

Massachusetts 2013 Vp Control Plan

Public Health Warm Weather Commercial Harvest Restrictions for Oysters:

A. Harvesters:

1. No provision of this plan shall apply to seed oysters.
2. The requirements of this plan shall apply to both wild oysters from the public fishery and privately cultured oysters harvested for commercial purposes.
3. The requirements of this plan shall apply to all oysters harvested in Massachusetts coastal waters from May 24th through October 20th. For the purposes of this plan coastal waters are the intertidal and subtidal zones where oysters are cultured or grow naturally.
4. All oysters harvested from May 24th through October 20th shall be **adequately shaded*** during transport from harvest area to original dealer.
5. All shellfish tags shall include the **time of harvest*** in addition to harvest date, harvest area, identification of harvester, type of shellstock and quantity. Time of harvest shall be placed on the harvester tag in indelible ink at the actual beginning of harvest.
6. All oysters shall be **adequately iced*** by the harvester at the point of landing immediately after harvest.
7. Shellfish handling by harvesters:
 - a. Oysters may be bagged during low tide up to twenty four (24) hours prior to actual harvest or removal from the culture site (“grant”).
 - b. If oysters are to be bagged prior to actual harvest, the containers need to be tagged with water proof tags stating “Pre-collected for later harvest” with the date and time bagged or placed in a container.
 - c. In this case, the harvest date and time shall be the date and time the bags/containers are finally removed from the water or are exposed to the air prior to being brought to the first wholesale dealer.
 - d. Each harvester will keep a bound harvest log book that records the date, time of harvest, time of icing, and amount harvested (bushels, or count bags, etc) recorded in indelible ink. Books will be filled out before the days harvest leaves the harvest area.

* See Definitions Section

- e. If shellfish are pre-collected prior to final harvest (per b. above) the date, time bagged and the quantity shall be entered into the log book on the same day.
 - f. No market size oysters (either legal size or “petites”) maybe removed from the grant for offsite culling and subsequently placed in commerce. Seed oysters may be removed from the grant for culling.
 - g. All oysters shall be transported directly to the wholesale dealer’s physical facility for sale as required by 105 CMR 533.007(I)(3)(f)(1&2). Harvesters are prohibited from holding oysters at a private residence or unlicensed facility prior to delivery to the original dealer.
8. The Division of Marine Fisheries shall, pursuant to 322 CMR 7.01(7) *Form ,Use and Contents of Permits* condition all Commercial Permits endorsed for shellfish to include the provisions governing commercial harvest of oysters in this *Vp* Control Plan.

B. Dealers:

- 1. All oysters received by the original shipper between May 24th and October 20th shall be cooled to 50°F within 10 hours of harvest or tidal exposure.
- 2. All dealers who receive oysters harvested from Massachusetts coastal waters between May 24th and October 20th inclusive shall implement a HACCP plan that indicates pathogen growth of naturally occurring *Vp* as a significant hazard that is reasonably likely to occur and includes the following at:
 - a. **Critical Control Point Receiving:** All oysters received by the original shipper shall be properly tagged in accordance with section A.5 of this Plan and packed in ice that is sufficient to ensure that immediate cooling begins and continues for all oysters;
 - b. **Critical Control Point Storage:** A Critical Limit indicating that the **internal temperature*** of oysters has reached 50°F (10°C) or below within 10 hours or less after harvest/tidal exposure; and
 - c. **Critical Control Point Storage:** A Corrective Action to ensure that oysters that are not cooled to an **internal temperature*** of 50°F (10°C) within 10 hours are not directed to the raw shellfish market.
- 3. To comply with dealer requirements of the plan, a dealer shall ensure that a temperature control mechanism for cooling and storing of oysters that:
 - a. Cools oysters to an internal temperature of 50°F (10°C) in 10 hours or less after harvest/tidal exposure; and

* See Definitions Section

- b. Maintains an ambient temperature of 45°F.

Note: Dealers should be advised that cooling rates for oysters will depend on size and capacity of refrigerated storage areas. Oysters should be stored in a manner that allows for the free circulation of refrigerated air in order to achieve even and rapid cooling throughout each containerized lot of shellstock.

4. Each dealers receiving records shall include the following minimum information:
 - a. Identification of harvester;
 - b. Harvest date and area;
 - c. Time of harvest;
 - d. Presence of **adequate ice***;
 - e. Time oysters were cooled to $\leq 50^{\circ}\text{F}$ with actual internal temperature.
5. In addition, dealers shall comply with all relevant requirements of 105 CMR 533.007 *Fish and Fishery Products*.
6. The Division of Marine Fisheries shall, pursuant to #22 CMR 7.01(7) *Form, Use and Contents of Permits*, condition all Wholesale Dealer Permits, endorsed for shellfish to include the provisions governing the receiving, handling and record keeping related to oysters in this Vp Control plan. Under no circumstances will it be permitted for oysters to be returned to the lease site or town waters.

C. Corrective Action:

1. Dealers shall reject any lots of oysters that are not properly tagged as harvested by a licensed harvester and/or are not adequately iced per Section B of this Plan.
2. Dealers who receive shipments of oysters that are not compliant with the requirements of Section B of this Plan shall place the shellstock on internal hold and immediately notify the Food Protection Program (FPP). Dealers shall then document the deviation in a Notice of Unusual Occurrence and Corrective Action (NUOCA) and await instruction from the FPP for final disposition of potentially time/temperature abused oysters.

* See Definitions Section

D. Enforcement:

1. Representatives of state and local regulatory agencies (DMF, DPH, OLE, etc.) shall conduct periodic unannounced inspections at harvest sites, common landings and wholesale dealer facilities to determine compliance with the requirements of this Plan.
2. All shellfish harvested under this plan shall be subject to embargo and/or disposal if found to be significantly time/temperature abused or non-compliant with requirements of this Plan.
3. Local Shellfish Constables and their deputies will conduct spot checks at harvest sites to verify harvest times on harvester tags and other controls such as shading and icing.
4. Inability or refusal of harvesters and/or dealers to maintain compliance with the requirements of this plan may result in enforcement up to and including suspension and revocation of harvester and/or dealer permits in accordance with Chapter 130, Section 2, of Massachusetts General Laws.

Definitions:

Adequately Iced means the containers holding the shellfish have enough ice on the shellfish that is sufficient to ensure that immediate cooling begins and continues to provide cooling until required internal temperatures are achieved within 10 hours of harvest/tidal exposure.

Adequately Shaded means that measures shall be taken to prevent oysters from direct exposure to sunlight that might cause a significant increase in pathogenic growth due to an increase in temperature.

Internal Temperature means the external temperature of the shell of the animal, at the center of a packaged mass of shellstock (box, sack, bag, etc.).

Time of Harvest means the time when the first shellstock in a lot is taken from the water or, in the case of intertidal harvest, the time of first exposure. Should the harvesting technique used involve re-submerging, the Authority must approve the harvesting technique to assure that the harvest method does not promote post harvest growth of *Vp* associated with oysters.

The MA Department of Public Health's Food Protection and the MA Division of Marine Fisheries will review this Plan on an annual basis and revise it as needed to maintain compliance with the National Shellfish Sanitation Program's Model Ordinance.

Appendix A

Massachusetts *Vp* Risk Evaluation - 2013

Massachusetts Division of Marine Fisheries

Pursuant to National Shellfish Sanitation Program (NSSP) requirements, every state from which oysters are harvested commercially shall conduct a *Vibrio parahaemolyticus* (*Vp*) risk evaluation annually. The evaluation shall consider each of the following factors, including seasonal variations in factors, in determining whether the risk of *Vp* infection from the consumption of oysters harvested from an area (hydrological, geographical, or growing) is reasonably likely to occur. For this risk assessment, “reasonably likely to occur” shall mean that the risk constitutes an annual occurrence. (NSSP Guide, Sec.II, Chapt. II, @.05, A, 2009).

1) Number of Cases

During 2012, Massachusetts reported nine confirmed individual sporadic cases of *Vp* traced to consumption of commercially harvested oysters from Massachusetts growing areas. Also, there were an additional five sporadic cases that were traced back to multiple sources that included some of the same Massachusetts growing areas in addition to sources in other states. As a result of the multiple sources, the specific origin of oysters related to the illness could not be conclusively determined.

In 2011, there were two illnesses linked in time to Eastern Cape Cod Bay, a region with similar tidal characteristics where oysters are exposed during lower tidal stages to sun and air temperature for several hours. An illness outbreak (2 or more illnesses) epidemiologically linked at the same time to oysters from an area triggers a Control Plan for the area under NSSP standards. In previous years, there have been sporadic *Vp* illnesses involving shellfish from a combination of in-state and out of state sources. This was the first time two illnesses have been associated with a strictly Massachusetts source. Another sporadic case was reported in the fall of 2011 linked to oysters commercially harvested from Duxbury Bay.

2) Levels of *Vp* in Water and Shellfish

Marine Fisheries does not test for levels of either total or pathogenic strains of *Vp* in water or shellfish. *Vp* has been known to occur in Massachusetts waters since the early 1960's especially in waters around Cape Cod and the Islands. It is generally assumed that *Vp* is ubiquitous in Massachusetts inshore coastal waters during the warmer months but not at levels in shellfish that are a problem at the time of harvest.

Over the past five years, one out of state oyster buyer has found low numbers of *Vp* in Cape Cod Bay oysters during the summer months as a result of their own quality assurance testing. Since this company has a zero tolerance for *Vp*, they do not buy Cape Cod Bay oysters during the summer.

3) Water Temperatures

It appears that excessive water temperature that would automatically trigger a *Vp* Control Plan (***above an average monthly daytime temperature of 81°F***) under the NSSP is not yet a problem in any area. There are five identified areas that approach but do not reach or exceed 81°F in either July and/or August. Four are shallow water, enclosed ponds or embayments with low flushing, and 2 to 4 foot tidal amplitudes, located in Buzzards Bay or on the south side of Cape Cod and account for minimal oyster production. One is in Eastern Cape Cod Bay.

Marine Fisheries has four years (2009 - 2011) of data at 8 sites and added 6 more sites in 2012 to acquire additional water temperature data for annual risk evaluations and to track the trend of increasing water temperatures due to climate change (Map 1, Tables 1 and 2). The original sites were selected because they were deemed to represent “worse case” situations.

In 2012, two sites in Buzzards Bay had average monthly temperatures in July and August that were between 79 and 80°F. Two other sites on Cape Cod and one on Nantucket had average monthly temperatures of 77.5 – 78°F in either July or August. During the period between 2009 and 2012 four sites exceeded a monthly average of 79°F and one exceeded 77.5°F.

The higher temperatures at these five sites do not automatically trigger a *Vp* Control Plan but are close enough to be of concern since they are conducive to rapid growth and survival of *Vp* bacteria which thrive at high water temperatures.

4) Air Temperatures

National Weather Service (NWS) air temperature data has been collected from Weather Underground for four years (2009 - 2012) from five airports: Chatham, Hyannis, Nantucket, New Bedford and Plymouth (Table 3-1). These sites are not on the water and also reflect warmer temperatures than would be seen at the oyster culture/harvest sites. From a public health perspective this is conservative. DMF deployed three shaded air temperature monitors in 2012 to actual culture/ harvest sites in Barnstable Harbor, Cotuit Bay and at Cape Cod Bay in East Dennis (Table 3-2). NWS, Weather Underground data was also collected from four new sites located on the water near oyster culture sites in Marion, Wareham, Eastham and Truro (Table 3-3). See Map 2 for location of temperature monitoring sites. Air temperatures can intermittently reach daytime highs above 90°F; however this is not the norm along the shore on Cape Cod or the Islands.

During the months of June through August 2012, the number of days over 90°F at the new *Marine Fisheries* growing area temperature stations was Barnstable Harbor (3), Cotuit Bay (3), East Dennis (6). The number of days over 80° F was Barnstable (35), Cotuit (42), and East Dennis (49).

5) Salinity

Vp bacteria survive in salinities ranging from 5 to 30 ppt (parts per thousand) while an optimum salinity of 23 ppt has been reported for *Vp* (Zimmerman 2007). This is considered high by other researchers. Massachusetts coastal waters supporting oysters are within that range. Optimum salinities for oysters are 10 to 28 ppt (Loosanoff, 1965). However, oysters will survive at low salinities of 5 to 7.5 ppt and in more Open Ocean like salinities of 32 to 33 ppt, the later generally being the case in Cape Cod Bay. Salinity is high in most culture sites throughout the state (25 to 32 ppt in summer). The only wild commercial oyster harvest in the summer months occurs in Wellfleet Harbor where summer salinities range from 29 to 33 ppt. at oyster sites.

6) Harvesting Techniques

Oyster harvesting techniques in Massachusetts fall into two categories depending almost entirely on tidal amplitude at the harvest location. Cape Cod Bay has tidal amplitudes with a mean range varying from 10 feet in Wellfleet to 9.5 feet at Beach Point, Barnstable Harbor and 9.1 feet at Provincetown. On extreme minus or moon tides, the tides can be 1 to 2 feet lower than average. As a result, most oyster culture and harvest in Eastern Cape Cod Bay is conducted in the intertidal zone where oysters are exposed to ambient air temperatures and sunlight in some cases for over four hours around the time of low tide. There is very little subtidal harvest of oysters in Cape Cod Bay except for about six commercial wild harvest draggers in Wellfleet Harbor.

All other summertime commercial oyster harvest in Massachusetts is conducted by private growers on their own licensed sites. Almost all of these are subtidal harvest situations because of the limited intertidal area available for oyster culture due to significantly smaller mean tidal amplitude. Throughout Buzzards Bay the mean amplitude is 3.1 to 4.0 feet; on the south side of Cape Cod and on Martha's Vineyard it is between 1 and 2 feet at oyster sites; and about 3 feet at a maximum on Nantucket.

With the exception of the Wellfleet wild fishery, summer harvesters are on their own licensed sites for relatively short periods of time harvesting what they need for that day and promptly delivering the oysters to their dealer where it can be placed in refrigeration. Some growers (prior to a required *Vp* Control Plan) voluntarily use ice and/or shading, or evaporative cooling while harvesting, handling and transporting to the first wholesale dealer.

The greatest potential for a problem seems to be exposure to high ambient air temperature and sunlight in intertidal culture and harvest situations at lower tidal stages prior to harvest rather than harvest directly out of the water from subtidal situations

7) Quantity of Harvest and Use.

In Massachusetts, summer time commercial harvest of oysters is conducted by private growers on municipally licensed shellfish aquaculture sites. Wellfleet is the only town that allows summer harvest from the wild fishery on public oyster beds. Statewide, there are 170

private growers that commercially cultivate and harvest only oysters and another 91 growers that raise oysters and other species of shellfish for commercial purposes. In total, there are 261 oyster growers operating in 22 coastal municipalities.

Almost all of the oysters produced by private growers in Massachusetts and a high percentage of summer wild caught Wellfleet oysters are consumed in the raw half shell market in both intrastate and interstate commerce. Those not used for raw consumption (mostly wild caught Wellfleet oysters) are shucked and cooked locally, usually as fried oysters.

Prior to large scale shellfish aquaculture and the more recent switch to oyster culture from quahogs; there was limited summer harvest of oysters in Massachusetts. Oyster harvest has increased rapidly in the last ten years and aquaculture accounts for an estimated 75 percent of overall oyster landings which have increased dramatically in the last three years.

Commercial oyster landings reported by wholesale dealers to *Marine Fisheries* in the Standard Atlantic Fisheries Information System (SAFIS) for the last three years are found below. Landings are reported as live weight/in shell and converted to bushels. Value is in dollars paid to producers (growers or fishermen) at first wholesale.

Year	Live Weight	Bushels	Value
2010	2,929,655 lb	58,593 Bu	\$6,969,003
2011	3,150,289 lb	63,006 Bu	\$7,238,401
2012	4,119,792 lb	82,396 Bu	\$11,640,498

CONCLUSIONS and RECOMMENDED ACTION

During 2011, two *Vp* illnesses were traced to consumption of commercially harvested oysters. These cases were linked in time and to the same region of Eastern Cape Cod Bay. This geographic area has similar tidal characteristics and culture techniques that expose most oysters to sun and ambient air temperatures for several hours around low tide. Such exposure in warm weather can cause vibrio bacteria to thrive and multiply at alarming rates.

In 2012, nine illnesses were traced to one or more of eight Massachusetts areas only. Four of these areas are in Eastern Cape Cod Bay, two in Western Cape Cod Bay; one is considered the Southside of Cape Cod and one area on Martha’s Vineyard. The five additional cases that involved consumption of both Massachusetts and out of state areas involved five of the eight Massachusetts areas implicated in the Massachusetts illnesses and five other Massachusetts areas, one in Eastern Cape Cod Bay, three on the Southside of Cape Cod and one in Buzzards Bay.

The NSSP requires a Vp Control Plan if an area was involved in an outbreak within the prior five years (NSSP Guide, Sec.II, Chapt. II, @ .05, B. (3) 2009). This year there were nine more confirmed sporadic Vp cases involving four other areas outside of Eastern Cape Cod Bay.

Summer water temperatures are well within the optimal range for Vp growth and in five areas approach the level (81°F) that would prompt the need for a Control Plan. Air temperatures exceed 80°F at shaded monitors in three growing areas by 47 days in Barnstable, 41 in Cotuit and 30 in East Dennis. At air temperatures above 80°F, vibrio levels can double every hour.

NSSP Guidance (Sec. IV, Chapt. IV, @ .03, B. 1. b. 2009) a Control Plan must apply to a period 30 days prior to and 30 days after an outbreak.

Considering the increase in the number of illnesses, the additional areas implicated in illnesses that encompass most other regions of the state, increasing summer oyster production primarily for raw consumption, water and air temperature data; it is logical to conclude that illnesses are “reasonably likely to occur on an annual basis”. Without controls, and with increased risk due to higher production and consumption of raw or lightly cooked oysters, the number of illnesses will increase as will the potential for more outbreaks.

Therefore, in order to protect public health and the oyster industry, the following is recommended:

- 1) A Vp Control Plan be developed and implemented for all oysters harvested in Massachusetts coastal waters that requires stringent time to temperature controls consistent with the NSSP and other controls such as immediate icing and shading of oysters at landing and during transport to the first wholesale dealer.
- 2) Since the NSSP requires that the time period of the Vp Control Plan must include a 30 day period on either side of reported illnesses, the time period of the plan should include late May through late October.
- 3) All oysters received by the original shipper under the plan shall be cooled to 50°F within ten hours of harvest.

Map 1

Locations of Water Temperature Monitors

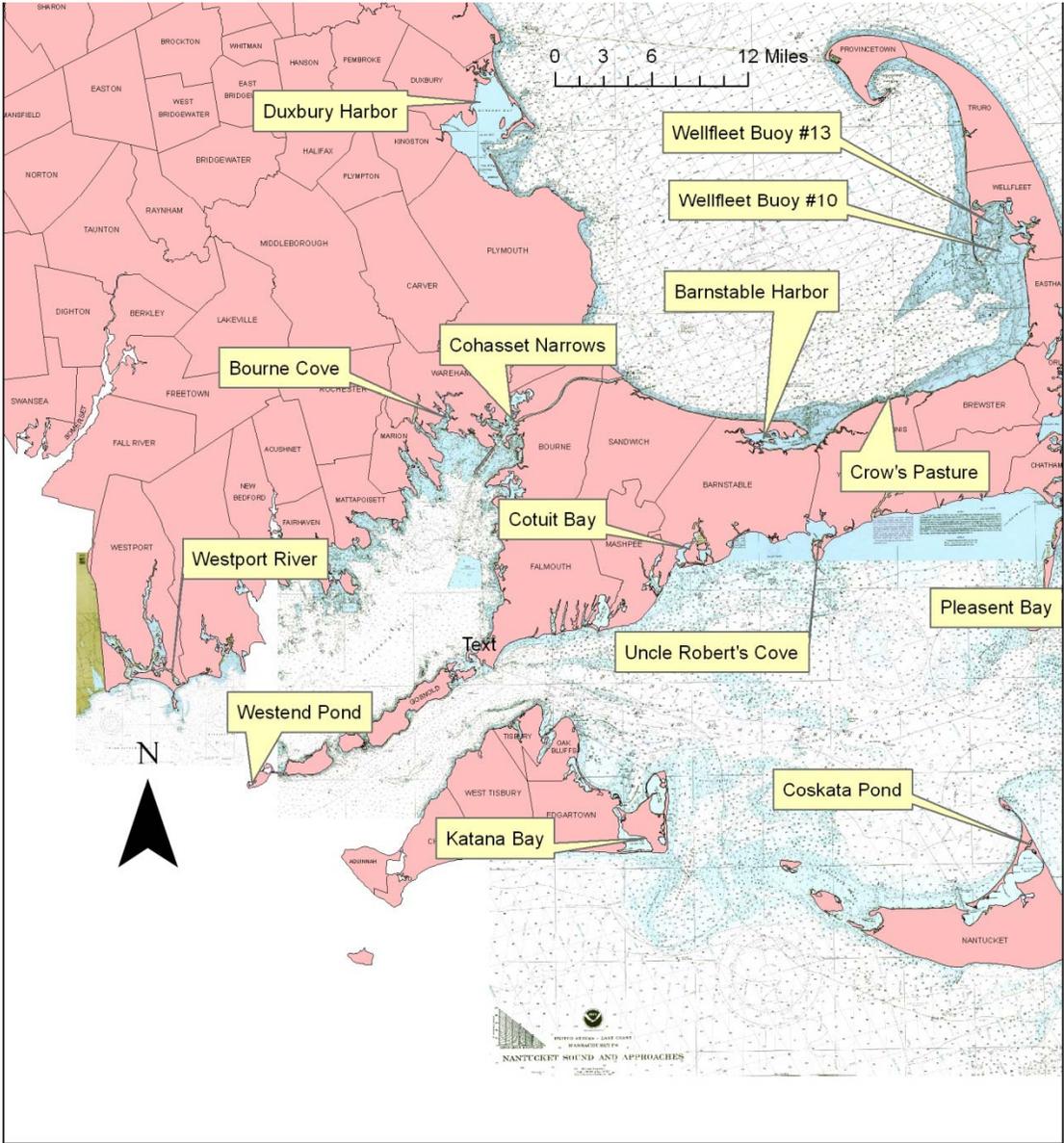


Table 1-1
 Marine Fisheries Water Temperature Data °F
 Cape Cod Bay June - September 2012
 Daylight Temperatures Only

Barnstable	Avg	Max	Min
June	69.6	83.2	54.8
July	77.2	85.0	70.3
August	76.7	83.6	69.1
Sept	68.5	79.0	60.7
Duxbury Bay	Avg	Max	Min
June	63.8	72.0	53.4
July	67.4	75.5	58.1
August	66.4	73.8	59.9
Sept	63.0	69.8	55.5
Dennis Grants	Avg	Max	Min
June	65.3	86.5	53.8
July	73.2	87.6	63.6
August	70.8	83.8	58.8
Sept	65.5	79.5	58.3
Wellfleet Buoy #13	Avg	Max	Min
June	68.8	78.6	59.2
July	77.6	84.3	73.1
August	77.4	82.3	72.4
Sept	69.6	76.2	63.6
Wellfleet Buoy #10	Avg	Max	Min
June	67.9	76.7	58.5
July	77.0	82.7	71.9
August	76.1	81.3	71.9
Sept	69.2	75.0	63.6

Table 1-2
 Marine Fisheries Water Temperature Data °F
 Buzzards Bay June - September 2012
 Daylight Temperatures Only

Bourne Cove	Avg	Max	Min
June	70.4	83.2	59.3
July	78.9	87.4	73.8
August	79.2	85.4	73.9
Sept	71.1	80.6	64.3
Cohasset Narrows	Avg	Max	Min
June	65.2	74.6	54.0
July	72.1	79.3	65.0
August	72.7	77.7	67.2
Sept	66.9	74.1	61.1
West End Pond	Avg	Max	Min
June	71.7	82.9	60.0
July	79.7	85.9	71.2
August	80.0	87.7	73.4
Sept	71.5	82.9	60.0
Westport River	Avg	Max	Min
June	69.8	82.9	59.3
July	76.9	85.2	69.6
August	77.5	83.8	71.3
Sept	69.7	78.8	62.4

Table 1-3
 Marine Fisheries Water Temperature Data °F
 South side of Cape Cod and Islands June - September 2012
 Daylight Temperatures Only

Cotuit Bay	Avg	Max	Min
June	72.0	81.1	62.6
July	76.7	86.8	75.7
August	76.7	83.9	75.3
Sept	72.0	78.6	64.8
Coskata Pond	Avg	Max	Min
June	69.6	78.6	58.1
July	77.2	83.9	70.7
August	78.2	83.2	71.0
Sept	70.0	78.6	63.1
Katama Bay	Avg	Max	Min
June	68.1	76.5	59.9
July	75.9	81.1	71.5
August	76.7	80.9	70.8
Sept	70.3	77.7	63.8
Lewis Bay	Avg	Max	Min
June	70.2	78.6	59.5
July	78.1	83.8	73.8
August	78.5	83.0	72.7
Sept	70.2	77.9	63.3
Pleasant Bay	Avg	Max	Min
June	68.7	79.7	56.8
July	75.9	82.9	69.4
August	75.8	81.1	69.6
Sept	68.1	76.4	60.4

Table 2-1
 Marine Fisheries Water Temperature Data °F
 Cape Cod Bay June – September 2009 -2012
 Daylight Temperatures Only

	Barnstable Harbor		
2012	Avg	Max	Min
June	69.6	83.2	54.8
July	77.2	85.0	70.3
August	76.7	83.6	69.1
Sept	68.5	79.0	60.7

	Duxbury Bay		
2012	Avg	Max	Min
June	63.8	72.0	53.4
July	67.4	75.5	58.1
August	66.4	73.8	59.9
Sept	63.0	69.8	55.5

	Barnstable Harbor		
2011	Avg	Max	Min
June	69.3	79.5	58.8
July	76.6	85.4	69.8
August	74.4	81.6	63.1
Sept	68.4	77.7	60.5

	Duxbury Bay		
2011	Avg	Max	Min
June	65.8	77.4	57.4
July	72.3	82.0	64.7
August	70.5	78.8	59.9
Sept	65.8	73.2	60.0

	Barnstable Harbor		
2010	Avg	Max	Min
June	71.3	82.0	61.2
July	77.7	88.5	70.7
August	73.2	82.0	62.6
Sept	68.8	82.2	60.4

	Duxbury Bay		
2010	Avg	Max	Min
June	68.0	84.8	58.6
July	71.4	81.3	62.8
August	68.8	77.4	62.3
Sept	66.9	77.1	61.6

	Barnstable Harbor		
2009	Avg	Max	Min
June	65.3	75.0	42.4
July	72.7	82.7	62.8
August	76.0	84.5	67.1
Sept	66.3	72.2	58.3

	Duxbury Bay		
2009	Avg	Max	Min
June	62.9	70.7	57.1
July	68.4	76.5	63.5
August	no data		
Sept	no data		

Table 2-2
 Marine Fisheries Water Temperature Data °F
 Buzzards Bay June – September 2009 -2012
 Daylight Temperatures Only

		Bourne Cove		
2012	Avg	Max	Min	
June	70.4	83.2	59.3	
July	78.9	87.4	73.8	
August	79.2	85.4	73.9	
Sept	71.1	80.6	64.3	

		Cohasset Narrows		
2012	Avg	Max	Min	
June	65.2	74.6	54.0	
July	72.1	79.3	65.0	
August	72.7	77.7	67.2	
Sept	66.9	74.1	61.1	

		West End Pond		
2012	Avg	Max	Min	
June	71.7	82.9	60.0	
July	79.7	85.9	71.2	
August	80.0	87.7	73.4	
Sept	71.5	82.9	60.0	

2011	Avg	Max	Min
June	70.3	81.3	62.1
July	77.8	83.9	72.9
August	76.6	84.8	69.1
Sept	71.0	94.1	62.9

2011	Avg	Max	Min
June	65.0	74.3	57.8
July	71.5	76.9	65.0
August	71.5	77.9	63.8
Sept	67.6	94.4	62.8

2011	Avg	Max	Min
June	69.3	94.1	60.7
July	74.1	101.5	59.0
August	77.1	100.1	44.6
Sept	70.7	80.9	61.1

2010	Avg	Max	Min
June	72.6	83.0	65.2
July	79.7	97.1	70.5
August	75.9	85.0	67.1
Sept	71.0	82.2	64.8

2010	Avg	Max	Min
June	65.7	73.2	59.0
July	72.2	82.3	65.5
August	69.8	76.7	61.7
Sept	67.9	76.0	63.5

2010	Avg	Max	Min
June	73.5	81.4	64.7
July	80.7	88.6	71.3
August	73.8	91.6	59.3
Sept	69.4	82.0	62.9

2009	Avg	Max	Min
June	66.0	73.6	61.4
July	74.1	80.9	68.1
August	78.3	85.6	63.1
Sept	No data		

2009	Avg	Max	Min
June	61.5	68.6	55.7
July	69.2	74.8	63.5
August	71.5	78.4	65.7
Sept	66.5	72.9	62.1

2009	Avg	Max	Min
June	67.2	84.8	49.1
July	74.7	81.1	68.8
August	77.9	82.9	70.0
Sept	67.9	80.0	55.7

Table 2-3
 Marine Fisheries Water Temperature Data °F
 South Side of Cape and Nantucket June – September 2009 -2012
 Daylight Temperatures Only

	Cotuit Bay		
2012	Avg	Max	Min
June	72.0	81.1	62.6
July	76.7	86.8	75.7
August	76.7	83.9	75.3
Sept	72.0	78.6	64.8

	Pleasant Bay		
2012	Avg	Max	Min
June	68.7	79.7	56.8
July	75.9	82.9	69.4
August	75.8	81.1	69.6
Sept	68.1	76.4	60.4

	Coskata Pond		
2012	Avg	Max	Min
June	69.6	78.6	58.1
July	77.2	83.9	70.7
August	78.2	83.2	71.0
Sept	70.0	78.6	63.1

2011	Avg	Max	Min
June	72.0	79.3	65.0
July	79.9	83.8	76.2
August	78.0	83.2	72.4
Sept	71.7	75.8	65.9

2011	Avg	Max	Min
June	68.7	76.5	59.9
July	76.2	82.3	71.2
August	74.2	80.2	66.2
Sept	68.7	75.0	61.6

2011	Avg	Max	Min
June	69.8	77.4	61.9
July	76.7	81.6	71.2
August	76.3	81.8	70.0
Sept	69.9	76.0	62.3

2010	Avg	Max	Min
June	No DATA		
July	No DATA		
August	No DATA		
Sept	No DATA		

2010	Avg	Max	Min
June	70.2	80.4	60.2
July	76.2	84.8	66.9
August	72.6	80.2	64.3
Sept	69.0	80.7	62.4

2010	Avg	Max	Min
June	71.9	83.2	61.2
July	79.2	87.2	70.8
August	75.6	83.6	65.3
Sept	71.7	91.1	59.7

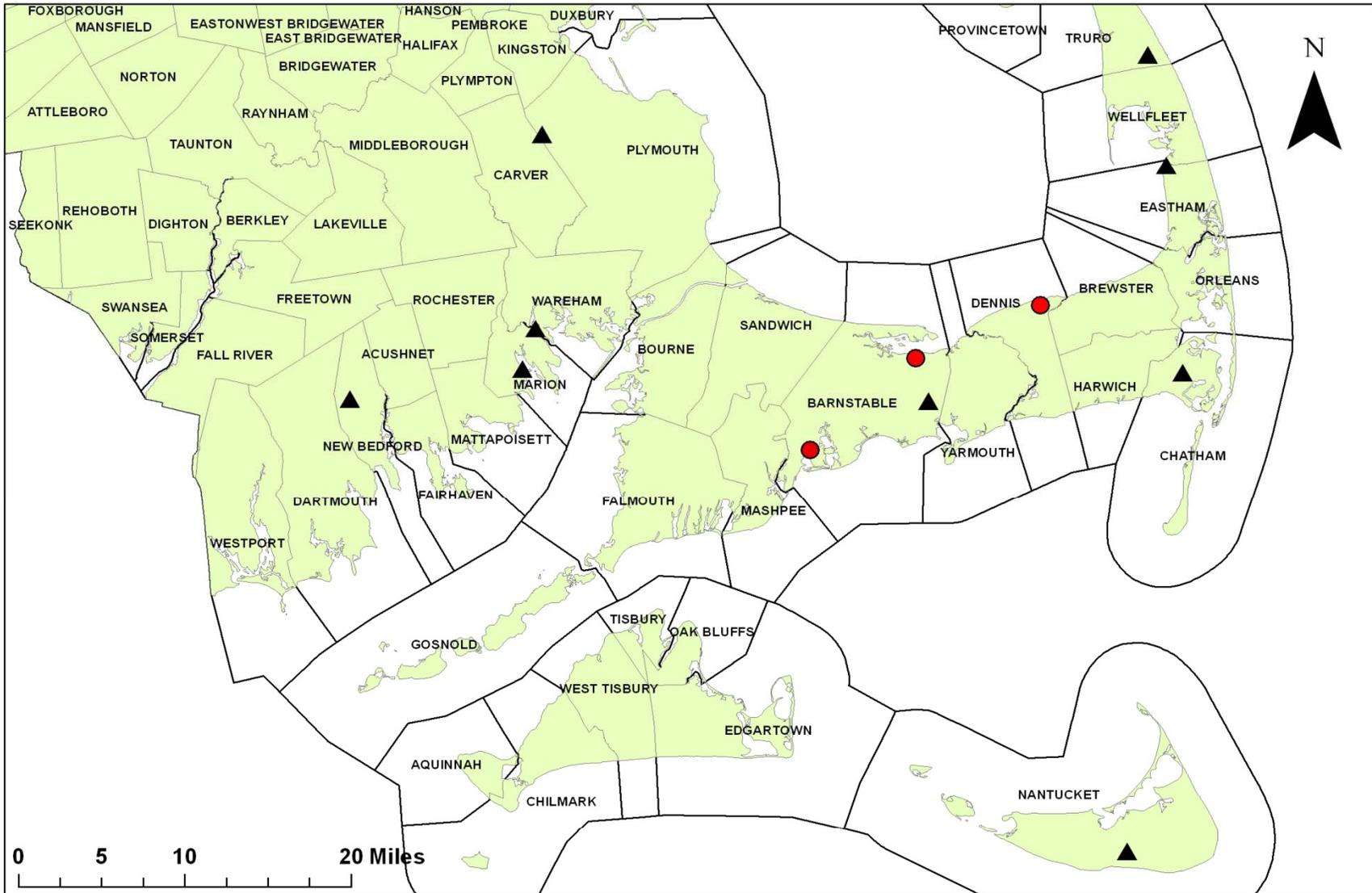
2009	Avg	Max	Min
June	66.6	73.1	61.9
July	74.4	83.6	69.6
August	78.2	83.4	71.2
Sept	68.8	74.4	64.0

2009	Avg	Max	Min
June	64.4	72.0	57.1
July	71.7	79.2	64.1
August	74.5	80.7	65.7
Sept	66.5	71.7	60.0

2009	Avg	Max	Min
June	65.6	76.0	55.2
July	74.6	82.3	65.9
August	77.7	84.1	68.2
Sept	68.5	75.5	59.0

Map 2

Air Temperature Stations for the Summer of 2012



Red Circles are DMF stations
Black Triangles are Weather Underground stations

Table 3-1
Weather Underground Average Air Temperature Data °F
June through September 2009 to 2012

Chatham				
	June	July	August	September
2009	60	68	72	62
2010	67	75	71	66
2011	65	73	72	67
2012	64	73	72	64

New Bedford				
	June	July	August	September
2009	63	69	72	60
2010	69	76	71	66
2011	67	75	72	66
2012	67	75	72	66

Hyannis				
	June	July	August	September
2009	62	70	72	61
2010	68	75	71	65
2011	64	72	71	65
2012	64	72	72	62

Plymouth				
	June	July	August	September
2009	62	69	72	61
2010	70	77	72	68
2011	65	73	71	66
2012	64.6	73	73	63

Nantucket				
	June	July	August	September
2009	59	66	70	62
2010	64	72	69	65
2011	32	70	69	65
2012	62	71	71	64

Table 3-2
Marine Fisheries Air Temperature Data °F
June through September 2012

	Monthly		Monthly	Days Over	Days Over
	Max	Avg	Min	80	90
Dennis					
June	95	65.8	48.7	8	4
July	94.1	74.2	57.3	19	2
August	88.5	74.1	58	20	0
September	82.2	65.8	47.3	2	0

	Monthly		Monthly	Days Over	Days Over
	Max	Avg	Min	80	90
Cotuit Bay					
June	93.1	67.4	50.6	7	3
July	89.2	73.5	55.2	17	0
August	87.6	73.8	55.5	17	0
September	82.5	65.4	43.1	1	0

	Monthly		Monthly	Days Over	Days Over
	Max	Avg	Min	80	90
Barnstable					
June	89.4	66.9	49.4	5	0
July	90.1	74.5	60.4	14	1
August	89	74.2	58.6	11	2
September	79.7	65.2	49.1	0	0

Table 3-3
Weather Underground Air Temperature Date °F
June through September 2012

	Monthly		Monthly
	Max	Avg	Min
Marion			
June	92.4	64.7	45.4
July	88.2	72.7	54.5
August	85.9	72.6	57.5
September	78.4	64.9	45.8

	Monthly		Monthly
	Max	Avg	Min
Eastham			
June	94.1	64.2	49
July	89.9	73.3	58.5
August	87.2	73.4	59.3
September	81.4	65.1	49.6

	Monthly		Monthly
	Max	Avg	Min
Wareham			
June	91.2	69.9	48
July	88	72.3	57
August	86	72.4	55
September	77	63.9	47

	Monthly		Monthly
	Max	Avg	Min
Truro			
June	94	64	46
July	94	72.4	58
August	98	64.5	n/a
September	83	62.5	47