when crabs present	30%

Sex ratios in Pleasant Bay are becoming increasingly male-skewed (Figure 5). In some areas, we saw single females spawning for the first time.

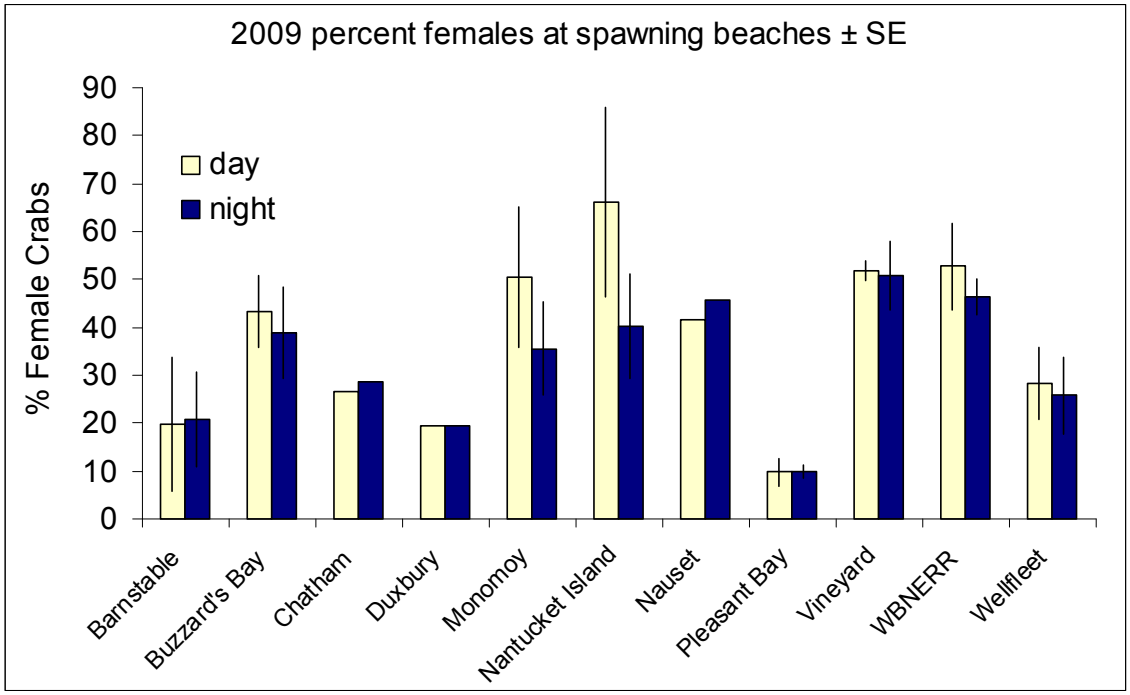


Figure 5. Percent females by area in Cape Cod estuaries 2009.

These trends illustrate potential problems for horseshoe crabs in these areas. As Pleasant Bay has been harvested only for biomedical purposes for 30 years, highly male-skewed sex ratios in that embayment raise concerns about whether bleeding is causing higher mortality than previously reported or may be having a sub-lethal effect on spawning behavior of females. To address the first question, we undertook a study of mortality of unbled females vs. those handled and bled by Associates of Cape Cod, the local biomedical company. The results documented a mortality rate of 30%, substantially higher than the 5-15% estimate currently used for management of this fishery. A paper about the study is currently under review for publication.

Another possibility is that when sex ratios approach 1:1-2 (F:M) and total crab densities are as low as those exhibited in the spawning surveys, males and females may not be finding each other. The vast majority of single females appear when there are 3 or fewer crabs per quadrat (Figure 6), which was the case in 97% of surveys (Table 1). Single female spawning appeared in 20% of all surveys and in 30% of surveys that had any crabs (non-zero surveys removed from data) (Table 1). Since eggs deposited by females without a male present will not develop, an increase in this trend represents a serious problem for local horseshoe crab populations.

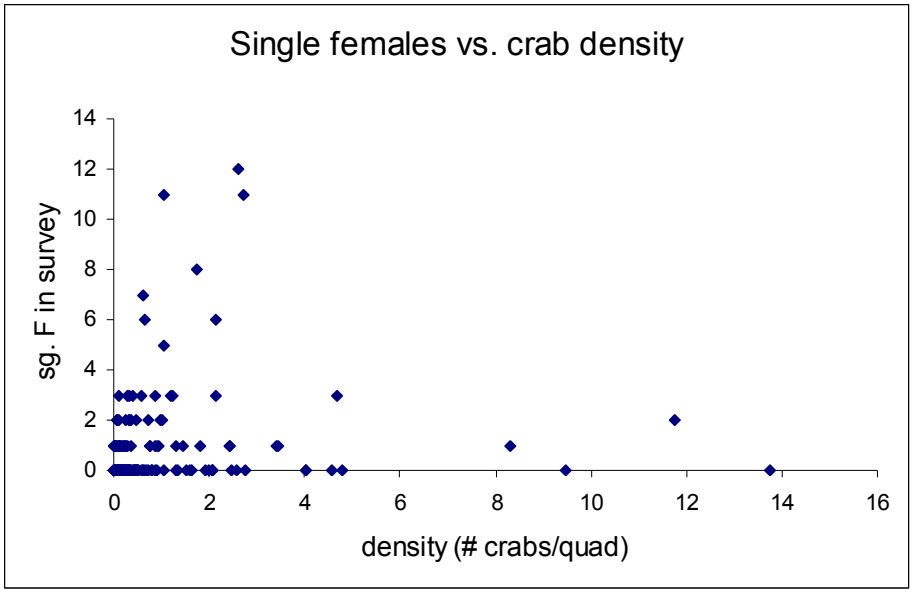


Figure 6. Single females vs. density of horseshoe crabs (# crabs/quadrat).

c. Regulations in effect for 2009.

The Code of Massachusetts Regulations 322(CMR) 6.34 Horseshoe Crab Management

(1) Permit. It shall be unlawful for any person to take, land, or possess more than six horseshoe crabs (*Limulus polyphemus*) per day for any purpose without a regulated fishery permit for horseshoe crabs issued by the Director. Licensed pot fishermen using horseshoe crabs as bait may possess more than six horseshoe crabs without a regulated permit, provided their documented source is a wholesale or bait dealer.

(a) Moratorium. As of March 28, 2008, the Director may not issue any new regulated fishery permit endorsements for horseshoe crabs. Failure to renew the horseshoe crab regulated fishery endorsement in any calendar year shall result in permit forfeiture to the Division.

(2) Reporting. Each holder of a regulated fishery permit for horseshoe crabs or a scientific collecting permit shall file a monthly catch report on forms supplied by the Division. Failure to report by the fifth day of each successive month shall be grounds for suspension or non-renewal of the permit.

(3) Dealers. Wholesale Dealers and Bait Dealers who purchase horseshoe crabs from licensed fishermen shall register with the Division and record purchases on forms supplied by the Division. Failure to report purchases shall be grounds for administrative action.

(4) Minimum Size. (reserved)

(5) Quotas. The annual Horseshoe Crab Quota shall be 165,000 crabs.

(6) Notice. When 100% of the annual quota is reached, a notice of fishery closure shall be filed with the Massachusetts Register and made available to all horseshoe crab regulated fishery permit holders.

(7) Daily Limit.

(a) Bait crab harvesters It shall be unlawful for any horseshoe crab harvester permitted to take crabs for bait purposes to take, land or possess more than 400 horseshoe crabs during any 24 hour period beginning at 12:00 P.M (noon).

(b) Biomedical crab harvesters It shall be unlawful for any horseshoe crab harvester permitted to take crabs for biomedical purposes to take, land or possess more than 1,000 horseshoe crabs during any 24 hour period beginning at 12:00 P.M (noon).

(c) The possession limit shall be vessel limits and shall apply regardless of the number of persons or permit holders aboard a vessel or working in conjunction with a vessel. It shall be unlawful for any person to harvest more than the possession limit in a day regardless of the number of permits held.

(d) The limit shall not apply to lawfully harvested horseshoe crabs held in frozen or cold storage by licensed conch or eel fishermen or bait dealers.

(8) Closed Days. No horseshoe crabs may be taken for any purpose at any time on Saturday or Sunday.

(9) Summer Closed Period. It shall be unlawful for any horseshoe crab harvester permitted to take crabs for bait purposes to take, land or possess horseshoe crabs after June 30. The Director may re-open the fishery after sufficiently compiling catch records to estimate the proportion of the annual quota taken. Upon re-opening the Director may adjust the daily limit.

(10~~9~~) Closed Areas. The Director may close any area to the taking of horseshoe crabs provided:

(a) A majority of the members of the Massachusetts Marine Fisheries Commission approve, and;
(b) A notice of closure has been filed with the Massachusetts Register stating the rationale for the closure, the duration of the closure and a description of the area to be closed, and;
(c) All permit holders and dealers are notified.

(11~~10~~) Biomedical/Research.

(a) Harvesters collecting horseshoe crabs exclusively for use by the biomedical industry for the manufacture of limulus lysate or sale to a permitted scientific institution for research purposes must obtain a special permit limited to that purpose.
(b) The holder of the biomedical special permit shall not be allowed to obtain a permit for bait harvest. Biomedical permit holders must sell horseshoe crabs directly to the biomedical company or to a biomedical crab dealer. It shall be unlawful for biomedical permit holders to sell horseshoe crabs to bait dealers including those bait dealers that supply horseshoe crabs to the biomedical company.
(c) Horseshoe crabs harvested for biomedical or research purposes by harvesters licensed under 322 CMR 6.34 (11)(a) which are bled and released alive in the area of capture or used for display or research shall not be counted against the annual quota established by the Atlantic States Marine Fisheries Commission, but must be reported to the Division by the harvester and the company or institution.

(d) If a biomedical company or permitted scientific institution chooses to purchase horseshoe crabs from persons licensed to harvest horseshoe crabs for bait, or from bait dealers, the company or institution shall keep records sufficient to show the number and source(s) of said horseshoe crabs, including the harvester or dealer and harvest area. Horseshoe crabs purchased from bait harvesters or bait dealers must be reported to the Division of Marine Fisheries by the harvesters or dealers and counted against the annual quota if harvested in Massachusetts.

(e) Horseshoe crabs purchased by a biomedical company from bait harvesters or bait dealers may be returned to the harvesters for use or sale as bait, or returned or sold to a bait dealer, at the discretion of the biomedical company.

(f) Horseshoe crabs which are imported from other states for biomedical purposes shall be counted against the quota of the producing state or returned to the producing state for release, according to established rules and regulations of the state of origin.

(12) Fishery Limit Adjustments.

(a) The Director may, by declaration, adjust the manner and times of taking horseshoe crabs, and the legal size limits, numbers and/or quantities of horseshoe crabs to be taken as prescribed by M.G.L. c. 130, § 17A and specified by the Atlantic States Marine Fisheries Commission (ASMFC).

(b) Declaration Process

1. a two-week comment period has been conducted by the Division;
2. it has been approved by a majority of the members of the Massachusetts Marine Fisheries Advisory Commission;
3. a notice has been filed with the Massachusetts Register;
4. a notice has been published by at least one local newspaper; and
5. a copy of the notice has been emailed via the Marine Fisheries Listserv and posted on the Division's website.

Closed areas

In addition to the above regulations, Monomoy National Wildlife Refuge (federal closure) and the National Season (NPS - federal) remain closed to all HSC harvest, and Pleasant Bay (state closure) remains closed to bait fishing only (Figure 7).

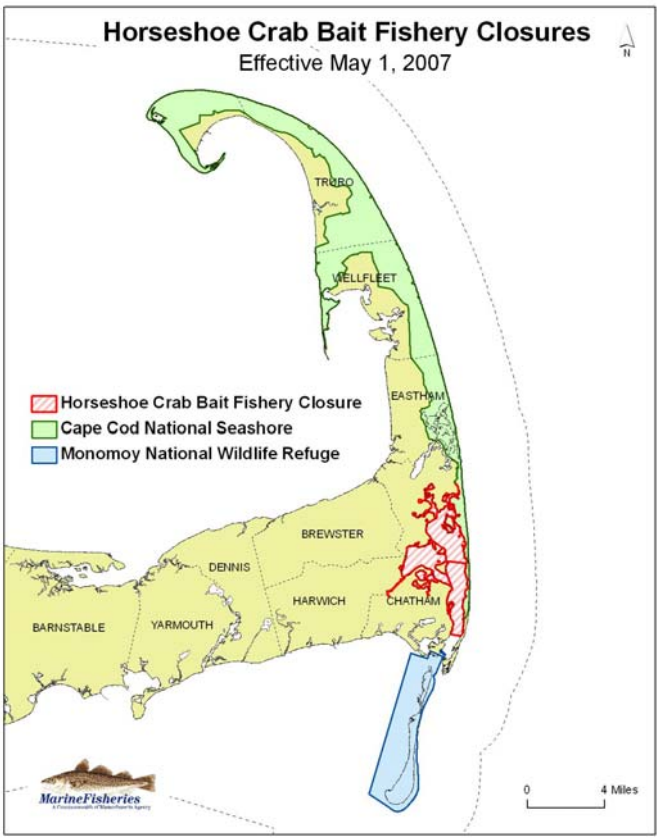


Figure 7. Areas closed to bait and/or biomedical harvest.

d. 2009 Horseshoe Crab Harvest Reported by Fishermen (as of 3/1/10)

2009 PERMITS	
Bait Permits Issued	273
Fished	82
Did Not Fish	172
Did Not Report	19
Biomedical Permits Issued	19
Fished	6
Did Not Fish	13
Did Not Report	0

2009 HORSESHOE CRAB BAIT HARVEST **98,279**

e. Review of progress in implementing habitat recommendations.

In an effort to conserve and maintain spawning and nursery habitat, *MarineFisheries* annually sends a letter to the Department of Environmental Protection, Coastal Zone Management and the Department of Environmental Management reminding them of the importance of protecting crab habitat. In addition, *MarineFisheries*' Environmental Review Project makes recommendations

on state and federal coastal alteration permits to protect horseshoe crab spawning and nursery areas. These typically take the form of recommendations to limit certain activities during the crab's May – July spawning season. Known spawning beaches have been entered into a GIS database to facilitate the environmental review process and this database will be updated annually. A Time-of-Year guidance document by DMF is under review and will reiterate specific recommendations regarding dredging, beach nourishment, and construction projects vis à vis their potential impact on horseshoe crabs.

IV. Planned management programs for 2010

a. Summarize regulations that will be in effect (copy of current regulations if different from III c).

The Division of Marine Fisheries is enacting three regulatory changes to the Commonwealth's horseshoe crab rules. These regulatory changes were approved by the Marine Fisheries Advisory Commission on March 11, 2010.

1) A uniform minimum size, 7 inch prosomal width, will be in effect for all commercial horseshoe crab harvesters and dealers.

2) Lunar closures for the months of May and June, where the commercial harvest of horseshoe crabs will be unlawful for a series of five-day periods coinciding with each new and full moon. These closures shall commence at 12:00 AM two days prior to - and cease at 11:59 PM two days after - the date of the new or full moon. These no-fishing days replace the current weekend closures.

3) Beginning on July 1, the daily trip limit for mobile gear commercial bait crab harvesters will increase from 400 to 600 crabs per 24 hour period.

b. Summarize monitoring program that will be performed.

We plan to continue spawning surveys. In addition, *MarineFisheries* recently received funding from Woods Hole Sea Grant for a telemetry tagging study in 2010 and 2011. By tagging crabs in areas closed to bait harvest and other spawning beaches and observing their movement patterns over two years, we will examine whether closed areas act as spawning sanctuaries from which crabs disperse to other nearby estuaries, or whether crabs remain in a single embayment from year to year. In the latter case, closed areas may act as Marine Protected Areas, but not supply crabs to other areas.

We began traditional tagging in Pleasant Bay in 2008, in conjunction with the National Park Service and USFWS coast-wide tagging program. We plan to continue and coordinate tagging between NPS, Mass Audubon, Waquoit Bay NERR, and possibly other groups to complement the telemetry data.

MarineFisheries will continue collecting catch reports from all crab harvesters, dealers, and scientific permit holders. The biomedical company will submit monthly reports and an annual questionnaire. *MarineFisheries* will also continue to identify horseshoe crab spawning and

nursery habitat and to characterize the commercial fishery. The *MarineFisheries* spring and fall trawl surveys will continue to monitor and record weight, number and prosomal width by sex of individuals collected. *MarineFisheries* will continue working on methods to reduce the number of crabs needed by the fishermen by encouraging the use of bait bags and bait cups as well as alternative baits. *MarineFisheries* will continue to encourage ACC to bleed as many bait crabs as possible in order to reduce the demand for biomedical crabs, particularly in light of our bleeding mortality study results.

c. Highlight changes from previous year.

The primary changes from 2008 were:

- the biomedical bleeding study which resulted in much higher mortality (30%) than previously reported or currently used for management
- sighting of numerous single females spawning. This latter finding raises concern that low spawning densities are compounded by sex ratios close to 1:1 with the effect that there are simply not enough crabs for females and males to find each other.
- approval of grant proposal to Woods Hole Sea Grant for telemetry tagging

V. Monitoring Program Requirements – Including Addendums I-III

Component A_1: Addendum III requires monthly reporting of all harvest of horseshoe crabs (bait fisheries, biomedical, industry, by-catch, educational and scientific research) by number landed, by sex and harvest method. Continue characterization of the commercial catch based on prosomal width by sex. States will be required to characterize a portion of the commercial catch based on maturity once an appropriate technique is developed and approved by the Technical Committee.

Massachusetts' existing regulations comply with Addendum III of the FMP. The Code of Massachusetts Regulations 322(CMR) 6.34 requires any person harvesting, taking or landing more than six horseshoe crabs per day for any purpose to have a regulated fishery permit from the Director of the Division of Marine Fisheries. Permit holders are required to report monthly the number of crabs harvested daily by gender, the beach or embayment of harvest, type of gear used and the intended use of the harvested crabs. If the crabs are sold, as a directed fishery or as by-catch, the fisherman must identify the dealer or individual buying the crabs. Failure to report shall be ground for suspension of the permit and non-renewal.

Wholesale or bait dealers purchasing horseshoe crabs from licensed fishermen are now required to submit weekly electronic SAFIS reports. Biomedical, research and educational research facilities must report the name of the harvester, number of crabs and the use of horseshoe crabs monthly.

Commercial horseshoe crab landings were sub-sampled during the hand harvest season by *MarineFisheries* biologists at bait dealer facilities. Approximately 1,019 horseshoe crabs (507 female and 511 male crabs) were identified by sex and measured to determine prosomal width. The mean prosomal width for female crabs was 24.64 cm and 19.60 cm for male crabs (Figure 8). The distribution of prosomal widths for females has been relatively stable since 2003,

although the center of the distribution has undergone a slight shift to smaller sizes (inter-quartile range) from 24 to 27 to 23 to 26 since 2007. Median and mean are relatively stable since 2003. Male's distribution appears stable, but with truncation of the largest individuals (highest 2.5th percentile) in the upper tail of the distribution and perhaps a slight increase in the lower tail (lower 5th percentile) in 2009. (See Attachment 1). The ratio of Female:Male was 1.08:1.

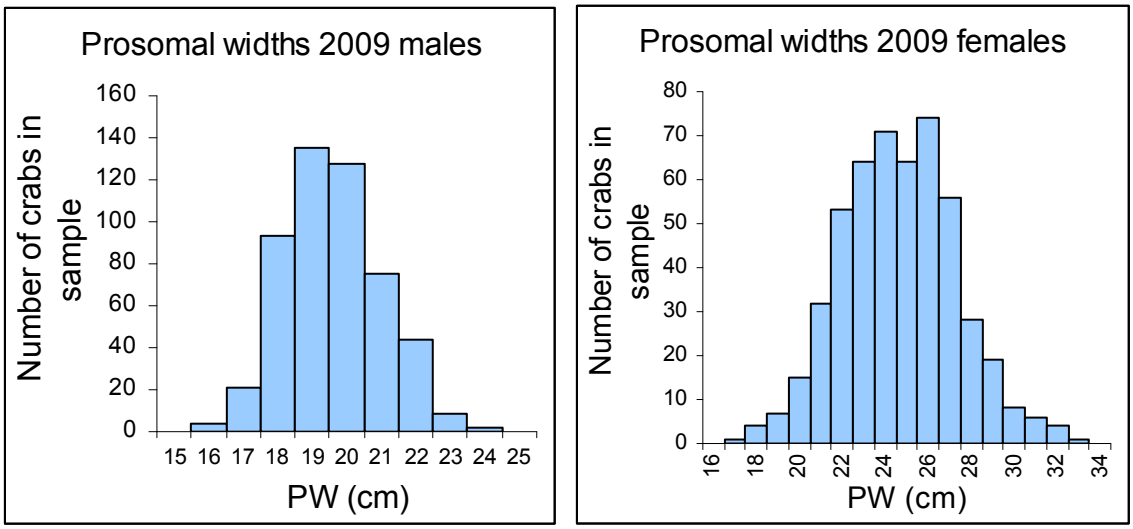


Figure 8. Prosomal widths (cm) for female and male horseshoe crabs sampled during market surveys.

Component A_2: To comply with Addendum III, states where horseshoe crabs are captured for biomedical use must monitor and report monthly and annual harvest of horseshoe crabs by biomedical facilities. All states must identify percent mortality from the point of harvest to release. States are required to use the HSC TC biomedical survey or some other means to obtain the required information.

The Massachusetts biomedical company, Associates of Cape Cod (ACC) obtains crabs from a single biomedical dealer, three licensed bait dealers, and one fisherman. Massachusetts regulations allow the biomedical company to purchase bait crabs for bleeding. Once bled, the crabs are returned to the bait dealers for sale as bait or to the biomedical dealer to be released at the site of capture. As a large percentage of the crabs used by the biomedical company came from the bait dealers, the number of crabs harvested by biomedical permit holders is reduced. This significantly reduces the total number of crabs harvested in the Commonwealth.

In an effort to comply with Addendum III, the biomedical company is required to file monthly reports noting the number of crabs received from each dealer, the number of dead or rejected crabs and the number of dead crabs returned to the dealers.

Dealers selling crabs to the biomedical company must submit the ASMFC biomedical questionnaire annually detailing the year's activities. Review of the questionnaires showed biomedical harvest was limited to three fishermen with biomedical permits harvesting crabs from May–October in one bay, and a new biomedical fisherman harvesting in a different bay. The biomedical company reported a rejection rate of approximately 5.3% for both the biomedical and bait dealers. Crabs from the biomedical dealer rejected by the biomedical company because of injury, size, etc. were returned to the water near the harvest site. Rejected crabs obtained from bait dealers were sold as bait.

State law does not allow *MarineFisheries* to release the biomedical harvest numbers by the dealer. Therefore, the completed questionnaires are not attached to this report and have been sent separately to the Biomedical Subcommittee.

Component A_3: States must identify spawning and nursery habitat. States that have completed this work must report changes in spawning and nursery habitat over time. States must actively intervene to the extent of their authority to ensure that spawning and nursery habitat is conserved and the quality and productivity is maintained.

A survey of horseshoe crab spawning and nursery habitat along the Commonwealth's 1,800 miles of coastline was completed in 2004 (Attachment 2). This will be updated in the coming years as staffing allows. All crab harvesters are required to identify beaches and embayments on the monthly catch reports. Normally beaches identified as harvest sites during the spawning season are investigated to determine if the beaches are spawning habitat. As in 2008, staff limitations allowed this to be done in only a few locations. Therefore the maps in Attachment 2 are from 2007.

MarineFisheries annually solicits public assistance by issuing a press release to newspapers, postings on the website, and in the *MarineFisheries* newsletter. Anyone observing spawning horseshoe crabs is asked to contact *MarineFisheries*. This coming year, shorebird biologists will also be looking out for spawning horseshoe crabs while they patrol the beaches.

In an effort to conserve and maintain spawning and nursery habitat, *MarineFisheries* annually sends a letter to the Department of Environmental Protection, Coastal Zone Management and the Department of Environmental Management reminding them of the importance of protecting crab habitat. *MarineFisheries'* Environmental Review Project also recommends conditions to all coastal alteration projects to protect horseshoe crab habitat and requests time-of-year restriction on any activities on known horseshoe crab spawning beaches.

Monitoring Program Recommendations – Including Addendums I-III

<u>Monitoring of Horseshoe Crab Populations and Habitat</u>

Component B_1: Continue working towards expanding the annual coastwide benthic trawl survey following methods described in Hata and Berkson (2003).

MarineFisheries continues working towards expanding the annual coastwide trawl survey. However, due to fiscal and manpower limits, the Commonwealth is unable to participate in a coastwide trawl survey at this time. *MarineFisheries*' Coastal Resource Assessment Project currently records the number, and prosomal width by sex of all horseshoe crabs collected during the annual spring and fall bottom trawl surveys. Survey data is forwarded to the Stock Assessment Committee.

Component B_2: Continue existing benthic sampling programs.

As noted in Component B_1, *MarineFisheries*' Resource Assessment Project currently records the number, and prosomal width by sex of all horseshoe crabs collected during the annual spring and fall bottom trawl surveys. Survey data is forwarded to the Stock Assessment Committee.

Component B_3: Continue monitoring spawning populations based upon standardized and statistically robust methodologies.

Massachusetts started annual spawning surveys in 2008 modeled after Delaware Bay's (with modification of quadrat size to 5 x 5 m^2 due to much lower populations in MA).

Component B_4 A coordinated tagging program should be implemented by the Tagging Subcommittee based upon the draft coast-wide framework developed in 2003.

MarineFisheries worked with NPS and USFWS to develop a smaller tag more suited to our smaller crabs. These tags were successfully used in 2009, primarily in Pleasant Bay, Monomoy NWR, and to a limited extent in Waquoit Bay.

Joint Monitoring of Delaware Bay Horseshoe Crabs and Shorebirds

Component B_5 Continue existing state egg abundance surveys, particularly in the Delaware Bay region.

MarineFisheries is exploring funding and implementation options to implement crab egg abundance surveys. Because there is no strong HSC-shorebird connection in MA, it may make more sense for MA to survey juvenile horseshoe crabs. Work began on this in 2009, but it was a "learning year" without substantive results. Survey efforts will continue in 2010.

Component B_6 Continue existing state shorebird monitoring programs.

Shorebird monitoring in Massachusetts is conducted by other agencies and organizations.

Component E: Evaluate the post-release mortality of horseshoe crabs used by the biomedical industry by initiating a tagging program.

MarineFisheries conducted a study in 2009 examining mortality in bled and unbled female crabs. The study results are described above and a draft publication is under review. In 2008, we conducted a preliminary study comparing tagged and untagged, bled and unbled female mortality. The tagged, bled group showed very high mortality. Sample sizes were too small to draw definitive conclusions, but we recommend that bled horseshoe crabs *not* be tagged until a larger study can be conducted.

Component F: Identify potential horseshoe crab spawning and nursery habitats.

See Component A_3.

Changes to Research Needs Section.

Section 6.1 Develop an effective and efficient field protocol to identify critical life history stages. At a minimum, the protocol should identify horseshoe crabs that have spawned previously, those that are within one year of spawning for the first time and those that are more than one year from spawning for the first time.

Once developed, Massachusetts will incorporate the protocol into the sampling design.

Section 6.2 In addition to investigating, encouraging and funding alternative bait sources, the Committee suggested focusing on alternative trap design (i.e. traps with bait bags).

In 2004, *MarineFisheries* in concert with several fishermen began trial use of bait cups and alternative baits. Preliminary results indicated that the use of the cups and bait bags reduced the amount of horseshoe crab required to bait a pot and extended the time between re-baiting. Over the course of the year quite a few conch fishermen began using modifications of the bait cups and bags. Almost all reported a significant reduction in the number of crabs needed per trip.

In 2005, fishermen continued modifying bait cups and bags and several new modifications were tested. All appeared to work well, allowing for smaller pieces of horseshoe crabs and other baits such as herring, skate or green crabs to be added to the containers. Based upon returns of a questionnaire sent to conch pot fishermen, nearly all are using some form of bait bag or bait cup.

At a recent meeting with conch fishermen, we learned there is a wide variety of techniques and number of pots/crab that people use. We hope to gather more information from the most efficient users of crabs, and share this information with other fishermen to potentially cut down on the need for crabs.

VI. Law enforcement reporting requirement: Horseshoe Crabs

b. Interstate Fishery Management Plan for Horseshoe Crabs

The ASMFC Law Enforcement Report form was sent to the Massachusetts Office of Environmental Law Enforcement (OLE) in the Executive Office of Energy and Environmental Affairs with a request to submit the form to the ASMFC Law Enforcement Committee.

ATTACHMENT 1
HORSESHOE CRAB PROSOMAL WIDTHS
2000 - 2009

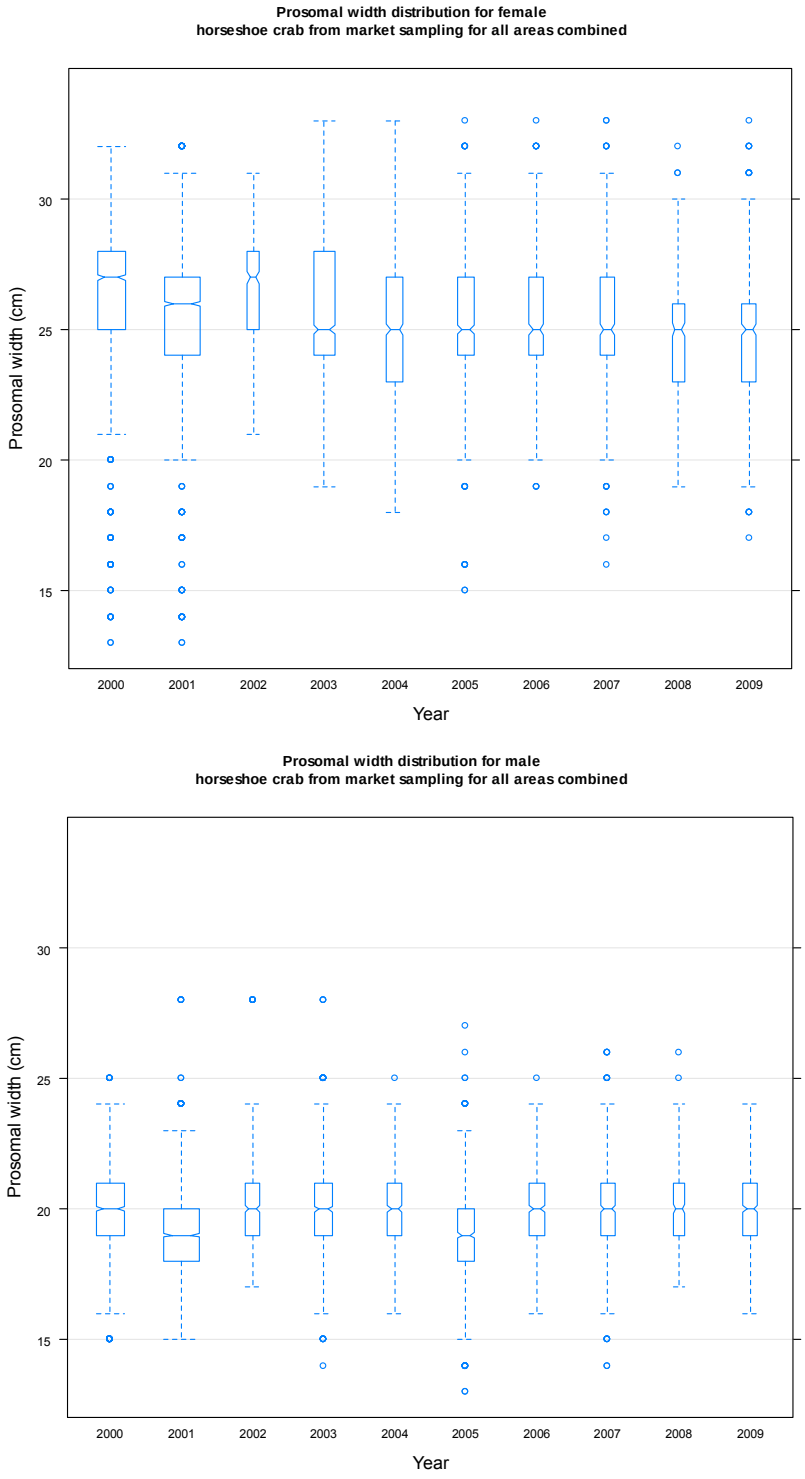


Figure 1. Box plots of prosomal widths taken in market sampling of horseshoe crabs for all areas combined (2000-2009). Top panel: female horseshoe crabs. Bottom panel: male horseshoe crabs. Width of box is proportional to the square root of sample size.

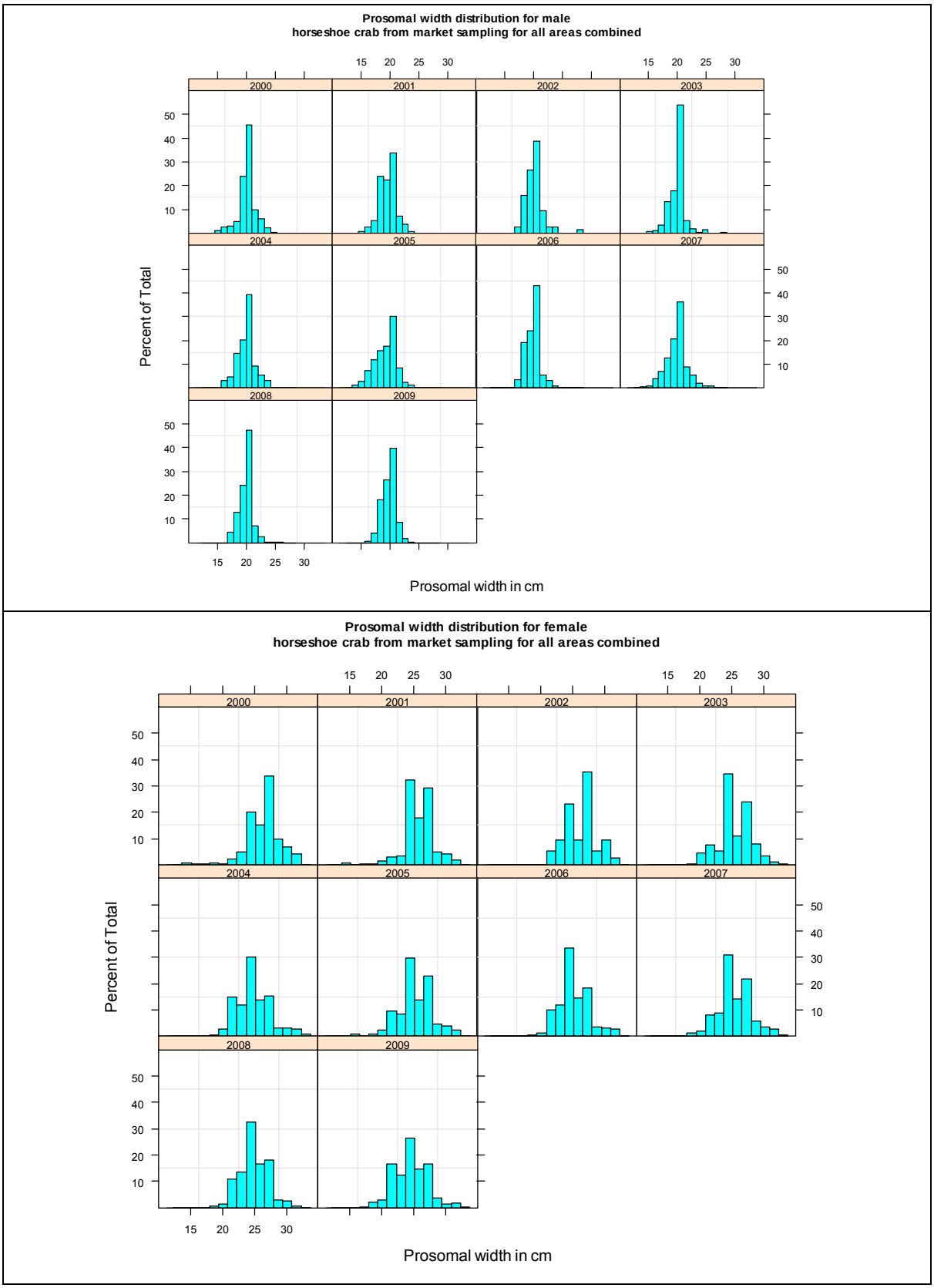
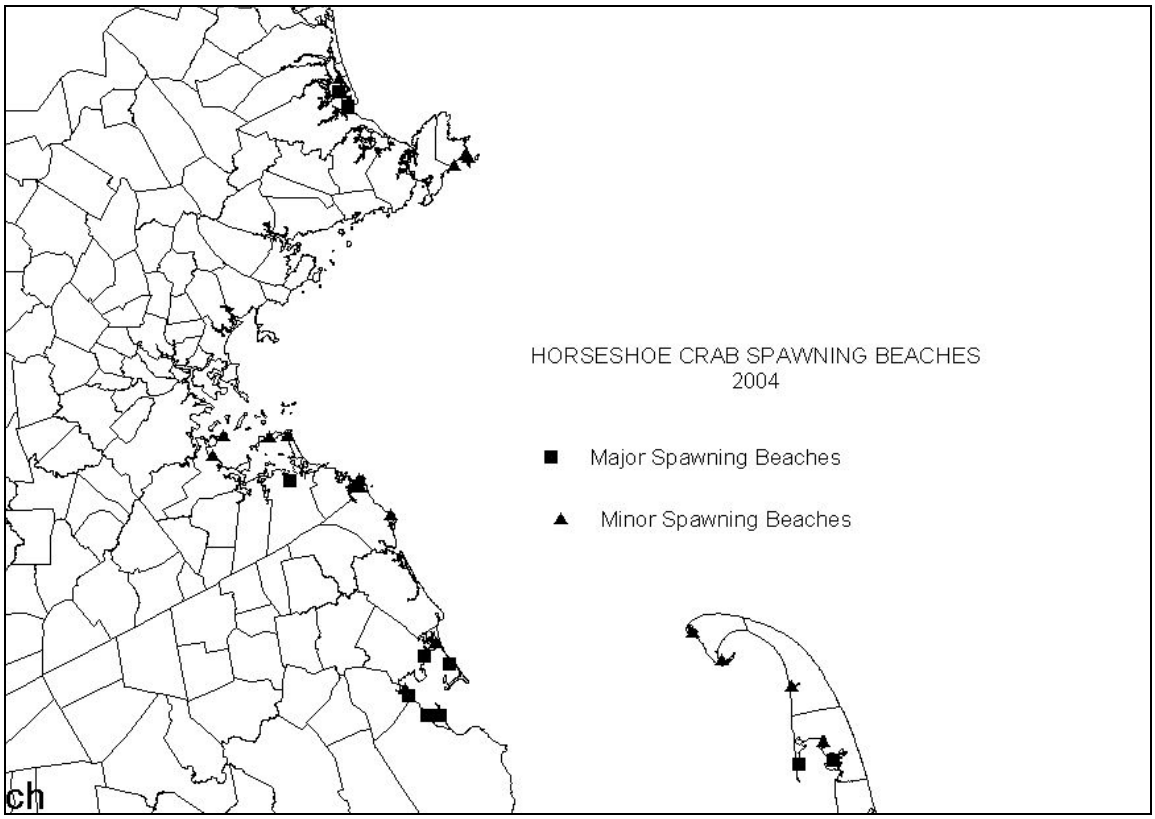
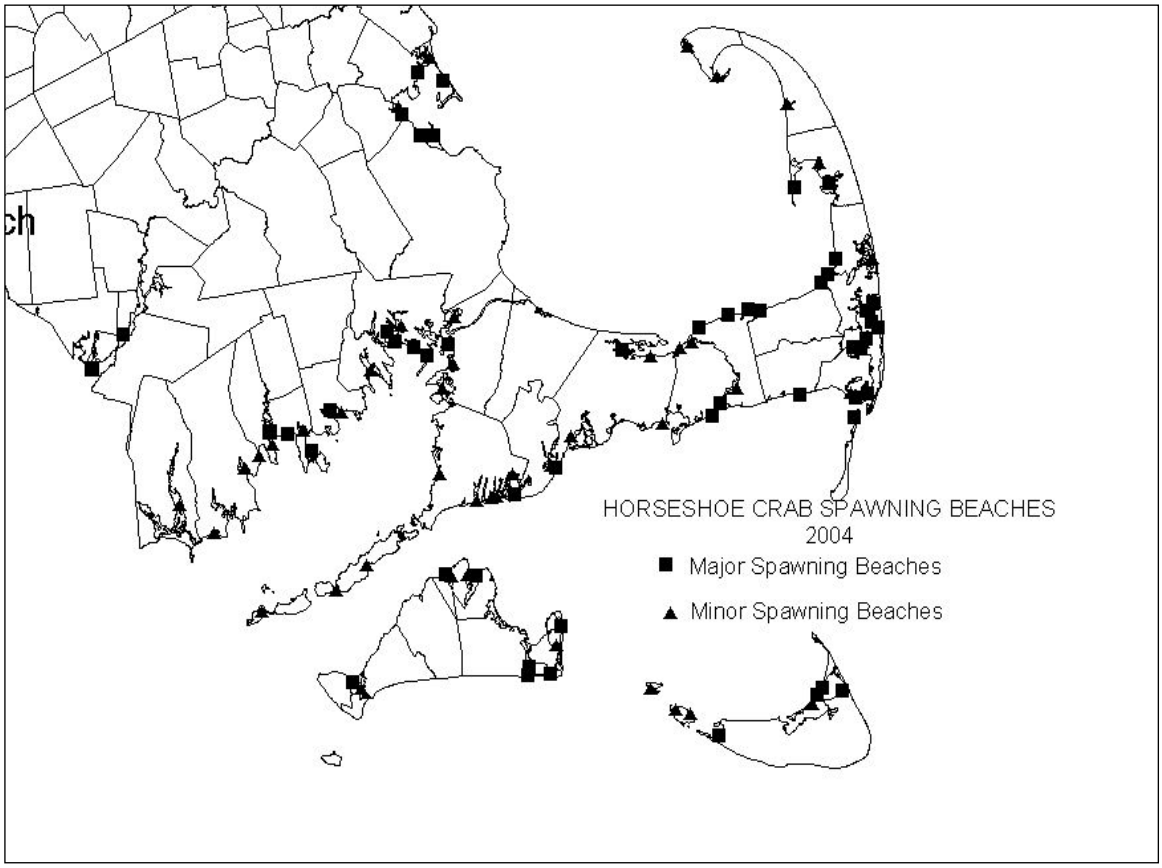


Figure 2. Prosomal width frequency from market sampling for horseshoe crabs (2000-2008). Top panel: male horseshoe crabs. Bottom panel: female horseshoe crabs.

ATTACHMENT 2
HORSESHOE CRAB SPAWNING BEACHES AND NURSERY AREAS


HORSESHOE CRAB SPAWNING BEACHES
2004
Major Spawning Beaches
Minor Spawning Beaches


HORSESHOE CRAB SPAWNING BEACHES
2004
Major Spawning Beaches
Minor Spawning Beaches

HORSESHOE CRAB SPAWNING BEACHES
2007

MOUNT HOPE BAY			
Town	**Embayment**	**Beach**	**Density**
Somerset	Mount Hope Bay	Brayton Pt Beach	High
	Taunton River	Pierce Town Beach	High
Fall River	Taunton River	Ark Bait Cove	High
Swansea	Coles River	Bluffs Beach	High
	Coles River	Ocean Grove	High
	Coles River	Cedar Cove	Moderate
BUZZARDS BAY			
Bourne	Buttermilk Bay	Hideaway Village	Moderate
	Phinney's Harbor	Monument Beach	High
	Phinney's Harbor	Mashnee Dike	High
	Phinney's Harbor	Toby Island	Moderate
	Pocasset Harbor	North Cove	Moderate
	Pocasset Harbor	Tahanto Beach	Moderate
Dartmouth	Allen's Pond	South Beaches	Moderate
	Clarks Cove	Anthony Beach	Moderate
	Apponagansett Bay	Apponagansett Park Beach	Moderate
	Little River	Beach at mouth	Reported
	Slocum River	Demarest Lloyd State Beach	Reported
	Clarks Cove	Jones Beach	Moderate
	Apponagansett Bay	Little Bridge Beach	Reported
Fairhaven	Nasketucket Bay	Deacon's Cove	High
	Nasketucket Bay	Edgewater Ramp Beach	Moderate
	Acushnet River	Fairhaven Common's Beach	High
	NB Outer Harbor	Fort Phoenix Beach	Reported
	Nasketucket Bay	Knomere Beach	Reported
	NB Outer Harbor	Priest Cove, Red Rock Beach	High
	Nasketucket Bay	Raymond Street Beach	Reported
	NB Outer Harbor	Silver Shell Beach	Reported
	Acushnet River	Tin Can Island	High
	Nasketucket Bay	Association Beach	Moderate
Falmouth	Great Sippewisset	Black Beach	Reported
	Buzzards Bay	Old Silver Beach	Reported
Gosnold	Cuttyhunk Pond	Church Beach	Reported
	Pasque Pond	Beach	Reported
	Vineyard Sound*	Tarpaulin Cove	Moderate
Mattapoisett	Aucoot Cove	Hollywood Beach	Moderate
	Mattapoisett Harbor	Neds Point	Reported
	Mattapoisett Harbor	Shining Tides Beach	Moderate
	Buzzards Bay	Point Connett Beach	Reported

Marion	Sippican Harbor	Meadow Island	Moderate
	Sippican Harbor	Ram Island	Reported
	Sippican Harbor	Planting Island	Moderate
	Aucoot Cove	Converse Pt Beach	Reported
New Bedford	Acushnet River	Palmer Cove	High
	NB Outer Harbor	East Beach	Moderate
	NB Outer Harbor	Ebb Tide Beach	Moderate
	NB Outer Harbor	Davy's Locker Beach	Reported
Wareham	Buttermilk Bay	Jefferson Shores	Moderate
	Wareham River	Long Beach	High
	Little Harbor	Little Harbor Beach	High
	Wareham River	Pine Hurst Beach	Reported
	Wareham River	Swifts Beach	High
	Buzzards Bay	Stony Point Dike	Moderate
Westport	Westport Harbor	Cherry & Webb Beach	Moderate
	East Branch West Branch	Upper Islands Sanford Flat Area	Reported Reported
	Westport Harbor	Boat Ramp Beach	Reported
SOUTH CAPE			
Barnstable	Centerville Harbor	Craigville Beach(5^{th} Ave)	Reported
	Cotuit Bay	Ropes Beach	Reported
	East Bay	Dawes Beach	Moderate
	Hall Creek	Backside Beach	Reported
	Hyannis Harbor	Kalmus Beach	Reported
	Cotuit Bay	Sampson Island	High
	Cotuit Bay	Pirate Cove	High
Chatham	Nantucket Sound	Cockle Cove Beach	High
	Nantucket Sound	Monomoy Island	High
	Stage Harbor	Harding Beach	High
	Stage Harbor	Morris Island	High
	Oyster Pond	Beaches at mouth	Reported
	Oyster River	Sear's Point Beach	High
Dennis	Bass River	Opposite High Bank	Moderate
	Bass River	Old Field Point	Reported
	Bass River	W. Dennis Beach	High
	Bass River	Georgetown Flats	Reported
Falmouth	Bourne's Pond	Old Mouth	Reported
	Great Pond	Entrance Beaches	Moderate
	Green Pond	Entrance Beaches	Moderate
	Eel River	Washburn Island	Reported
	Waquoit Bay	WBNERR Beach	Reported
Mashpee	Waquoit Bay	Sage Lot Pond	High
	Nantucket Sound	South Cape Beach	Reported
	Popponesset Bay	Popponesset Beach	Reported
	Popponesset Bay	Daniel Island Beach	Reported

	Popponesset Bay	Pirates Cove Landing	Moderate
Yarmouth	Bass River	Wind Mill Beach	Moderate
	Nantucket Sound	Sea Gull Beach	Moderate
	Nantucket Sound	Lighthouse Beach	Moderate
	Parker River/ Lewis Pond	Landing Beach	Reported
MARTHA'S VINEYARD			
Aquinnah	Menemsha Pond	Red Beach	High
Chilmark	Menemsha Pond	Landing	Moderate
Edgartown	Cape Poge Bay	Simon Point	Moderate
	Katama Bay	SE Corner	High
	Katama Bay	South Side	High
	Salt Pond	Fuller Street Beach	Reported
Oak Bluffs	Lagoon Pond	Worcester St.	Reported
	Vineyard Haven	Eastville Point	Moderate
Tisbury	Lake Tashmoo	Flats at mouth	High
	Lagoon Pond	Cedar Neck	Reported
NANTUCKET			
Nantucket	Madaket Harbor	Hither Creek	Moderate
	Muskeget Island	Coves	Reported
	Nantucket Harbor	Backside Outer Beach	Reported
	Nantucket Harbor	Pocomo Point Beach	High
	Tuckernut Island	Coves	Reported
OUTER CAPE			
Chatham	Bassing Harbor	Fox Hill	Moderate
	Crows Pond	Nickerson Neck	Moderate
	Chatham Harbor	North Beach	Reported
	Chatham Harbor	Outermost Marine Cove	High
	Pleasant Bay	Muddy Creek Landing	Reported
	Chatham Harbor	South Beach	Reported
	Pleasant Bay	Strong Island, East Side & Creeks	High
	Pleasant Bay	Ryders Cove	Reported
Eastham	Nauset Harbor	Stony Island	Reported
	Nauset Harbor	Outer Beach	Reported
Harwich	Round Cove	Landing	Reported
Orleans	The River	Barley Neck	High
	Little Pleasant Bay	Hog Island	High
	Little Pleasant Bay	Jack Knife Cove	High
	Kesczyogansett Pond	Town Landing	Moderate
	Town Cove	YC Landing	Moderate
	Little Pleasant Bay	National Seashore	High
	Little Pleasant Bay	Pochet Island	High
	Little Pleasant Bay	Sampson Island	High
	Little Pleasant Bay	Old Field Point	Reported
	Pleasant Bay	Strong Island	High

Cape Cod Bay			
Barnstable	Barnstable Harbor	Scudder Lane	High
	Barnstable Harbor	Sand Island	High
	Barnstable Harbor	The Cove	Reported
	Barnstable Harbor	Calves Pasture Point	High
	Barnstable Harbor	Bone Hill	Reported
	Barnstable Harbor	Eastern end	High
	Barnstable Harbor	Salten Point	High
Brewster	Cape Cod Bay	Brewster Flats	High
	Cape Cod Bay	Ellis Landing	High
	Cape Cod Bay	Namskaket Creek	High
	Cape Cod Bay	Paine's Creek	Moderate
Dennis	Cape Cod Bay	Chapin Beach	High
	Cape Cod Bay	Corporation Beach	High
	Cape Cod Bay	Cold Storage Beach	Moderate
	Cape Cod Bay	Quivett Creek	Moderate
	Cape Cod Bay	Chase Garden Creek	Reported
Duxbury	Duxbury Bay	Back River	High
	Duxbury Bay	Duxbury Beach	High
	Duxbury Bay	Ship Yard Lane	High
	Duxbury Bay	Bradford Street	High
Eastham	Cape Cod Bay	First Encounter	High
	Cape Cod Bay	Sunken Meadow	High
	Cape Cod Bay	Boat Meadow Sand Spit	Reported
Kingston	Kingston Bay	Gray's Beach	Reported
	Kingston Bay	Rocky Nook Association Beach	Reported
Orleans	Cape Cod Bay	Rock Harbor Beach	Moderate
	Cape Cod Bay	Skaket Beach	Reported
Plymouth	Plymouth Harbor	Plymouth Beach	High
	Duxbury Bay	Saquish Cove	Reported
	Plymouth Harbor	Steven's Field	High
Provincetown	Hatches Harbor	Entrance Beach	Reported
	Inner Harbor	Wood's End	Moderate
Truro	Pamet Harbor	Harbor Bar	Reported
	Pamet Harbor	Landing Beach	Reported
	Cape Cod Bay	Corn Hill Beach	Reported
Wellfleet	Wellfleet Harbor	Chipman Cove	High
	Wellfleet Harbor	Great Island	Moderate
	Wellfleet Harbor	Mayo Beach	Reported
	Wellfleet Harbor	WBWS	High
	Wellfleet Harbor	Indian Neck	Moderate
Yarmouth	Cape Cod Bay	Bass Creek	Moderate
	Chase Garden Creek	Gray's Beach	Moderate
MASSACHUSETTS BAY			
Cohasset	Cohasset Harbor	Bassing Harbor Beach	Moderate

	Cohasset Harbor	Briggs Cove	Reported
Hingham	Hingham Harbor	Hingham Beach	Reported
Hull	Hull Bay	Pt Allerton Beach	Reported
	Hull Bay	Windmill Pt Beach	Reported
Scituate	Scituate Harbor	Jericho Landing Beach	Reported
NORTH SHORE			
Ipswich	Ipswich Bay	Cranes Beach	Reported
Newbury	Plum Island Sd.	Parker River Refuge	High
Quincy	Quincy Bay	Wollaston Beach	Reported
Rockport	Sandy Bay	Old Garden Beach	Moderate
		Back Beach	Reported
		Front Beach	Reported

HORSESHOE CRAB NURSERY AREAS
2007

MOUNT HOPE BAY		
TOWN	**EMBAYMENT**	**DENSITY**
Somerset	Mount Hope Bay	High
	Taunton River	High
Swansea	Mount Hope Bay	High
	Coles River	High
BUZZARDS BAY		
Bourne	Buttermilk Bay	High
	Phinney's Harbor	High
Fairhaven	Nasketucket Bay	High
	Outer Harbor	Moderate
Mattapoisett	Mattapoisett Harbor	Reported
New Bedford	Outer Harbor	Moderate
Wareham	Buttermilk Bay	Reported
	Outer Wareham River	Moderate
Westport	Westport Rivers	Reported
SOUTH CAPE		
Barnstable	Lewis Bay	Reported
	Cotuit Bay	Moderate
Chatham	Cockle Cove Beach	High
	Stage Harbor	High
	Monomoy Island	High
Dennis	Bass River	High
Falmouth	Waquoit Bay	Reported
Mashpee	Waquoit Bay (Sage Lot Pond)	High
	Popponesset Bay	Moderate
Yarmouth	Bass River	High

MARTHA'S VINEYARD		
Aquinnah	Menemsha Pond	Moderate
Chilmark	Menemsha Pond	Moderate
Edgartown	Cape Poge Bay	Moderate
	Katama Bay	High
Oak Bluffs	Lagoon Pond	Reported
	Vineyard Haven Harbor	Reported
Tisbury	Lake Tashmoo	Moderate
NANTUCKET		
Nantucket	Madaket Harbor	Reported
	Muskeget Island	Reported
	Nantucket Harbor	High
	Tuckernuck Island	Reported
OUTER CAPE		
Chatham	Bassing Harbor	Reported
	Chatham Harbor	High
	Crowes Pond	Reported
	Pleasant Bay	High
Eastham	Nauset Marshes	Moderate
Harwich	Pleasant Bay	High
Orleans	Little Pleasant Bay	High
	Pleasant Bay	High
CAPE COD BAY		
Barnstable	Barnstable Harbor	High
Brewster	Brewster Flats	High
Dennis	Dennis Flats	High
Duxbury	Duxbury Bay	High
	Back River Marsh	High
Eastham	Eastham Flats	High
Kingston	Kingston Bay	Moderate
Orleans	Orleans Flats	High
Plymouth	Plymouth Harbor	High
Provincetown	Hatches Harbor	Reported
Truro	Pamet Harbor	Reported
Wellfleet	Wellfleet Harbor	High
Yarmouth	Yarmouth Flats	High
	Chase Garden Creek	Reported
MASSACHUSETTS BAY		
Cohasset	Cohasset Harbor	Reported
Hull	Hull Bay	Reported
Scituate	Scituate Harbor	Reported
NORTH SHORE		
Ipswich	Plum Island Sound	High
Newbury	Plum Island Sound	High