# ANNUAL SUMMARY OF PHYTOPLANKTON BLOOMS AND RELATED CONDITIONS IN THE NEW JERSEY COASTAL WATERS SUMMER OF 2005

# New Jersey
# Department of Environmental Protection


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# Contents

# Executive Summary

Phytoplankton monitoring is conducted annually in New Jersey's coastal waters and major estuaries for the presence and abundance of potentially harmful algal species. Traditionally, sampling has been conducted biweekly from May to September, in cooperation with the USEPA Helicopter monitoring, but because the helicopter was needed in the Gulf of Mexico because of Hurricane Katrina, sampling was terminated in early August 2005. During the 2005 summer season, as has been the case in recent years, diatoms (not normally associated with harmful effects) were the dominant phytoplankton forms overall. The highlight of the 2005 sampling season in Barnegat Bay was the lack of a "brown tide" bloom. This is the third year in a row that the Barnegat Bay did not have such a bloom. In June 2005, the highest chlorophyll *a* concentration that has been recorded was observed in the ocean off the coast of Long Branch (169 µg/L). Examination showed an ongoing bloom of mixed diatoms consisting mostly of *Cerataulina pelagica*; however, no adverse effects were observed. A bloom of *Olisthodiscus luteus,* a potentially toxic red tide alga, was detected off the coast off New Jersey during the week of July 18, 2005. *Olisthodiscus luteus* is considered to be a toxic organism involved in fish farm kills in Washington State on the West Coast. No fish or human health effects have been associated with this species on the East Coast.

# Introduction

The New Jersey Department of Environmental Protection (NJDEP) Water Monitoring and Standards program annually monitors phytoplankton assemblages in New Jersey's coastal waters and major estuaries as part of the State's compliance with the National Shellfish Sanitation Program (NSSP). Under the statutory authority of NJSA 58:24, the Department is mandated to ascertain the condition of shellfish beds and the fitness of the shellfish for human consumption. The National Shellfish Sanitation Program requires that each coastal state develop a contingency plan that includes control measures for marine biotoxins [1]. Filter-feeding molluscan shellfish, known as "bivalves" (clams, oysters, and mussels), are capable of accumulating toxins that may be produced by certain algal species. Species of concern include: *Pseudonitzschia sp.* which causes Amnesic Shellfish Poisoning (ASP); *Prorocentrum sp.* and *Dinophysis sp,.* whose toxins cause Diarrhetic Shellfish Poisoning (DSP); and *Alexandrium sp.,* which is the cause of Paralytic Shellfish Poisoning (PSP). The phytoplankton-monitoring program complements this portion of New Jersey's contingency plan through surveillance of shellfish growing areas for possible toxin-producing algal species, which are identified and enumerated along with other phytoplankton present.

The primary purpose of this program is to ensure that shellfish harvested in New Jersey are not toxic for human consumption due to the presence of certain phytoplankton known to produce toxins. However, algal blooms may have other harmful effects including marine fauna kills, mild toxicity to bathers and reduced aesthetic quality. This information, which is obtained cooperatively with the US Environmental Protection Agency (EPA) Region II during their summer New York Bight Water Quality helicopter survey [3], and the NJDEP's Water Quality Monitoring Network is summarized for 2005 in this report. These results complement the extensive bacteriological monitoring and pollution source surveys conducted by NJDEP as part of the NSSP [1]. They also complement the offshore dissolved oxygen and bathing area bacteriological data, gathered by the USEPA. Also involved are the Southern Planning Bureau of NJDEP's Division of Watershed Management and the Coastal county health agencies [4]. Further information regarding this monitoring plan may be obtained by contacting the Bureau of Marine Water

Monitoring at (609) 748-2000 or visiting the bureau's web site at www.nj.gov/dep/bmw.

Routine helicopter surveillance by the USEPA, with sample collections in coastal waters of the New York Bight, commenced in 1977 following the massive offshore bloom of *Ceratium tripos*, a non-toxic dinoflagellate, which was associated with oxygen depletion and consequent widespread fish mortalities [5]. Prior to this, bloom incidence had been primarily estuarine or coastal. Beginning in 1973, the NJDEP and the National Marine Fisheries Service (NMFS) Sandy Hook Laboratory conducted an intensive phytoplankton survey of the New Jersey northern estuarine and coastal area [6]. Late spring and summer red tides, caused by several species of phytoflagellates, especially *Olisthodiscus luteus*, *Katodinium rotundatum* and *Prorocentrum* spp. have been recurrent in this region since the early 1960's. The blooms often extended from the Hudson-Raritan estuary southward along the NJ coast, sometimes as far as Belmar or beyond. The blooms have been associated with hypertrophication in the region [7].

Adverse effects were usually only aesthetic in nature (water discoloration and resultant accumulations of brown foam or floc), albeit occasional fish kills via hypoxia or complaints by bathers of minor irritation. The dinoflagellate "green tides" of 1984-85, caused by *Gyrodinium* cf *aureolum*, were the first serious blooms along the southern New Jersey coast. These were associated with several cases of mild sickness in bathers, and a few localized kills of benthic fauna [8, 9]. Also in 1985, yellowish-brown water caused by the minute chlorophyte, *Nannochloris atomus*, became conspicuous in the Barnegat Bay system and has recurred each subsequent summer [10]. The principal consequence has been diminished aesthetic quality of the water. Following these later events, routine surveillance was expanded southward from Island Beach to Cape May. A history of bloom events in New Jersey waters, and the phytoplankton species involved, may be in the annual reports found at www.nj.gov/dep/bmw/reports.htm [2]. Of the major blooms mentioned above, only those of *Prorocentrum* spp. and *G.* cf *aureolum* were associated with mild irritation or discomfort to bathers. Most instances of distress or mortality to marine fauna were attributed to hypoxia from decomposition, rather than toxicity of the algae. Algae-derived toxins associated with acute illness in humans via consumption of fish or shellfish have not been detected in New Jersey waters; however, a few species known to be toxic in other regions have formed a portion of our coastal phytoplankton community.

In recent years, major phytoflagellate red tides have been confined primarily to the Hudson-Raritan estuary. Here, however, diatoms (e.g. *Skeletonema costatum and Thalassiosira spp.*), normally most abundant during the cooler months, have dominated from mid to late summer. From 1996 to 2004, flagellate red tides were overshadowed by dense summer blooms of several diatom species in the estuary and, to a lesser degree, along the adjacent New Jersey northern coastline. In 1995, the minute "brown tide" alga, *Aureococcus anophagefferens*, associated with damage to shellfish crops in eastern Long Island (NY) embayments, was documented in bloom proportions for the first time in New Jersey, in lower Barnegat Bay and adjacent Little Egg Harbor Bay [11]. In 1996, 1998, 2003, 2004, and 2005, *A. anophagefferens* was detected here only in low numbers, but the species bloomed in 1997, 1999 –2002 [12,14]. The green tide (*G.* cf *aureolum*) reappeared in our coastal waters in 1996 and 1997 but to a lesser extent than previously, being most concentrated in the Atlantic City - Ocean City area [2]. No green tide has been observed from 1997 to 2005.

Table 2 (page 5) lists selected species with their bloom tide color and possible adverse effects.

# Methods

The current survey encompasses the entire New Jersey coastal region, including the major estuaries at the northern and southern extremes. A total of sixteen (16) stations (see map "New Jersey's Coastal Phytoplankton Monitoring Network") were sampled bi-weekly during the summer for phytoplankton in 2005. All of the stations monitored are part of WM&S' Bureau of Marine Water Monitoring's Estuarine Monitoring Program and were chosen to obtain the best coverage of state shellfish resource waters. In 2005, the EPA summer sampling was performed a total of five times, approximately every two weeks, from June into August. In addition to the helicopter sampling, a subset of the Bureau's year-round 260 station monitoring network of coastal water quality is assessed based upon the chlorophyll *a* concentration obtained from the samples. Remote sensing chlorophyll *a* data are obtained from NOAA when available.

In 2005, members of the USEPA Region II Monitoring and Assessment Branch (Edison, NJ) made field collections via helicopter, as in previous years. Samples were taken at a one-meter depth using a Kemmerer sampler. Coastal stations were sampled just outside the surf zone. Water aliquots for phytoplankton species composition and chlorophyll a were iced and analyzed within 24 hours of collection. Surface samples are collected by WM&S'Bureau of Marine Water Monitoring personnel, outside of the summer season, and analyzed for chlorophyll *a*, dissolved oxygen, phytoplankton composition, total suspended solids and nutrients. All procedures were in accordance with NJDEP standard field methods [13]. Phytoplankton identification, differential cell counts, and chlorophyll *a* analysis were performed according to Standard Operating Procedures (SOP) of the Bureau of Marine Water Monitoring.

Staff from USEPA and the Monmouth County Health Department, which also performs phytoplankton identification and enumeration, make ancillary measurements (e.g. dissolved oxygen, temperature). The NJDEP Southern Planning Bureau of the Division of Watershed Management makes supplementary aerial observations. Brown tide information was obtained from the NJDEP Division of Science, Research and Technology. Relevant observations from various sources are also directed to the bureau. Information received from these other sources is used to locate possible algae blooms, so samples can be collected and analyzed during the period of time between scheduled sampling events.

# Results and Discussion

**Table 1. 2005 Significant Events**

| Sample Date | Event |
|---|---|
| **June 8** | |
| Sandy Hook Bay | *Dinophysis sp*,. a potentially toxic alga, was detected below bloom or toxic concentrations. |
| Little Egg Harbor | *Prorocentrum lima*, a potentially toxic alga, was detected below bloom or toxic concentrations. |
| Northern New Jersey Coastal Ocean Waters | Large bloom of diatoms with total cell counts around 25,000 cells/ml. |
| **June 22** | |
| Sandy Hook Bay | *Pseudonitzschia sp* and *Dinophysis sp*, potentially toxic algae, were detected below bloom or toxic concentrations |
| **July 20** | |
| Northern New Jersey Coastal Ocean Waters | *Olisthodiscus luteus*, a species potentially toxic to fish, was present in bloom concentrations with no adverse effects reported. |
| **July 27** | |
| Barnegat Bay (near Barnegat Inlet) | Mixed diatom bloom consisting mostly of *Nitzschia sp.* Cell counts of 1,600 cells/ml. |
| **August 10** | |
| Barnegat Bay (near Island Beach State Park) | *Prorocentrum lima*, a potentially toxic alga, was detected below bloom or toxic concentrations. |
| Sandy Hook Bay | Moderate bloom of mixed diatoms. Cell counts of 1,000 cells/ml. |

**Table 2. Select Phytoplankton Species with Associated Effects and Tide Color**

| Species | Tide Color | Adverse Effects |
|---|---|---|
| *Ceratium Tripos* | Red | Distress to fish/shellfish |
| *Cochlodinium heterolobatum* | Red | Distress to fish/shellfish |
| *Alexandrium tamerensis* | Red | Paralytic shellfish poisoning |
| *Katodinium Rotundtum* | Red | Hypoxia/fauna kills |
| *Olisthodiscus luteus* | Red | Possibly toxic to fish |
| *Prorocentrum species* | Red | Fauna kills |
| *Schripsiella trochordia* | Red | Possibly toxic |
| *Dinophysis acuta* | Red | Diarrhetic shellfish poisoning |
| *Pseudonitzschia species* | Brownish | Amnesic shellfish poisoning |
| *Gyrodinium cf aureolum* | Green | Mild bather irritation |
| *Aureococcus anaphagefferens* | Brown | Shellfish growth/ eelgrass mortality |
| *Nannochloris atomus* | YellowishBrown | Aesthetic quality of the water |

# Phytoplankton Species Composition/Bloom Effects

A summary of phytoplankton composition, chlorophyll *a* concentrations, and water temperature for each station for the 2005 season is presented in the Appendix to this report.

For historical information on algal conditions in New Jersey's estuarine and coastal waters, see the *Annual Summary of Phytoplankton Blooms and Related Conditions in New Jersey Coastal Waters Summer of 2000* [2].

## HUDSON/RARITAN ESTUARY

As in recent years, phytoplankton this season in the Hudson/ Raritan estuary were dominated by a diverse assemblage of diatoms in mild to full bloom proportions. Dominant diatoms included *Skeletonema costatum, Asterionella glacialis, Thalassiosira nordenskioeldii, nitzschia spp.* and *Cylindrotheca closterium*. Dinoflagellates detected during this season were *Gyrodinium undulans,Olisthodiscus luteus,* and *Prorocentrum micans*. In addition, *Pseudonitzschia spp.,* and *Dinophysis spp.* both potentially toxic species were detected below bloom or toxic concentrations on 6/22/05.

## BARNEGAT BAY

The highlight of 2005 sampling season in Barnegat Bay was the lack of a “brown tide” bloom. This is the third year in a row that the Barnegat Bay did not have a “brown tide” bloom caused by the picoplankter *Aureococcus anophagefferens*. In the 2005 summer season, Barnegat Bay experienced a bloom of *Nitzschia spp.* from Barnegat Inlet to the Route 72 bridge in late July. No acutely toxic species were detected in these waters during the 2005 sampling season.

## GREAT BAY

During the 2005 summer sampling season, the waters of Great Bay were generally clear with sparse algal concentrations. No acutely toxic species were detected in these waters during the 2005 sampling season.

## GREAT EGG HARBOR

Great Egg Harbor experienced sparse algal concentrations for most of the 2005 summer sampling season. No acutely toxic species were detected.

## NEW JERSEY COASTAL AREA

Northern New Jersey coastal waters were characterized by sparse algal concentrations in August. Species composition was similar to that in the Hudson/Raritan estuary, although generally in lesser concentrations. The highlights of the northern coastal waters were a red tide bloom of *Olisthodiscus luteus* in July and an extremely large bloom of *Cerataulina pelagica* in early June. In addition, *Dynophysis spp,*. a potentially toxic species, was detected below bloom or toxic concentrations on 6/22/05.

Southern New Jersey coastal waters were generally clear, with sparse algal concentrations for the months of June, August, and September. In July, the waters had moderate concentrations of mixed diatoms. No acutely toxic species were detected in the southern coastal waters during the 2005 sampling season.

## DELAWARE BAY

Due to time restrictions the EPA helicopter was only able to sample the Delaware Bay one time during the 2005 sampling season.

In August, the portion of Delaware Bay near

Dias Creek was generally clear with sparse algal concentrations. The portion of the Delaware Bay near the mouth of the bay experienced a moderate bloom of a diverse assemblage of phytoplankton.

# Biomass Measurements

Species differential cell counts and chlorophyll *a* measurements are performed by the Bureau of Marine Water Monitoring. These measurements are made in conjunction with the summer phytoplankton samples. Chlorophyll *a* measurements are also collected at approximately 260 stations throughout the year for the Bureau's Coastal Water Quality Monitoring Network.

Chlorophyll *a* is reflective of the total phytoplankton biomass present in the water column. A high chlorophyll *a* concentration can be used as an indicator of an algal bloom. In the previous years of surveying, mean chlorophyll *a* levels, as well as seasonal variation, were generally greatest in the major estuaries at the northern and southern extremes of the New Jersey coast. This is attributed in part to tidal fluctuation, but even more to the intense bloom pulses that occur in these estuaries. In 2005, mean chlorophyll *a* levels attributed to phytoplankton (Table 3) were highest in the Northern New Jersey coastal waters. This is different from previous years mainly because of an extremely large bloom off the coast of Long Branch during June.

Individual station data for 2005 was assessed for blooms, using a chlorophyll index as described in Cosper (1995) [16]. Excessive phytoplankton conditions were defined first as chlorophyll concentrations greater than 2 times the long term monthly mean chlorophyll *a* concentrations for each area, secondly, greater than 20 μg/L, and thirdly greater than 40μg/L.

Using the 6-year mean chlorophyll *a* concentrations from the coastal monitoring network for each area used in this monitoring program, concentration limits were set for bloom conditions (Table 4). Using this approach, two waterbodies experienced algal blooms on 6/8/05. These waters are the Sandy Hook Bay and the Atlantic Ocean off Long Branch. Other blooms were detected in the northern coastal waters and Raritan Bay on July 13, Barnegat Bay near the inlet and Raritan Bay on July 27, and the Delaware Bay near the mouth and Sandy Hook Bay on August 10 (see highlighted results in Table 3). Using the concentration limits that were set for bloom conditions matches up with the results from the microscopic examination with regards to full bloom conditions. It does not address mild to moderate bloom conditions, which might be a growing or declining bloom.

This is a useful screening tool to find unusual algal conditions for an area, and will allow for prioritization of microscopic sample analysis.

Maps of seasonal chlorophyll *a* levels, from 1/1/05 through 12/30/05, at sites in New Jersey's coastal and estuarine waters are included in the Appendix to this report (pages 16-20).

# Phytoplankton Monitoring Factors

Different waterbodies experience algal bloom conditions during varying times throughout the year. Plotting 6 years of chlorophyll *a* data for each month for each estuary type sampled in New Jersey coastal waters, it can be seen that each of the estuaries has peak algal conditions during different months of the year (Chart 1).

River-dominated estuaries, such as the Delaware Bay and its coves, Raritan/Sandy Hook Bay, Shrewsbury River, and Navesink River experience highest chlorophyll *a* concentrations during March and April. They also record high levels in January and October. Lowest concentrations were measured in May and December.

Shallow estuaries, which include Barnegat Bay, Manahawkin Bay, Little Egg Harbor, Jarvis Sound, and Cape May Harbor, reach peak chlorophyll *a* concentrations in July, with the increase starting from May to June.

Tidal tributaries are waters collected in the tidal portion of streams and creeks below or up to the head of tide that drain into a major estuary; these reach peak chlorophyll *a* concentrations in March,

and have smaller peaks in June, August, and October.

River locations, such as the Manasquan River, Maurice River, Mullica River, and Toms River, reach peak concentrations in July, followed by high levels in October and March.

Ocean samples are divided into three categories: Ocean, Ocean near Outfall, and Inlet. All three categories reach peak chlorophyll *a* concentrations during January. No large differences are noted between the three categories.

Because of this information, microscopic examine as been implemented for all samples from the year-round routine monitoring program that have high chlorophyll *a* concentrations for their locations.

In August of 2005, one of the highest chlorophyll *a* concentrations recorded was observed in Branchport Creek (158 µg/L). Examination showed an ongoing bloom of mixed diatoms in the portion of the Branchport Creek at Branchport Ave. Follow-up samples were taken within one week, and the bloom had dissipated. Branchport Creek is a tidal tributary. Reviewing Chart 1, shows that it is not unusual for algal blooms to occur in a tidal tributary during this time of year. The data shows that March and August are the most productive months for phytoplankton in a tidal tributary.

These data show that algal blooms can occur at any time of the year. It also shows that the time of the year that algal blooms occur can be dependent on the type of waterbody or specific to a location. Also, it shows that year-round monitoring is necessary to fully understand the conditions that exist in New Jersey's coastal waters with regard to algal blooms.

# New Technologies

Two sensors for the remote detection of chlorophyll *a* were obtained by the Bureau of Marine Water Monitoring in December of 2004 through funding and support from USEPA Region 2. During summer 2005, all possible wavelengths were tested and it was concluded that 667nm and 678nm were most suitable for the calculation of chlorophyll *a* concentrations. There was also some ground testing on docks and boats. More testing of this equipment will occur in Spring 2006, and the sensors may be deployed between May and September on the NJDEP's airplane and in the EPA Region 2 helicopter during their summer sampling flights. The information collected from the sensors will be used to find possible algal bloom conditions so samples can be collected and analyzed.

# Recommendations

- Use the Cosper chlorophyll index to calculate the bloom chlorophyll *a* concentrations for each area of the state, using existing Water Quality Monitoring Network data and update these data annually.

- Use the new remote sensing technology to more efficiently target sample collection areas for possible algal bloom events during other times of the year by increasing the months of the coastal fly over.

- Use existing data obtained from the Coastal Water Quality Monitoring Network to identify seasonal and regional differences, so efforts can be made to focus on the areas most likely to have algal blooms at specific times of the year.

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**New Jersey's Summer Coastal Phytoplankton Monitoring Network**

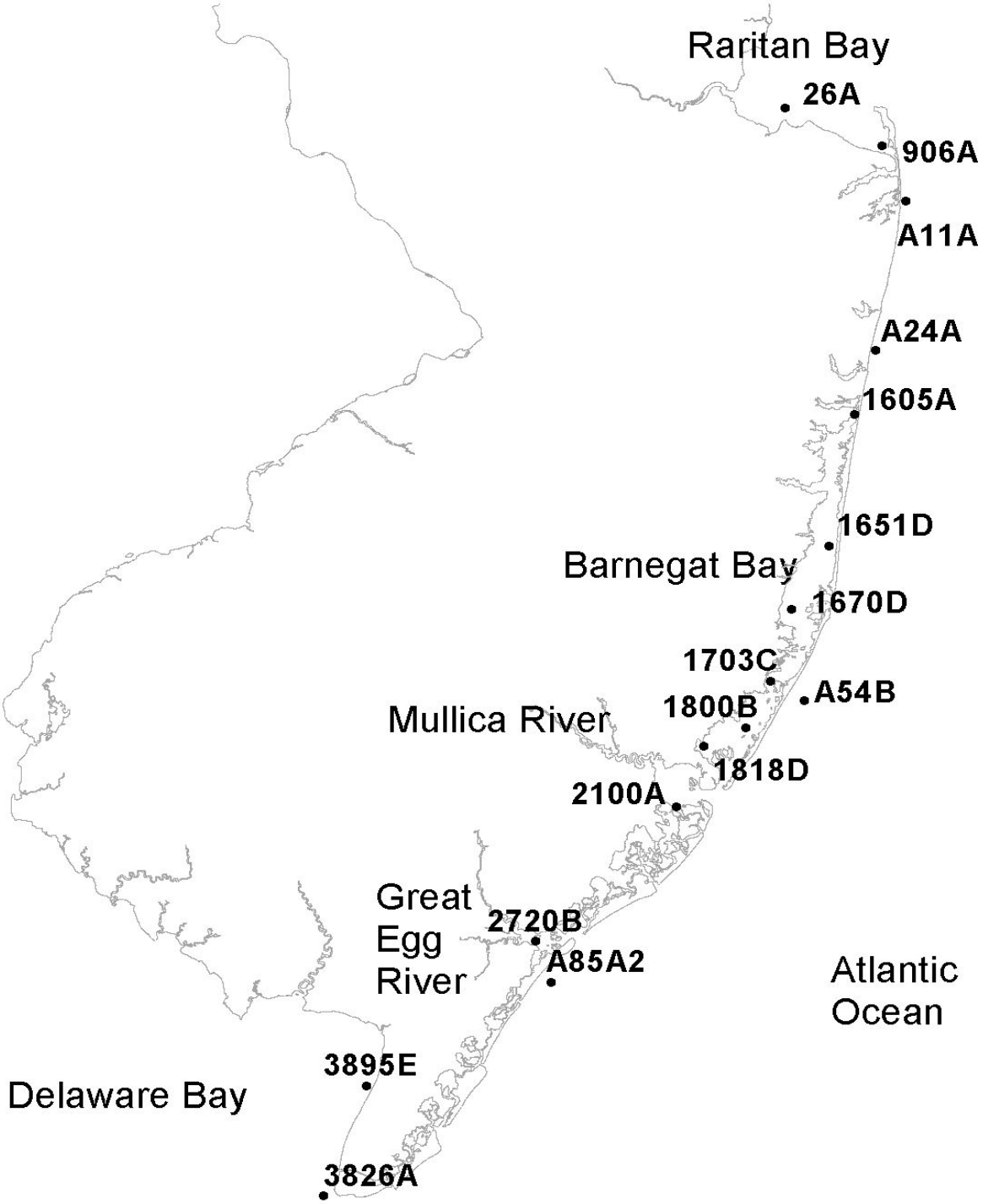


**Table 3. Chlorophyll *a* (µg/L) for the 2005 Summer New Jersey Coastal and Estuarine Phytoplankton Survey.**

| HUDSON/RARITAN | 8-Jun | 22-Jun | 13-Jul | 27-Jul | 10-Aug | MEAN |
|---|---|---|---|---|---|---|
| 26A | 15.14 | 8.41 | 22.71 | 31.96 | 2.94 | 16.23 |
| 906A | 23.13 | 6.73 | 7.15 | 15.14 | 35.32 | 17.49 |
| MEAN | 19.14 | 7.57 | 14.93 | 23.55 | 19.13 | 16.86 |

| NORTHERN COASTAL WATERS | 8-Jun | 22-Jun | 13-Jul | 27-Jul | 10-Aug | MEAN |
|---|---|---|---|---|---|---|
| A11A | 169.24 | 3.78 | 12.61 | 1.26 | 1.68 | 37.71 |
| A24A | 0.42 | 3.36 | 6.73 | 1.26 | 2.94 | 2.94 |
| MEAN | 84.83 | 3.57 | 9.67 | 1.26 | 2.31 | 20.33 |

| SOUTHERN COASTAL WATERS | 8-Jun | 22-Jun | 13-Jul | 27-Jul | 10-Aug | MEAN |
|---|---|---|---|---|---|---|
| A54B | 1.68 | | 4.20 | | 1.26 | 2.38 |
| A85A2 | 1.26 | 2.94 | | | 2.10 | 2.10 |
| MEAN | 1.47 | 2.94 | 4.20 | | 1.68 | 2.57 |

| BARNEGAT BAY | 8-Jun | 22-Jun | 13-Jul | 27-Jul | 10-Aug | MEAN |
|---|---|---|---|---|---|---|
| 1605A | 5.47 | 4.63 | 17.66 | 7.99 | 17.66 | 10.68 |
| 1651D | 2.94 | 13.88 | 12.61 | 10.93 | 13.03 | 10.68 |
| 1670D | 0.42 | 2.10 | 12.19 | 65.17 | 13.03 | 18.58 |
| 1703C | 9.67 | 0.84 | 7.99 | 15.14 | 5.47 | 7.82 |
| 1800B | 3.78 | 0.42 | 2.94 | 6.73 | 5.47 | 3.87 |
| 1818D | 4.20 | 1.68 | 2.94 | 3.36 | 2.10 | 2.86 |
| MEAN | 4.41 | 3.93 | 9.39 | 18.22 | 9.46 | 9.08 |

| GREAT BAY | 8-Jun | 22-Jun | 13-Jul | 27-Jul | 10-Aug | MEAN |
|---|---|---|---|---|---|---|
| 2100A | 2.52 | 0.42 | 3.36 | | 3.36 | 2.42 |
| MEAN | 2.52 | 0.42 | 3.36 | | 3.36 | 2.42 |

| GREAT | 8-Jun | 22-Jun | 13-Jul | 27-Jul | 10-Aug | MEAN |
|---|---|---|---|---|---|---|
| 2720B | 0.84 | 2.52 | | | 9.67 | 4.34 |
| MEAN | 0.84 | 2.52 | | | 9.67 | 4.34 |

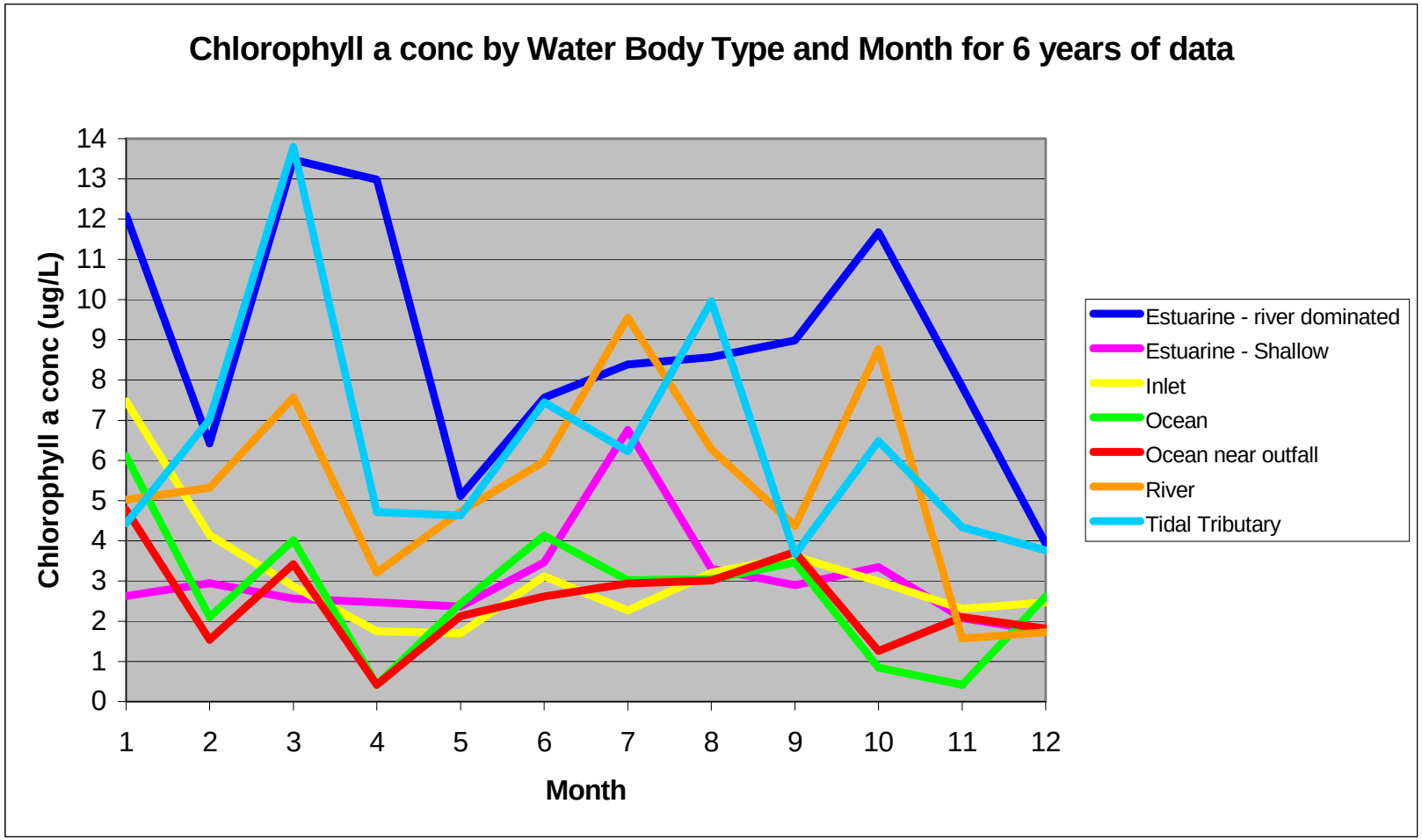
| DELAWARE BAY | 8-Jun | 22-Jun | 13-Jul | 27-Jul | 10-Aug | MEAN |
|---|---|---|---|---|---|---|
| 3826A | | | | | 15.56 | 15.56 |
| 3895E | | | | | 2.10 | 2.10 |
| MEAN | | | | | 8.83 | 8.83 |

**Table 4.**

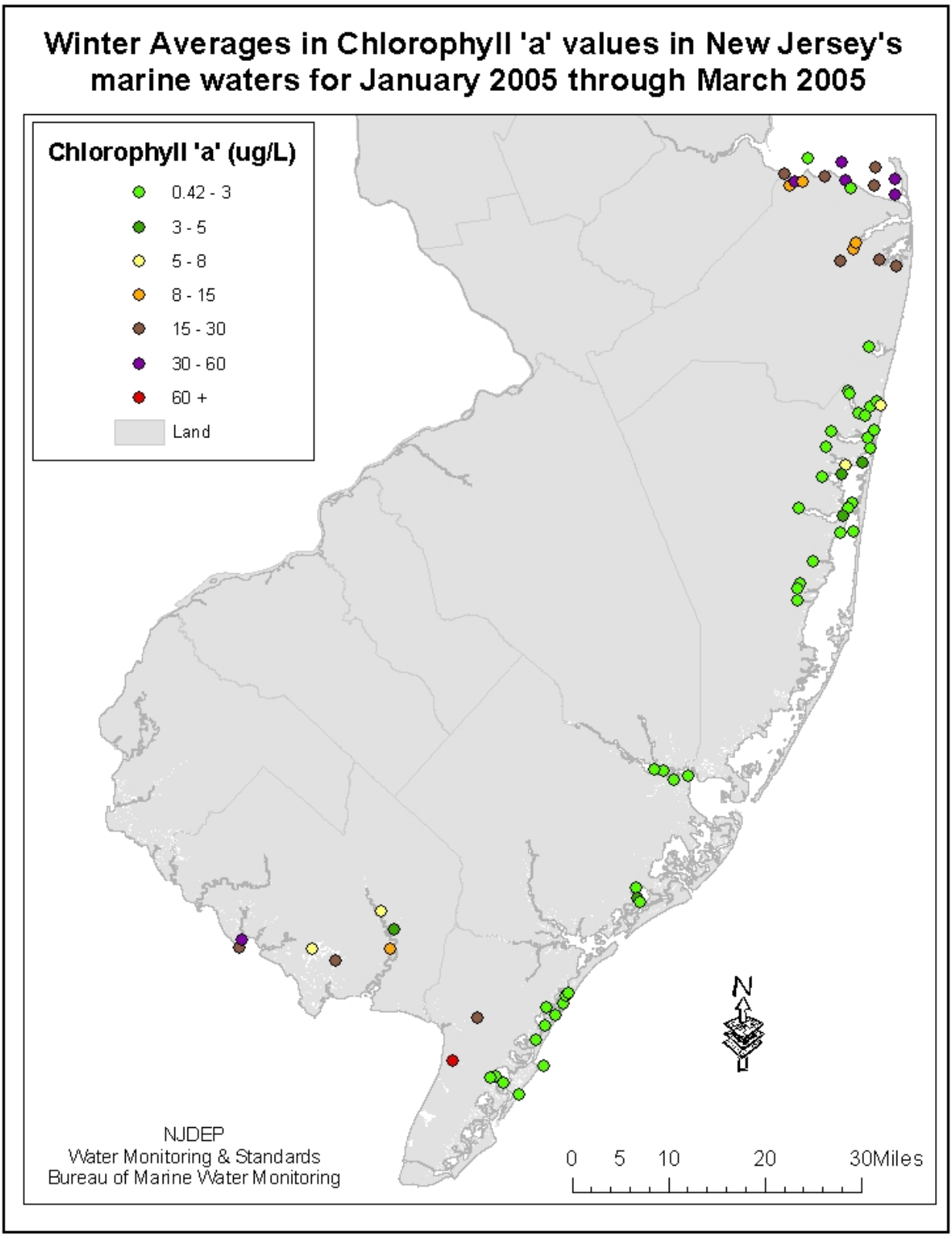
**Chlorophyll *a* concentration limits (ug/L) for algal blooms**

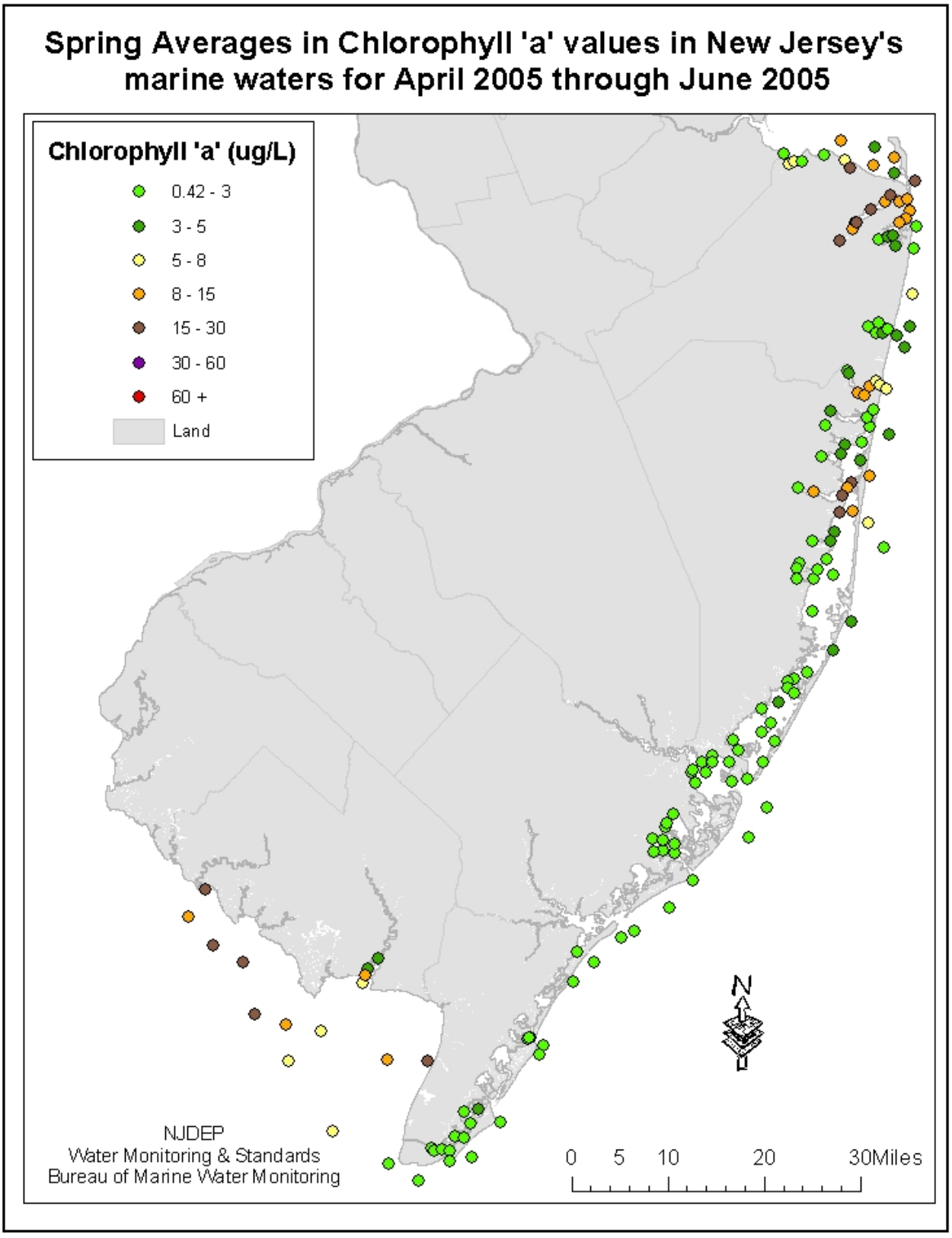
| Location | June | July | August | September |
|---|---|---|---|---|
| **Hudson/Raritan** | > 20 | > 20 | > 20 | > 20 |
| **Barnegat Bay** | 8.14 | > 20 | 12.32 | 6.55 |
| **Manahawkin Bay** | 19.02 | > 20 | 11.33 | 9.49 |
| **Little Egg Harbor** | 12.19 | 15.65 | 3.39 | 3.26 |
| **Great Bay** | 3.27 | 9.62 | 3.50 | 4.99 |
| **Great Egg harbor** | 3.25 | 1.31 | 5.65 | 2.18 |
| **Delaware Bay** | 10.95 | 14.00 | 10.03 | > 20 |
| **Atlantic Ocean** | 5.61 | 5.58 | 6.34 | 8.92 |

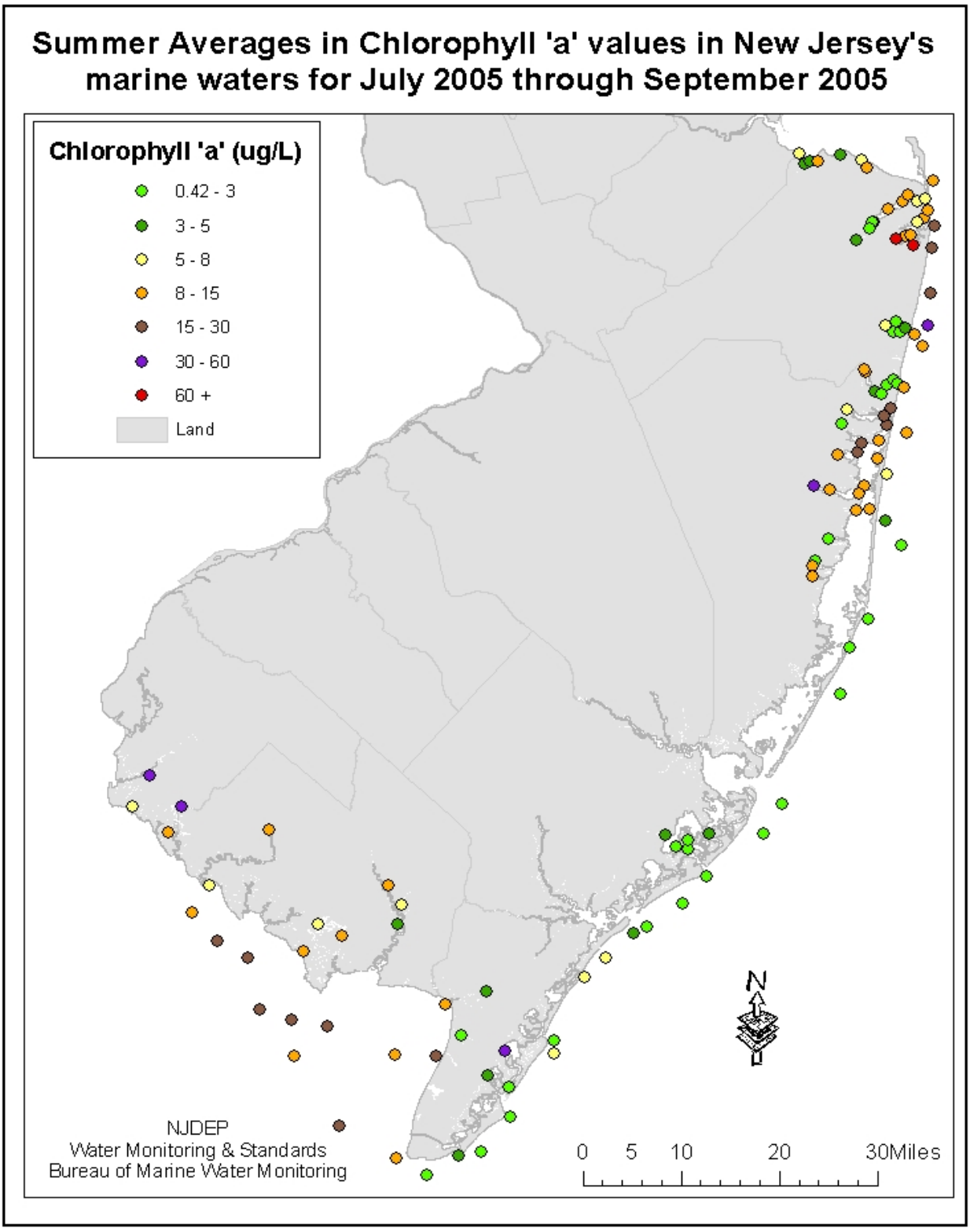
Chart 1.

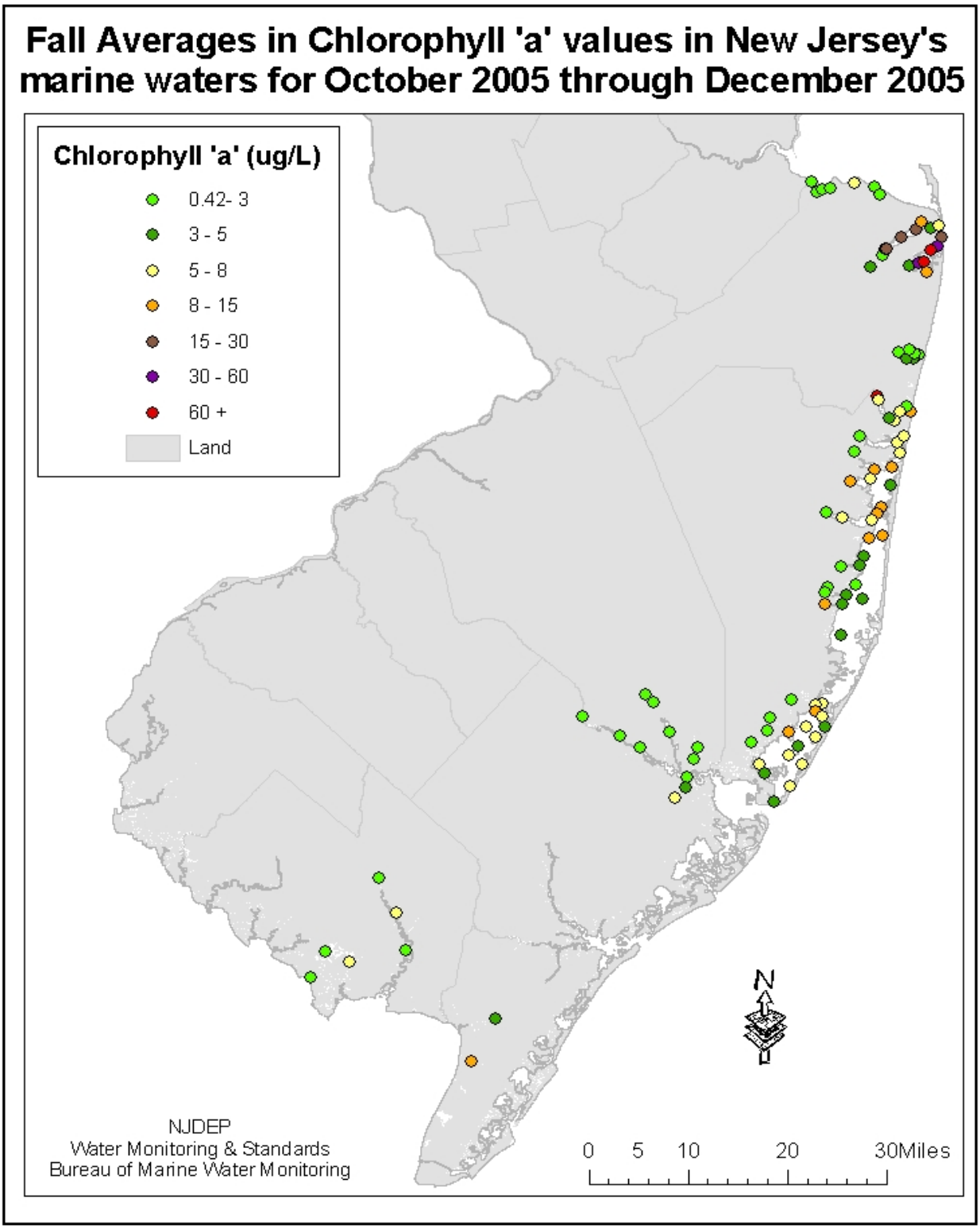

Chlorophyll a conc by Water Body Type and Month for 6 years of data
Chlorophyll a conc (ug/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
1
2
3
4
5
6
7
8
9
10
11
12
Month
Estuarine - river dominated
Estuarine - Shallow
Inlet
Ocean
Ocean near outfall
River
Tidal Tributary

# Maps of Seasonal Chlorophyll *a* Levels from the Bureau of Marine Water Monitoring's Estuarine Monitoring Network


Winter Averages in Chlorophyll 'a' values in New Jersey's marine waters for January 2005 through March 2005
Chlorophyll 'a' (ug/L)
0.42 - 3
3 - 5
5 - 8
8 - 15
15 - 30
30 - 60
60 +
Land
N
NJDEP
Water Monitoring & Standards
Bureau of Marine Water Monitoring
0 5 10 20 30Miles


Spring Averages in Chlorophyll 'a' values in New Jersey's marine waters for April 2005 through June 2005
Chlorophyll 'a' (ug/L)
0.42 - 3
3 - 5
5 - 8
8 - 15
15 - 30
30 - 60
60 +
Land
N
NJDEP
Water Monitoring & Standards
Bureau of Marine Water Monitoring
0 5 10 20 30Miles


Summer Averages in Chlorophyll 'a' values in New Jersey's marine waters for July 2005 through September 2005
Chlorophyll 'a' (ug/L)
0.42 - 3
3 - 5
5 - 8
8 - 15
15 - 30
30 - 60
60 +
Land
N
NJDEP
Water Monitoring & Standards
Bureau of Marine Water Monitoring
0 5 10 20 30Miles


Fall Averages in Chlorophyll 'a' values in New Jersey's marine waters for October 2005 through December 2005
Chlorophyll 'a' (ug/L)
0.42- 3
3 - 5
5 - 8
8 - 15
15 - 30
30 - 60
60 +
Land
N
NJDEP
Water Monitoring & Standards
Bureau of Marine Water Monitoring
0 5 10 20 30Miles

# Data summary for each station for the 2005 season

**NJDEP Leeds Point Laboratory**
**Phytoplankton Data Sheet**

**Hudson/Raritan (26A)**

| Date | Time | Water | Chlorophyll | Dominant Species | Toxic Species |
|---|---|---|---|---|---|

| | | Temperature | (µg/L) | | |
|---|---|---|---|---|---|
| **06/8/05** | 10:32 | 23.2 | 15.14 | Mixed diatoms in equal concentrations | None |
| **06/22/05** | 9:23 | 21.6 | 8.41 | *Gyrodinium undulans* | None |
| **07/13/05** | 9:12 | 23.9 | 22.71 | Sparse algal concentrations Significant amount of detritus | None |
| **07/27/05** | | | 31.96 | Bloom of a diverse assemblage of phytoplankton | None |
| **8/10/05** | 9:21 | 25.8 | 2.94 | Sparse algal concentrations | None |

**Hudson/Raritan (906A)**

| Date | Time | Water Temperature | Chlorophyll (µg/L) | Dominant Species | Toxic Species |
|---|---|---|---|---|---|
| **6/8/05** | 10:37 | 25.6 | 23.13 | Mixed diatoms in equal concentrations | *Dinophysis* |
| **6/22/05** | 9:31 | 21.3 | 6.73 | Mixed diatoms in equal concentrations | *Pseudonitzschia* *Dinophysis* |
| **7/13/05** | 9:19 | 23.3 | 7.15 | Sparse algal concentrations | None |
| **7/27/05** | | | 15.14 | *Cerataulina pelagica* | None |
| **8/10/05** | 9:28 | 24.8 | 35.32 | Moderate bloom of mixed diatoms (1000 cells/mL) | None |

**Jersey Coast (A11A)**

| Date | Time | Water Temperature | Chlorophyll (μg/L) | Dominant Species | Toxic Species |
|---|---|---|---|---|---|
| **6/8/05** | 10:51 | 21.2 | 169.24 | *Cerataulina pelagica* (25,000 cells/mL) | None |
| **6/22/05** | 9:31 | 16.5 | 3.78 | Mixed diatoms in equal concentrations | *Dinophysis* |
| **7/13/05** | 9:34 | 23.1 | 12.61 | Mixed diatoms in equal concentrations | None |
| **7/27/05** | | | 1.26 | Sparse algal concentrations | None |
| **8/10/05** | 9:42 | 23.4 | 1.68 | Sparse algal concentrations | None |

**Jersey Coast (A24A)**

| Date | Time | Water Temperature | Chlorophyll (μg/L) | Dominant Species | Toxic Species |
|---|---|---|---|---|---|
| **6/8/05** | 11:03 | 21.6 | <0.42 | Sparse algal concentrations | None |
| **6/22/05** | 10:06 | 16.0 | 3.36 | Mixed diatoms in equal concentrations | None |
| **7/13/05** | 9:56 | 22.3 | 6.73 | Mixed diatoms in equal concentrations | None |
| **7/27/05** | | | 1.26 | Sparse algal concentrations | None |
| **8/10/05** | 10:01 | 24.2 | 2.94 | Sparse algal concentrations | None |

**Barnegat Bay (1605A)**

| Date | Time | Water Temperature | Chlorophyll (μg/L) | Dominant Species | Toxic Species |
|---|---|---|---|---|---|
| **6/8/05** | 12:35 | 25.6 | 5.47 | Sparse algal concentrations | None |
| **6/22/05** | 10:16 | 22.6 | 3.36 | Sparse algal concentrations | None |
| **7/13/05** | 10:07 | 24.6 | 17.66 | *Gyrodinium spp.* | None |
| **7/27/05** | | | 7.99 | Sparse algal concentrations<br>Significant amount of detritus | None |
| **8/10/05** | 10:13 | 25.7 | 17.66 | Sparse algal concentrations<br>Significant amount of detritus | None |

**Barnegat Bay (1651D)**

| Date | Time | Water Temperature | Chlorophyll (μg/L) | Dominant Species | Toxic Species |
|---|---|---|---|---|---|
| **6/8/05** | 12:51 | 24.6 | 2.94 | Sparse algal concentrations | None |
| **6/22/05** | 12:24 | 24.4 | 13.88 | Sparse algal concentrations<br>Significant amount of detritus | None |
| **7/13/05** | 11:08 | 24.4 | 12.61 | *Gyrodinium spp.* | None |
| **7/27/05** | | | 10.93 | *Gyrodinium estuariale* | None |
| **8/10/05** | 10:26 | 26.0 | 13.03 | Sparse algal concentrations<br>Significant amount of detritus | None |

**Barnegat Bay (1670D)**

| Date | Time | Water Temperature | Chlorophyll (μg/L) | Dominant Species | Toxic Species |
|---|---|---|---|---|---|
| **06/8/05** | 13:01 | 24.2 | 0.42 | Sparse algal concentrations | None |
| **6/22/05** | 12:40 | 23.3 | 2.10 | Sparse algal concentrations | None |
| **7/13/05** | 11:19 | 25.0 | 12.19 | *Gyrodinium spp.* | None |
| **7/27/05** | | | 65.17 | Bloom of *Nitzschia spp.*<br>(1,600 cells/mL) | None |
| **8/10/05** | 11:55 | 26.6 | 13.03 | Sparse algal concentrations<br>Significant amount of detritus | None |

**Barnegat Bay (1703C)**

| Date | Time | Water Temperature | Chlorophyll (μg/L) | Dominant Species | Toxic Species |
|---|---|---|---|---|---|
| **6/8/05** | 13:07 | 25.5 | 9.67 | Mixed diatoms | None |
| **6/22/05** | 12:52 | 23.9 | 0.84 | Sparse algal concentrations | None |
| **7/13/05** | 11:26 | 25.9 | 7.99 | Sparse algal concentrations<br>Significant amount of detritus | None |
| **7/27/05** | | | 15.14 | *Nitzschia sp.* | None |
| **8/10/05** | 12:00 | 26.4 | 5.47 | *Pleurosigma spp.* | None |

**Jersey Coast (A54B)**

| Date | Time | Water Temperature | Chlorophyll (μg/L) | Dominant Species | Toxic Species |
|---|---|---|---|---|---|
| **6/8/05** | 13:24 | 17.0 | 1.68 | Sparse algal concentrations | None |
| **6/22/05** | NS | NS | NS | No Sample | NS |
| **7/13/05** | 11:31 | 23.0 | 4.2 | Low concentration of mixed diatoms | None |
| **7/27/05** | NS | NS | NS | No Sample | NS |
| **8/10/05** | 12:09 | 25.4 | 1.26 | Sparse algal concentrations | None |

**Barnegat Bay (1800B)**

| Date | Time | Water Temperature | Chlorophyll (μg/L) | Dominant Species | Toxic Species |
|---|---|---|---|---|---|
| **6/8/05** | 13:15 | 24.0 | 3.78 | Sparse algal concentrations | None |
| **6/22/05** | 13:05 | 23.1 | <0.42 | Sparse algal concentrations | None |
| **7/13/05** | 11:37 | 25.4 | 2.94 | Sparse algal concentrations | None |
| **7/27/05** | | | 6.73 | *Nitzschia sp.* | None |
| **8/10/05** | 12:14 | 26.2 | 5.47 | Sparse algal concentrations Significant amount of detritus | None |

**Barnegat Bay (1818D)**

| Date | Time | Water Temperature | Chlorophyll (μg/L) | Dominant Species | Toxic Species |
|---|---|---|---|---|---|
| **6/8/05** | 13:31 | 24.9 | 4.20 | Sparse algal concentrations | *Prorocentrum lima* |
| **6/22/05** | 13:10 | 23.0 | 1.68 | Sparse algal concentrations | None |
| **7/13/05** | 11:40 | 25.8 | 2.94 | Sparse algal concentrations | None |
| **7/27/05** | | | 3.36 | Sparse algal concentrations | None |
| **8/10/05** | 12:20 | 26.7 | 2.10 | Sparse algal concentrations | None |

**Great Bay (2100A)**

| Date | Time | Water Temperature | Chlorophyll (μg/L) | Dominant Species | Toxic Species |
|---|---|---|---|---|---|
| **6/8/05** | 13:35 | 25.3 | 2.52 | Sparse algal concentrations | None |
| **6/22/05** | 13:24 | 22.5 | 0.42 | Sparse algal concentrations | None |
| **7/13/05** | 11:46 | 26.0 | 3.36 | Sparse algal concentrations | None |
| **7/27/05** | NS | NS | NS | No Sample | NS |
| **8/10/05** | 12:25 | 26.3 | 3.36 | Sparse algal concentrations | None |

**Great Egg Harbor (2720B)**

| Date | Time | Water Temperature | Chlorophyll (μg/L) | Dominant Species | Toxic Species |
|---|---|---|---|---|---|
| **6/8/05** | 14:00 | 24.5 | 0.84 | Sparse algal concentrations | None |
| **6/22/05** | 13:45 | 23.8 | 2.52 | Sparse algal concentrations | None |
| **7/13/05** | NS | NS | NS | No Sample | NS |
| **7/27/05** | NS | NS | NS | No Sample | NS |
| **8/10/05** | 12:44 | 26.2 | 9.67 | Sparse algal concentrations<br>Significant amount of detritus | None |

**Jersey Coast (A85A2)**

| Date | Time | Water Temperature | Chlorophyll (μg/L) | Dominant Species | Toxic Species |
|---|---|---|---|---|---|
| **6/8/05** | 14:05 | 18.4 | 1.26 | Sparse algal concentrations | None |
| **6/22/05** | 13:52 | 19.6 | 2.94 | Sparse algal concentrations | None |
| **7/13/05** | NS | NS | NS | No Sample | NS |
| **7/27/05** | NS | NS | NS | No Sample | NS |
| **8/10/05** | 12:48 | 25.6 | 2.10 | Sparse algal concentrations | None |

**Delaware Bay (3826A)**

| Date | Time | Water Temperature | Chlorophyll (μg/L) | Dominant Species | Toxic Species |
|---|---|---|---|---|---|
| **6/8/05** | NS | NS | NS | No Sample | NS |
| **6/22/05** | NS | NS | NS | No Sample | NS |
| **7/13/05** | NS | NS | NS | No Sample | NS |
| **7/27/05** | NS | NS | NS | No Sample | NS |
| **8/10/05** | 13:17 | 22.7 | 15.56 | Diverse assemblage of algae | None |

**Delaware Bay (3895E)**

| Date | Time | Water Temperature | Chlorophyll (μg/L) | Dominant Species | Toxic Species |
|---|---|---|---|---|---|
| **6/8/05** | NS | NS | NS | No Sample | NS |
| **6/22/05** | NS | NS | NS | No Sample | NS |
| **7/13/05** | NS | NS | NS | No Sample | NS |
| **7/27/05** | NS | NS | NS | No Sample | NS |
| **8/10/05** | 13:22 | 26.8 | 2.10 | Sparse algal concentrations | None |