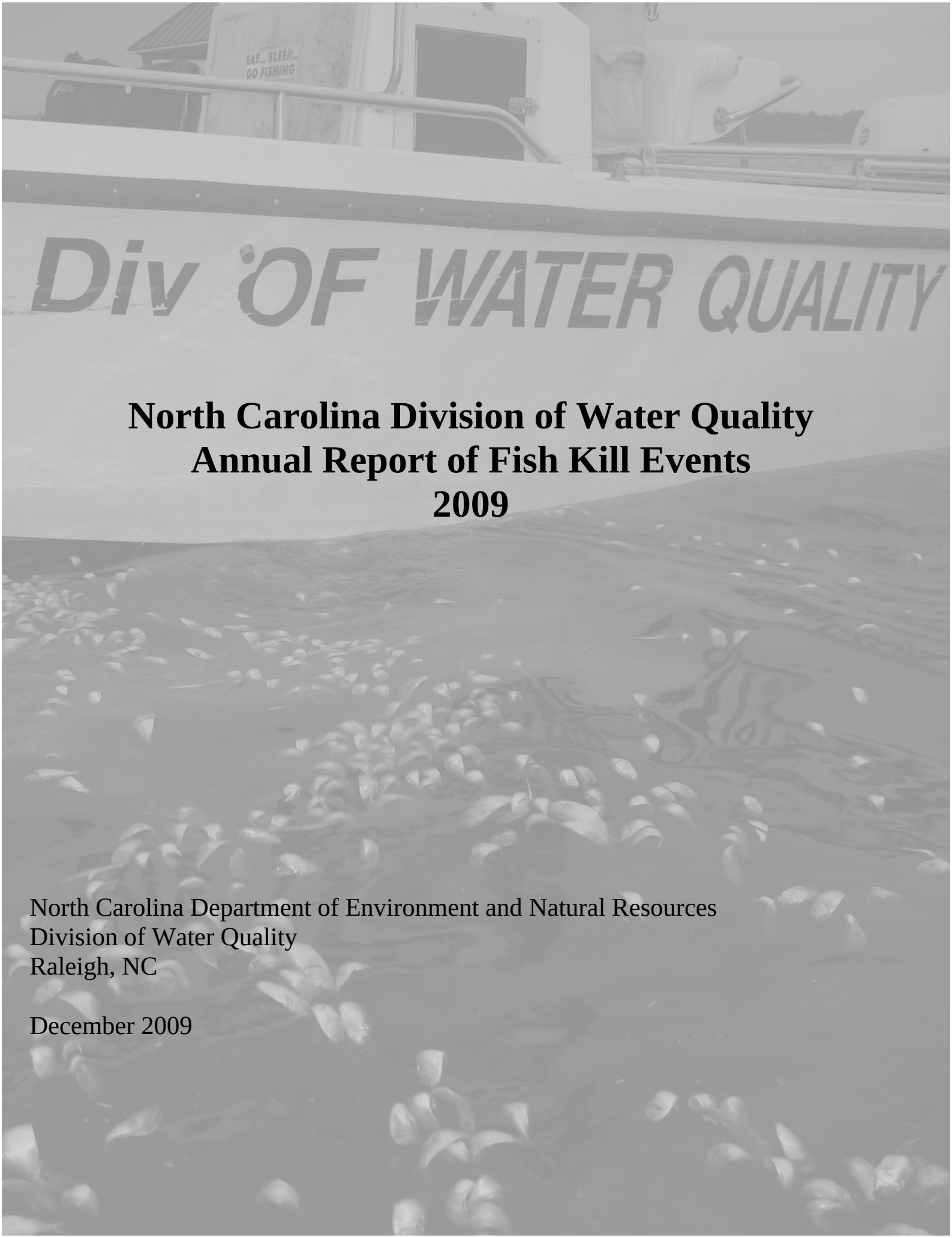

North Carolina Division of Water Quality
Annual Report of Fish Kill Events
2009

North Carolina Department of Environment and Natural Resources
Division of Water Quality
Raleigh, NC

December 2009

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Introduction

The investigation of fish kill activity across North Carolina currently involves protocols established by the North Carolina Division of Water Quality (DWQ) in 1996. The protocols were developed with assistance from DWQ Regional Office staff, North Carolina Wildlife Resources Commission biologists, and Division of Marine Fisheries personnel as a means to improve the tracking and reporting of fish kill events throughout the state. Fish kill and fish health investigation data are recorded on a standardized form and sent to the Division's Environmental Sciences Section DWQ where the data are reviewed and compiled. Data from fish kill investigation forms, laboratory test results and supplemental information sent to the ESS are entered into a central database where the information can be managed, queried and reported. The procedure also requires the notification of appropriate state officials and scientists associated with the investigation of such events. The protocols have proven successful in standardizing reporting methods and enhancing the quality and quantity of information reported from kill events.

Fish kill information is posted weekly from June to November on the ESS website: http://h2o.enr.state.nc.us/esb/Fishkill/fishkillmain.htm. Kill reports for the current year are now available in a new interactive format using Google Earth software. The new format provides better visual representations of current fish kill activity across the state and allows the user more control in the visualization process. The following report will also be available at the ESS website after submittal.

This document is a summary of fish kill events reported to the DWQ from January to early December, 2009. The report is mandated under Section 4 of Chapter 633 of the 1995 North Carolina General Assembly Session Laws.

Dead menhaden, Neuse River at Union Point, September 2009.

2009 Fish Kill Event Summary

To date, investigators have reported 33 fish kill events statewide for 2009 (Figure 1). Kill events were reported from coastal and inland waters across the state as far west as Union County. Kill activity was documented during the year in 5 of the state's 17 major river basins with nearly two thirds of the year's reported events occurring in the Neuse and Tar/Pamlico estuaries (Figure 2).

While the number of statewide fish kill events in 2009 is comparable to previous years, fish mortality (observed dead fish) was at the highest level since systematic reporting began in 1996. According to DWQ investigations, the total statewide mortality figure for the year is over 13.8 million fish. Investigators acknowledged that the reported mortality figures for a number of Neuse estuary events are extremely conservative and that actual fish counts for the Neuse events could have been nearly double what was observed. Mortality totals for individual events in 2009 ranged from 100 to over 7.3 million.

ESS records fish kill events when at least 25 fish are affected and the event is confirmed by trained investigators from regional offices and cooperating agencies.

• **Total Reported Events for 2009**	**33**
• **Freshwater Kills**	**12**
• **Estuarine Kills**	**21**
• **Cumulative Mortality for 2009**	**13,800,000***
▪ ***Estuarine Mortality***	***13,783,800***
▪ ***Freshwater Mortality***	***16,200***
• **Report Mortality Range**	**100 to 7,350,000**
• **River Basins with Kill Activity**	**5 (of 17)**

** Investigators acknowledged that mortality estimates were extremely conservative and that actual fish counts could have been nearly double what was observed.*

Figure 1 : Fish kill events and observed mortality reported to NCDWQ during 2009

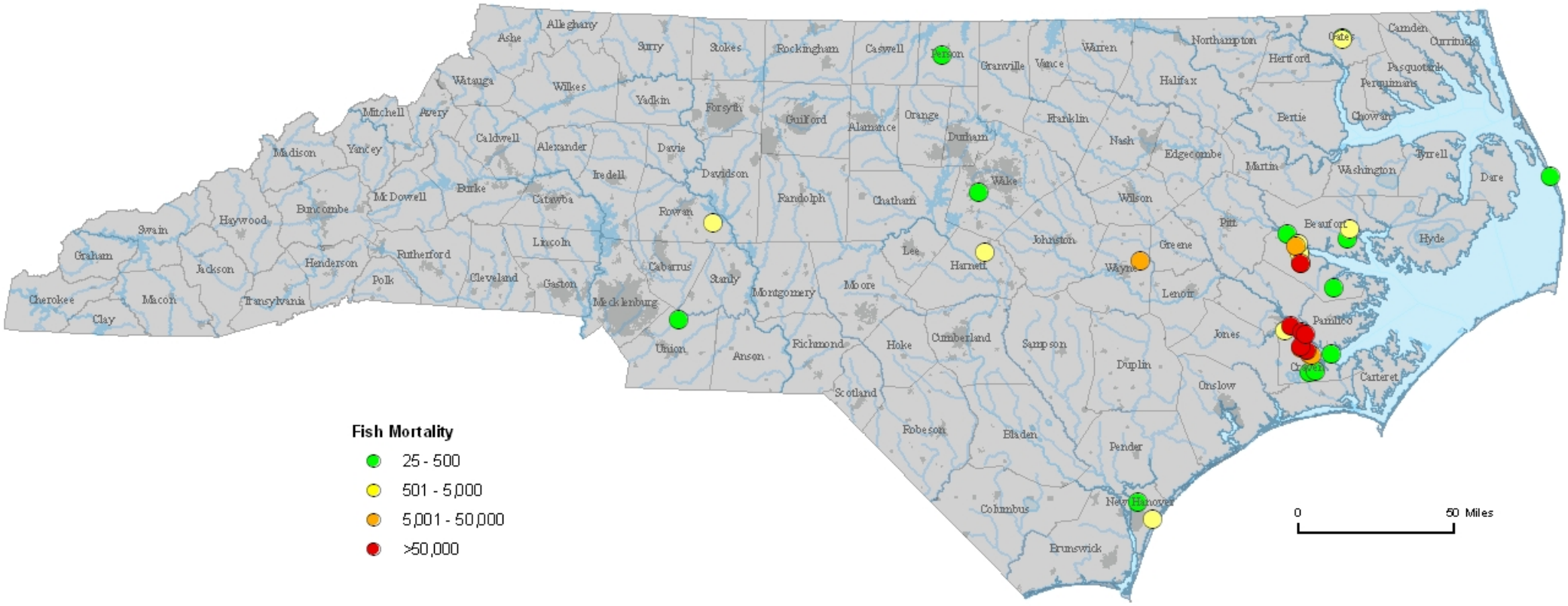
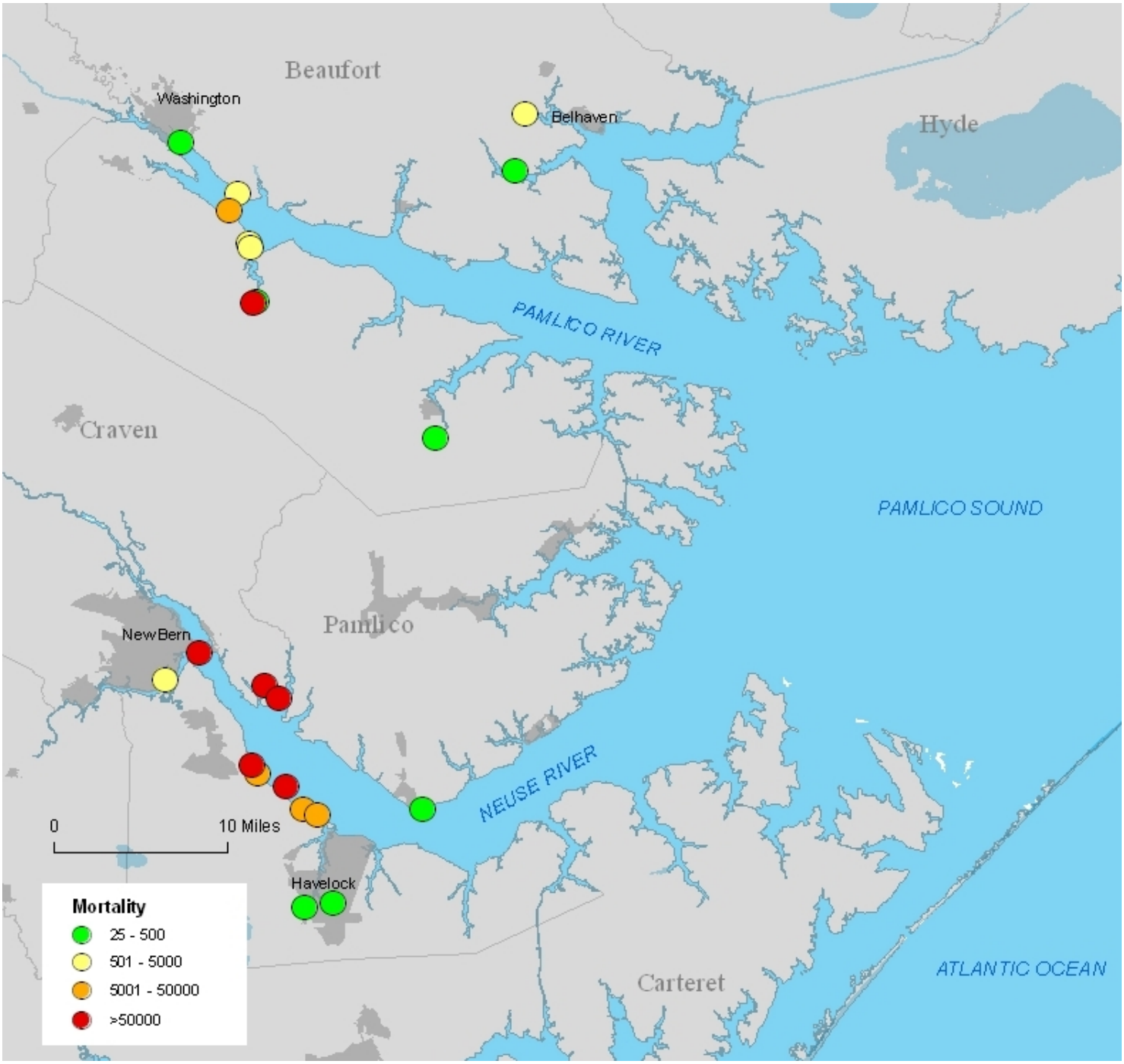


Figure 2 : Fish kill events and observed mortality reported to NCDWQ during 2009 – LowerTar/Pamlico and Neuse River estuaries



Basin Activity

Investigators reported fish kill events in 5 of the state's 17 major river basins during the 2009 season (Figure 1, Table 1). Kill activity was most frequent in the Neuse basin (15 events), a trend that has continued nearly every year since systematic reporting was implemented in 1996. Frequent kill activity was also reported in the Tar/Pamlico basin. The lower Neuse, as well as the lower Tar/Pamlico estuary, have experienced adverse environmental factors such as low dissolved oxygen, high water temperatures, and fluctuating salinities. These factors have played a significant role in the frequency of events reported annually from the two areas. Activity in other river basins across the state remained relatively light or absent throughout the 2009 season. The statewide number of reported events decreased from a total of 61 observed in 2008 to 33. The 2009 total is comparable to the range of annual report totals received since 1997 (Figure 3).

Table 1: Fish kill reports by basin, 1996 – 2009

Year	Broad	Cape Fear	Catawba	Chowan	French Broad	Neuse	Lumber	Pasquotank	Roanoke	Tar/Pamlico	New/Watauga	White Oak	Yadkin	Annual Totals
1996	None	21	None	2	None	14	4	10	2	3	None	3	1	**60**
1997	None	16	3	2	2	12	3	2	None	6	None	3	10	**59**
1998	None	23	1	1	3	8	5	8	1	5	None	1	2	**58**
1999	1	14	3	1	1	16	None	2	None	11	1	3	1	**54**
2000	None	12	2	None	None	23	2	None	None	14	None	3	2	**58**
2001	None	5	4	1	None	37	None	1	None	23	None	3	3	**77**
2002	None	8	1	2	1	9	None	6	None	8	None	3	8	**46**
2003	None	3	None	2	1	21	2	2	2	6	2	None	2	**43**
2004	None	1	None	1	None	8	1	None	1	2	None	None	3	**17**
2005	None	2	None	1	None	9	1	2	1	1	None	1	1	**19**
2006	1	5	2	None	None	10	2	None	2	2	None	None	1	**25**
2007	1	1	2	1	3	10	None	1	1	5	None	None	2	**27**
2008	None	10	2	2	2	21	None	4	None	16	None	None	4	**61**
2009	None	3	None	2	None	15	None	None	None	11	None	None	2	**33**
Total	**3**	**124**	**20**	**18**	**13**	**213**	**20**	**38**	**10**	**113**	**3**	**20**	**42**	**637**

***** *No fish kill reports have been received from the Hiwassee, Little Tennessee., and Savannah basins since 1996.*

Fish Mortality

While the number of statewide fish kill events in 2009 is comparable to previous years, the fish mortality rates were significantly higher as a result of a series of large events in the Neuse estuary (Figure 4). The 2009 season produced a reported fish mortality total of over 13.7 million individuals, however, investigators commented that mortality estimates for the large Neuse estuary kills were extremely conservative, possibly resulting in an annual total of nearly double that reported. The 2009 total is the highest since systematic reporting began in 1996. The majority of the annual mortality for 2009 was reported from a few events located in estuarine waterbodies. Over 97% of the total dead (13 million) were reported from the Neuse estuary and nearly 75% (9.8 million) from one prolonged event on the Neuse during September.

Figure 3: Reported annual fish kill events, 1996 to 2009

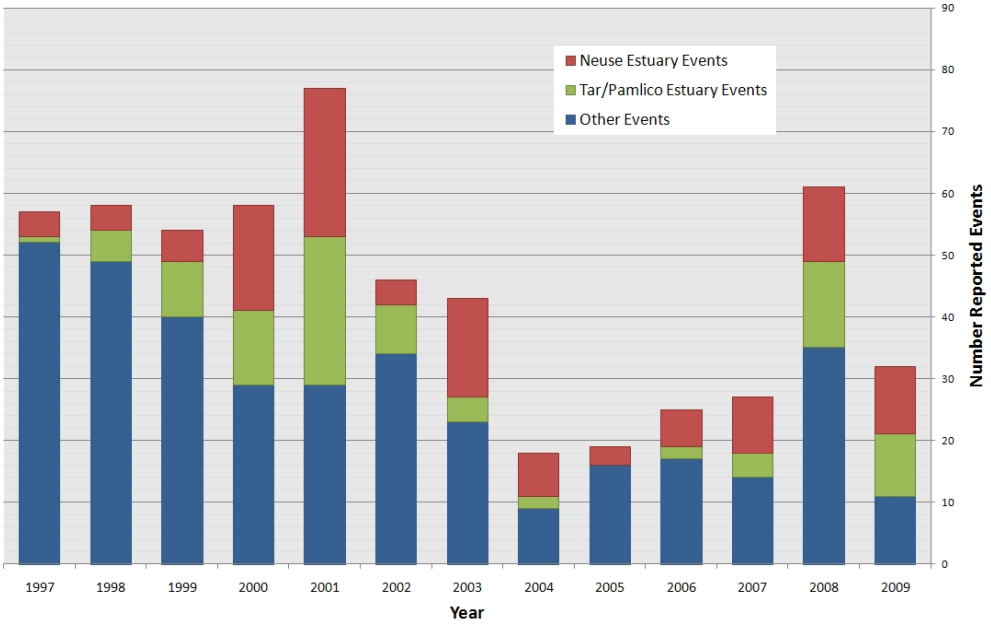
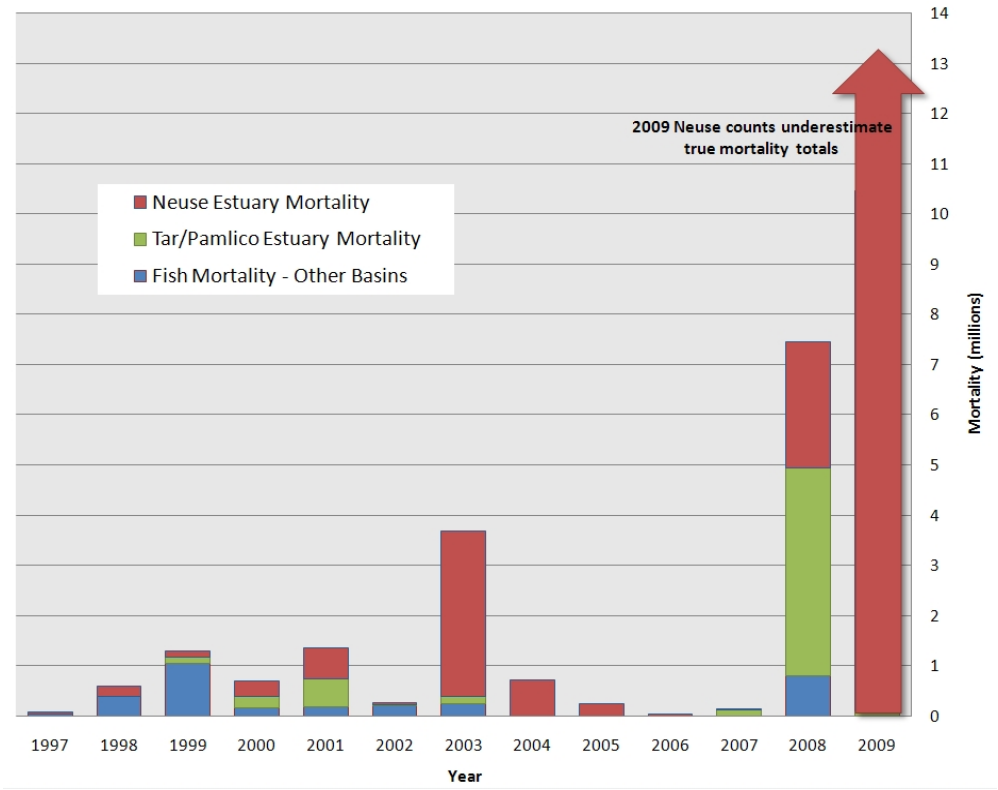


Figure 4: Reported annual fish kill mortality, 1996 to 2009



Finfish and Other Species Reported

Fish kill events in 2009 involved at least 35 species of fish in estuarine and freshwaters (Figures 5 and 6). Estuarine species most frequently reported included Atlantic menhaden, spot, flounder and croaker. Freshwater species most frequently observed included sunfishes, largemouth bass, carp, and catfish. Atlantic menhaden, by all accounts comprised the vast majority of the total mortality during 2009. Huge numbers of menhaden (nearly 97% of the 2009 total) were reported from a series of large fish kills in the Neuse estuary during August and September.

Non-finfish species were observed at eight kill events during 2009. These included blue crab and crayfish. Most notable was kill of over 17,000 blue crab during a large event on the Neuse River near Flanners Beach (August 21, 2009). Historically, the frequency and numbers of non-finfish species reported in association with fish kills has remained relatively low.

Figure 5: Estuarine/Ocean finfish and frequencies observed during 2009 fish kill events

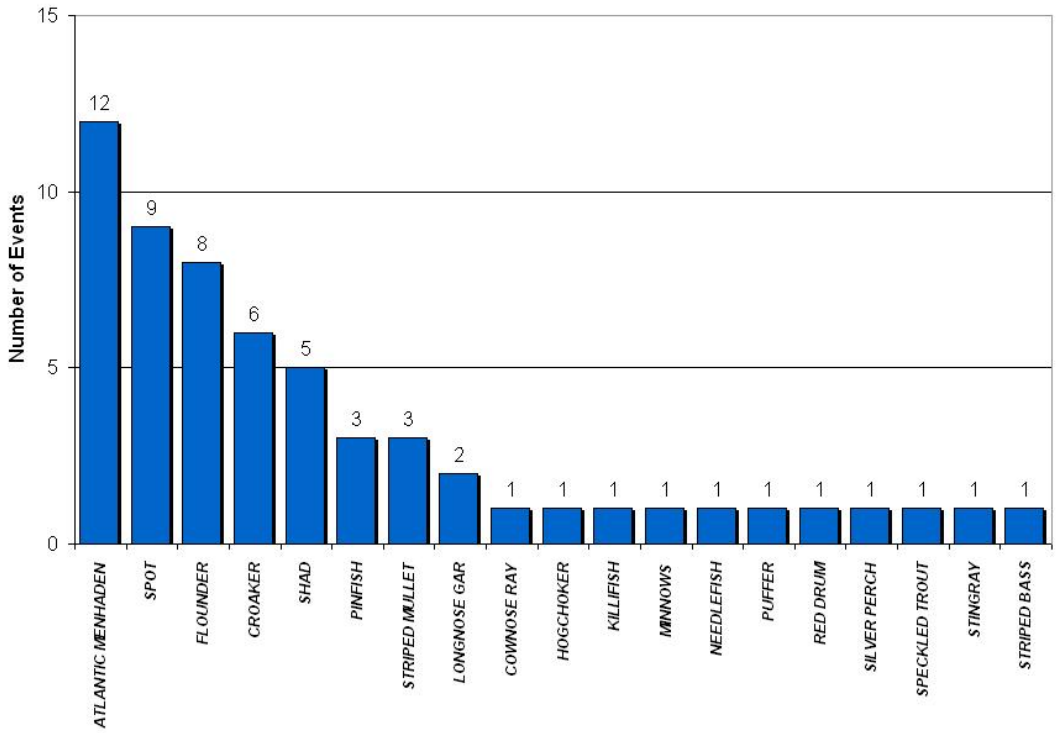
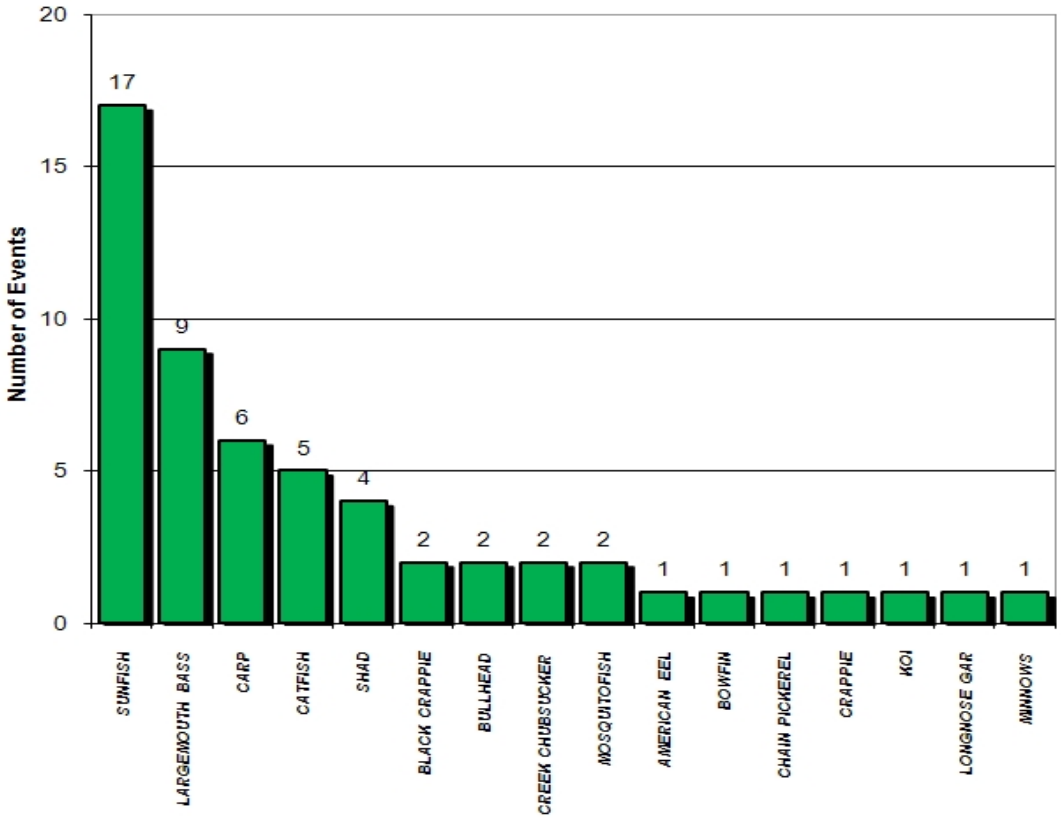


Figure 6: Freshwater finfish and frequencies observed during 2009 fish kill events



Reported Causes for Fish Kill Events

Specific causes of fish kill events may or may not be obvious to investigators depending on a number of factors. Causes are often identified, but others remain unconfirmed or unclear due to an investigation occurring hours or days after the actual event. Kill events often result from many environmental factors, and sorting out the major reason(s) why a fish kill occurs is frequently a difficult and often subjective task. Investigators generally monitor water quality and environmental conditions surrounding an event and are encouraged to submit this information on reports along with observations regarding a suspected cause. This information aids in evaluating potential water quality trends and problems, and assists scientists and decision-makers with formulating future courses of action. Reported causes should not be viewed as a definitive label for a particular event. Reported causes of 2009 kill events are listed in Table 2 in order of frequency. The statewide fish mortality associated with each cause category is also shown.

Table 2: Reported causes, frequencies, and associated fish mortality for 2009 fish kill events

Reported Cause	Events	Mortality
Dissolved Oxygen Depletion	15	11,800,000
Unknown*	12	1,944,000
Algal/Phyto Blooms	5	55,700
Spills	1	200

** "Unknown" causes were reported for those events where no specific causes could be determined.*

Dissolved Oxygen Depletion: Low dissolved oxygen (DO) was the most frequently reported cause for fish kill events during the 2009 season. DO stress was cited as a factor in nearly half of the years events and associated with over 85 percent of the year's fish mortality. DO depletion was reported as a likely cause in most large events in the lower Neuse and Tar/Pamlico estuaries. Estuarine fish kills have historically been associated with upwelling of hypoxic water from the river bottom or a depletion of DO in warm shallow areas, especially during the season's warmest months.

U*nknown Causes*: Causes for kill events are reported as "unknown" when investigators fail to cite specific reasons for an event. Investigations may not provide definitive causes when they are conducted too long after an event and no clear factors are determined, or when causes are suspected but not confirmed. Investigations for such events yielded few clues and environmental conditions or water quality measurements were often reported as normal by the time personnel arrived on scene. Investigators failed to cite or confirm causes for 12 of the year's events. Kills with unknown causes occurred in both fresh and estuarine waters and included several large events in the lower Neuse and Tar/Pamlico basins.

Algal Blooms: Algal bloom activity was a reported factor in five kills during 2009. ESS staff members identified at least 19 algal species in both fresh and estuarine waters in association with fish kill events (Table 3). Several algal species known in academic literature as capable of producing toxins were found in samples collected during 2009 investigations, but none were identified as a source of toxicity. It should be noted that the presence of these species alone does not infer toxicity or environmental concerns. In general, all coastal algal species identified by DWQ staff were typical for local estuarine rivers during the summer season. Most of the blooms recorded in the state's coastal waters this year were dominated by diatoms, chrysophytes, and dinoflagellates.

Algal blooms reported this year in the state's freshwaters were dominated by bluegreen and green algae. The most notable was observed on the Cape Fear River and extended from Lock and Dam 1, downstream to Brunswick County. The event was considered harmless but created taste and odor problems in municipal water supplies. The freshwater algal community seen this summer is similar to those observed in recent years.

ESS staff members routinely examine water samples associated with kills for the presence of harmful species. Samples that contain significant amounts potentially

harmful algae are often sent to research laboratories throughout the state. The Center for Applied Aquatic Ecology in Raleigh has the ability to examine samples under scanning electron microscopy. Laboratories at the University of North Carolina at Greensboro and the National Oceanic and Atmospheric Administration laboratory in Beaufort can examine samples with molecular probes. Laboratories at UNC-Chapel Hill and UNC-Wilmington provide valuable taxonomic expertise. Algal samples and results are collected, exchanged, and discussed between labs.

Table 3: Algal species collected during 2009 fish kill events and identified by ESS staff.

Genus	Waterbody Type	Fish Kill Reports Cited
Diatoms	Estuary	11
Cylindrospermopsis	Estuary	6
Leptocylindrus	Estuary	3
Gyrodinium instriatum	Estuary	2
Chattonella	Estuary	2
Karlodinium	Estuary	2
Scrippsiella	Estuary	2
Chaetoceros	Estuary	1
Pseudonitzschia	Estuary	1
Heterosigma	Estuary	1
Oxyrrhis	Estuary	1
Prorocentrum minimum	Estuary	1
Peridiniella	Estuary	1
Polykrikos	Estuary	1
Microcystis	Freshwater	1
Aphanizomenon	Freshwater	1
Trachelomonas	Freshwater	1
Coelastrum	Freshwater	1
Chlamydomonas	Freshwater	1

Spills: Toxic spills may deplete DO levels in receiving streams or induce kills outright through physical or chemical toxicity. During 2009, investigators reported one event where the release of toxic substances induced a fish kill. In March, 2009 MCAS Cherry Point Environmental Division officials reported a suspected spill and associated fish kill in a stormwater ditch leading to Schoolhouse Branch, a tributary to Slocum Creek (Neuse River). The spilled substance was not identified but results from water samples did not indicate metals or cyanide concentrations above state standards. The spill resulted in a kill of at least 200 mosquitofish, sunfish and crayfish.

Notable Events

Investigators reported six events where fish mortality exceeded 50,000 individuals (Table 4). All but one of these large events occurred in the Neuse estuary during August and September. Physical conditions in the Neuse River, combined with nutrient cycling processes, algae blooms, waste produced by massive, concentrated schools of menhaden and depletion of oxygen levels created significant areas of low oxygen water. Low DO concentrations were observed near the bottom of the river and also in proximity to large schools of menhaden.

A large kill of primarily Atlantic menhaden and spot was also documented in the Blounts Creek near Blounts Bay in June. Investigators indicated that heavy algae bloom activity and the subsequent algal decomposition likely created a low DO environment within the creek, resulting in the death of over 54,000 fish.

Table 4: Large (Mortality > 50,000) fish kill events reported during 2009

Date	Waterbody	Location	Mortality
9/16/2009	Neuse River	New Bern	7,350,000
8/21/2009	Neuse River	Flanners Beach to Slocum Creek	3,400,000
9/4/2009	Neuse River	Black Beacon Pt to Carolina Pines	1,900,000
9/16/2009	Northwest Creek	Fairfield Harbor	658,000
9/29/2009	Broad Creek	near mouth	333,000
6/10/2009	Blounts Creek	near Blounts Bay	54,500

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2009 Summary

Investigators reported fish kill events in 5 of the state's major river basins during 2009. Kill activity was documented throughout the state but was heaviest in historical trouble spots within the lower Neuse and Tar/Pamlico basins. The number of fish kills reported during the year totaled 33, a decrease from the previous year and in the range of totals seen since systematic reporting was established in 1996. While the number of statewide fish kill events is comparable to DWQ historical data, the fish mortality total reported during 2009 was significantly higher than any year since 1996. The increase was due to a series of large fish kill events in the Neuse estuary during August and September.

DWQ investigations place the total statewide mortality figure for the year at over 13.4 million fish. Over 97% of the total (13 million) was reported from the Neuse estuary, and nearly 75% (9.8 million) from one prolonged event on the Neuse during September. Investigators stressed that the reported mortality figures for the Neuse events are extremely conservative and that actual fish counts could be nearly double what was observed. Reports from the Tar/Pamlico estuary show much lighter kill activity with a total mortality of around 83,000 mixed species individuals.

Feedback from investigators and review of fish kill reports revealed several factors that may explain the sharp increase in fish kill mortality in the Neuse during the 2009 season. Physical and chemical measurements taken at the time of the Neuse investigations indicated the large events were related to fish stresses incurred during exposures to waters containing little or no oxygen (hypoxia). Estuarine fish kills are often associated with upwelling of hypoxic water from the river bottom or depletion of dissolved oxygen in warm shallow areas. Hypoxic conditions have historically occurred in North Carolina's estuaries as nutrient and organic loading coupled with water column stratification deplete dissolved oxygen levels during the summer and early fall months. Episodic and climatic events such as storms and hurricanes have also played a major role in large fish kill events, causing sudden shifts in wind direction and velocity, and exposing fish to underlying hypoxic water. Estuarine reports received during 2009 do not indicate any events were caused by specific pollutants or toxic releases. NCDWQ data and observations by investigators indicate conditions that determine dissolved oxygen levels in coastal estuaries appear to be significant drivers of fish kill activity.

Investigators and fisheries experts suspect the extreme density of Atlantic menhaden schools observed during 2009 may have also played a role in the large kill events on the Neuse. Studies indicate that large menhaden schools have a significant impact on surrounding waters through feeding, respiration and excretion of wastes. These activities could potentially result in a substantial decrease in dissolved oxygen as dense schools enter enclosed waterbodies and consume the available oxygen (NCDMF). Low DO concentrations were observed during numerous investigations near the bottom of the river and also in proximity to large schools of menhaden. Furthermore, coastal fish kill reports indicated that very few Atlantic menhaden individuals (1%) displayed lesions or sores

historically associated with the species. Further analyses of menhaden tissue samples revealed no widespread signs disease, parasites, or damage from toxic agents.

Algal blooms were observed throughout the time frame of a number of estuarine kills this year; however, none have been identified as a direct cause for fish mortality. In general, all coastal algal species associated with fish kill events and identified by DWQ staff were typical for local estuarine rivers during the summer/fall season. No harmful algal species were found in numbers to infer toxicity or acute environment concerns. Investigators and scientists point to algal blooms as an indirect factor in fish kill activity. Nutrient enriched waters may produce blooms that act as a source of organic matter and can increase the potential for hypoxia.

Results from 2009 fish kill investigations continue to suggest that a majority of North Carolina's annual kill activity is dependent on crucial environmental conditions in key areas of the state, namely, the Neuse and Tar/Pamlico estuaries. Results further suggest that the interaction of several key biological, chemical, and physical elements in the Neuse estuary produced an especially intense and prolonged series of events in August and September.

Appendix: 2009 Fish Kill Event Summaries Listed by County

Total 2009 Fish Kills: 33

Total 2009 Fish Mortality: 13794083

2009 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
Beaufort					
5/1/2009	WA09001	Pamlico River	Washington Park	126	The Pamlico Response Team investigated a fish kill today, Friday May 1st. DMF dispatch relayed a phone call from a resident in Washington Park. Staff responded on scene to find 112 fish washed up on the shoreline from the Mouth of Jacks Creek to a canal just downstream of Washington Park. This area covered approximately 1 shoreline mile and consisted mainly of menhaden (170 mm), gar, bowfin, carp, and crab. The decomposition of the fish ranged from 24- 48 hours old. Gill net activities have been observed in the area. However, no lesions or scars were observed. Physical data recorded Tuesday April 26th indicated warmer water temperatures (20 deg C) and salinities increasing (0-5 ppt, top-bottom) from Hwy 17 bridge to Blount's bay (5-10 ppt, top-bottom). Dissolved oxygen ranged from 7 mg/L to less than 3 mg/L at 2 meters depth. Several sites exhibited elevated algae bloom activity (DO >120%) from Blount's Bay to Chocowinity Bay. Winds were variable and from the northwest until Wednesday evening, switching to northeast winds Thursday morning. Surface foam was observed since Tuesday. Real time bottom WQ data from the Hwy 17 bridge indicated a drop in DO Wednesday evening to <2 mg/L, dropping further to near zero by Thursday morning. Surface WQ data also dropped to < 3 mg/L Thursday morning. Physical data recorded on scene indicated salinities from 2 -4 ppt (top-bottom). DO values ranged from 8 to 2 ppt (top-bottom). Water temperatures were 22 deg C. Based upon the variable stages of decomposition, these fish may have succumbed to low dissolved oxygen, resulting from previous bloom activity. Water samples were collected at the fish kill site and sent to Raleigh's ESS for further analysis. The samples indicated a bloom of small round diatoms and the dinoflagellate Prorocentrum. All taxa seen in the sample are typical in local estuarine rivers during spring.
6/10/2009	WA09006	Blounts Creek	near Blounts Bay	54500	The Pamlico Response Team investigated a fishkill in Blounts Creek at 10:00 a.m. this morning, June 10th. The kill claimed 54,524 fish, consisting primarily of Menhaden and Spot. The area extended 1.6 miles upstream from Cotton Patch Landing to the confluence with Nancy Run. Due to the decomposition of the fish, investigators believed that two separate fish kills occurred within 24 hours of each other. Menhaden and Spot (1 - 4 inches) were within 12-18 hours old. The remaining fish were 6- 14 inches (sunfish, bream, gizzard shad) and observed to be at least 24 hours old. No lesions were observed. Investigators began recording physical data near Cotton Patch Landing with surface DO levels near 3.3 mg/L to 2.9 mg/L (1 meter down). Fish were observed swimming in the area. As they worked their way upstream, surface DO levels were 0.4 mg/L to 0.1 mg/L (1 meter down). The few fish observed in this area were lethargic. An oily sheen and grey-colored water was observed in this area. Salinity levels along the entire stretch of the event were consistent from 5.5 to 6.6 ppt. Investigators arrived back at Cotton Patch Landing within 2 hours and noticed green water. Physical data indicated an algae bloom (161% Saturation). Previous weather events included 60 mph winds and heavy rainfall in the area Tuesday evening. Although dissolved oxygen may be the obvious culprit in this event, the factors contributing to low DO are still in question. Perpetual algae blooms and the resultant decomposition may have created a hypoxic environment. Strong Northeast winds and heavy rainfall may have exacerbated the issue. Water samples were collected and sent to ESS for further analysis.

2009 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
6/14/2009	WA09008	Pungo Creek	near Sullivan Point	350	The Pamlico River Response Team investigated a fish kill in a small section of Pungo Creek at 11:30 a.m. on Sunday, June 14th. The fish kill zone was located along 3,000 linear feet of shoreline on the north side across from Sullivan Point. The PRRT counted a total 350 finfish and 3 blue crab that were involved in the kill. The dead fish were believed to have died recently since rigor mortis had not occurred yet and many of the fish were on the bottom of the creek. Investigators also observed 5 flounder, 1 gizzard shad, 12 hogchokers, and 2 eels that were still breathing, but were very sluggish and appeared to be dying. No lesions were observed. Some fish were observed swimming in the fish kill zone at the time of the investigation. Water quality parameters indicated good oxygen levels at the surface (7.4 mg/L, 103 % saturation), but the dissolved oxygen levels at the bottom (depths of 1.2-2.0 m) were low (0.27 mg/L to 0.43 mg/L). The salinities ranged from 9.1 ppt at the surface to 10.5 ppt at the bottom. At the time of the investigation water quality parameters indicated a slight phytoplankton bloom, but observations and citizen accounts indicate that a dense phytoplankton bloom may have occurred during the previous days. Weather conditions over the pass several days included hot, sunny, and calm days with scattered afternoon thunderstorms. Hypoxic conditions from oxygen and salinity stratification, coupled with phytoplankton blooms may have stressed and killed the fish that were unable to find refuge from low oxygen water. Water samples were collected and were sent to Raleigh Lab Monday for phytoplankton and nutrient analysis. The samples indicated a bloom of small round diatoms and the dinoflagellate Karlodinium. All taxa seen in the samples were typical in local estuarine rivers during summer. Several area residents observed a crop duster plane flying over Pungo Creek very low on Friday 6/12/2009. They said they were spraying cucumber fields. PRRT did observed several cucumbers in the creek. Residents observed thick brown, discolored water several days ago and they believe the spray event may have contributed to the local kill.
6/22/2009	WA09009	Broad Creek	near Belhaven	1600	The Pamlico Response Team responded to a citizen's report of a fish kill in Broad Creek on Monday afternoon, June 22, 2009. Broad Creek is located upstream of Pantego Creek, near Belhaven. The kill seemed to be located in a wide and shallow (1.0 m deep) section of the creek. The team found a total of 1,596 dead fish consisting mostly of spot , and gizzard shad . Other fish species included sunfish, catfish, largemouth bass, minnows (silversides, mud minnows, and finger mullet), silver perch, flounder, striped bass, and cownose ray. Numerous fish were observed swimming in the fish kill zone during the investigation, including menhaden. The estimated time of death may have occurred within 36-48 hours prior to the investigation. Physical parameters measured during the investigation did not point to any specific cause of death, although conditions indicated an algal bloom in progress. Temperatures have been extremely hot and winds have been strong over the last several days. Given the diversity of fish species and high water temperatures, it is highly likely there has been an on-going bloom in this area that may have caused DO to drop during its decomposition phase. Water samples were taken and sent to Raleigh for further analysis. Samples indicated a bloom of small round diatoms and the dinoflagellates Scrippsiella and Karlodinium. All taxa seen in the sample are typical in local estuarine rivers during summer.

2009 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
6/26/2009	WA09010	Blounts Bay	Blounts Creek	5000	The Pamlico Response Team responded to a citizen's report of a fish kill on the Western Shore of Blount's Bay on Friday afternoon, June 26th. This Bay is located on the south side of the Pamlico River near the mouth of Blount's Creek. The team counted approximately 5,000 croaker and 4 small flounder. Numerous fish were observed swimming in the fish kill zone during the investigation. No lesions were observed. Water quality parameters measured on site indicated DO near 6 mg/L and salinities near 9.4 ppt. Although no specific cause of death was apparent, temperatures have been extremely hot over the last several days. Two algal blooms were recorded on June 23rd within a mile radius of the kill zone during the team's Ambient Sampling. The occurrence of these blooms near the fish kill area may be an indication that blooms were on-going during this week and may have caused short localized drops in DO during the late evening or early morning. The team was unable to take water samples due to a thunderstorm that occurred during the investigation.
8/19/2009	WA09016	Pamlico River	Camp Hardee	17830	The Pamlico Response Team received a call from PTRF Wednesday morning, indicating a fish kill near Camp Hardee on the south side of the Pamlico River. Local residents observed the fishkill Tuesday evening between 6 and 7 p.m. Staff observed spot & croaker, blue crab, and flounder along a 1.2 mile stretch of shoreline extending from Hill Creek's mouth downstream, past Camp Hardee to Hills Point. Fish totals were approximated near 17,973. The majority of fish were juvenile spot and croaker, ranging from 30 to 60 mm. No lesions or sores were observed. Physical data on site indicated an active bloom (DO % > 150). Salinity values were near 9 ppt. Water temperatures were over 30 degrees C. The Response Team was also on the Pamlico River Tuesday collecting physical data and water samples from regularly scheduled monitoring. Tuesday's physical data indicated algal blooms extending from Chocowinity Bay downstream to the mouth of the Pungo River. DO values dropped to near zero at 2 meters. The past several days have been near 100 degrees with relatively little wind activity. Tuesday winds steadily increased to 10 mph by late afternoon from the southwest. A localized upwelling event may have occurred during this time, bringing near anoxic waters towards the surface of the south side of the Pamlico River. Bloom samples were collected and sent to Raleigh's ESS for analysis. Phyto samples indicated a bloom of the flagellated raphidophyte Chattonella and the filamentous bluegreen Cylindrospermopsis. All taxa seen in the sample are typical in local estuarine rivers during summer.
8/23/2009	WA09018	Blounts Creek	above Cotton Patch Landing	220	Pamlico River Rapid Response team responded to a fish kill in Blounts Creek on Sunday, August 23, 2009. Physical data at the time of the investigation revealed dead water with little to no oxygen (0.07 mg/L to 0.40 mg/L) 1.0 meter and deeper throughout the 2.5 mile fish kill site. The salinity at the center of the fish kill site ranged from 9.41 ppt at the surface to 10.50 ppt at the bottom (2.0 m). Extensive decay and missing tails from scavengers were observed. Investigators believe the fish kill occurred 48+ hours prior to the investigation. Investigators observed live fish in the fish kill site and did not observe any fish succumbing to the low oxygen during the investigation. This fish kill was similar in location to previous fish kills. Blounts Creek's headwaters to the mouth, is much deeper than the adjoining Blounts Bay and Pamlico River. When the creek's water column turns over, the large volume of dead water (1-3 m) tends to cause large drops in dissolved oxygen throughout the length and width of the creek. The drop in dissolved oxygen in the narrow and winding creek likely lead to a multispecies fish kill. Investigators believes that many factors could have lead to the fish kill. These include algal die-off, high decomposition levels from higher than normal nutrient inputs, recent rains flushing local swamp areas, or possibly an upwelling event caused by winds/rains preceded by several days of hot and calm winds, high salinity levels, and high temperatures. Water quality samples were collected and sent to Raleigh's ESS for analysis. Samples revealed a bloom of cryptomonads, the dinoflagellate Scrippsiella, small round diatoms, and the filamentous bluegreen Cylindrospermopsis. The algae found in the sample are common in local estuarine rivers during summer

2009 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
8/24/2009	WA09019	South Creek	near Idalia	200	The Pamlico Response Team received a phone call from a resident near Aurora concerning dead fish along the headwaters of South Creek. Upon investigation, the team observed catfish and carp along a 1.7 mile stretch from the confluence of Broomfield Swamp Creek upstream towards the confluence of Gum Swamp Run. A majority of the fish were approximately 48 hours with only a handful of fish less than 36 hours old. Dissolved oxygen values along the 1.7 mile stretch were near 4.0 mg/L at the surface. DO dropped to near zero within 1 meter. Salinities in general ranged from 11.8ppt (surface) to 14 ppt (bottom). Salinity values towards the headwaters of South Creek ranged from 8 ppt (surface) to 11.8 ppt (bottom). Water temperatures were near 30 degrees C. Precipitation totals in the area within the past 48 hours were from 1 -1.5 inches. It is highly likely that these fish were already stressed from high salinities. Heavy rainfall and winds combined with high salinities and near-anoxic waters may have contributed to the demise of these freshwater fish. Water samples were collected and sent to Raleigh's ESS for further analysis. The samples indicated a bloom of small round diatoms, the dinoflagellate Peridiniella, cryptomonads, and the filamentous bluegreen Cylindrospermopsis. All taxa seen in the sample are typical in local estuarine rivers during summer.
8/26/2009	WA09021	Blounts Bay	West Side	1100	The Pamlico Rapid Response Team received a citizen's report of a fish kill on the Western Shore of Blount's Bay on Wednesday, August 26, 2009. The total finfish mortality was 1,111. The kill area was localized, extending about 150' along the shoreline. The mortalities appeared to be fresh, within 12 to 18 hours. Mullet and small fish were seen swimming in the fish kill site. No lesions or sores were observed. Water quality conditions at the time of the investigation revealed high dissolved oxygen levels (10.6 mg/L, 151 %), high temperatures (31.1 degrees Celsius), high pH (8.1) and high salinities (10.45 ppt). This physical data indicated an algal bloom was in progress. There have been no major weather condition changes in the previous days which could have contributed to major water quality changes. It is possible that an algal bloom die-off occurred leading to low dissolved oxygen levels. The possible combination of low dissolved oxygen levels with high water temperatures, high pH, and high salinities along with the topography of the bay may have contributed to the fish kill. Water quality samples were collected and sent to Raleigh's ESS for analysis. Samples showed a bloom of small round diatoms and the filamentous bluegreen Cylindrospermopsis. The algae found in this sample are common in local estuarine rivers during summer.
8/27/2009	WA09022	Pamlico River	Swan Point	2240	The Pamlico Response Team received a phone call from PTRF concerning dead fish along the northern shoreline of the Pamlico River near Swan Point. Upon investigation, the team observed 2237 juvenile spot and 2 pinfish along a 869 foot stretch. These fish were well into the decomposition phase, suggesting the kill began at least 2-3 days prior. Physical parameters at the surface were as follows: DO 13.4 mg/L ; DO% 198; water temp 34 deg C ; salinity 8.5 ppt. Bottom physical parameters at 1 meter were as follows: DO 5.4 mg/L; temp 30 deg C; salinity 10.4 ppt. Given the state of decay, wind direction, composition and small number of species (mainly spot), and short length of the kill, it is likely that this fishkill originated from the south side of the Pamlico River, near the Blounts Bay area. Water samples were collected and sent to Raleigh's ESS for further analysis. Samples indicated a bloom of small round diatoms and the flagellated raphidophyte Chattonella. All taxa seen in the sample are typical in local estuarine rivers during summer.
					Total Kills for County: 10 Total Mortality for County: 83166

2009 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
Craven					
3/9/2009	WA09005	Trib to Schoolhouse Branch (Slocum Creek)	MCAS Cherry Point	200	On March 11, 2009, MCAS Cherry Point Environmental Assessment Division (EAD) officials reported to the Neuse River Response Team (NRRT) a suspected spill and associated fish kill in a stormwater ditch leading to Schoolhouse Branch, a tributary to Slocum Creek. NRRT staff investigated the afternoon of March 11. MCAS officials on site stated that the kill and orange, turbid, water was initially discovered the evening of March 9, 2009. During the NRRT investigation, a milky white liquid was observed discharging from a stormwater pipe at a rate of approximately 3 gpm into an open stormwater junction area. The junction had five inlet pipes and two outlet pipes. Clear water was discharging from the other four inlet pipes. The two outlet pipes led to a stormwater ditch that lead to Schoolhouse Branch. A flood control valve was located at the end of the ditch and was closed. It appeared that all mortality was confined to the stormwater system and did not affect Schoolhouse Branch. Mortality from this event included 209 mosquitofish, 108 Louisiana red crayfish, and 8 bluegill. The fish and crayfish appeared to have been dead 48-60 hours. A 3,000 gallon capacity pump-out truck was actively pumping stormwater and the white liquid from the storwater convergence for disposal. This was the third truckload that had been pumped out and MCAS officials estimated approximately 5,000 gallons had been pumped out up to that time. MCAS officials had taken toxicity, metals, and cyanide samples from the convergence area on March 10, 2009. Preliminary metals and cyanide results from those samples did not indicate concentrations above state standards. Based on the lack of recent rains and observations from MCAS officials, it is likely the white liquid was directly discharged into a stormwater drain on March 8 or 9 and that the substance was the cause of the kill. Prior to the NRRT departing the site, MCAS officials received an anecdotal report of a construction crew discharging a white liquid into a storm drain in the area around the time of the fish kill. MCAS officials stated they would continue to pump out the stormwater junction area and the stormwater ditch, continue monitoring the area, and prepare an incident report and send it to the NRRT and Al Hodge at the Washington Regional Office.
5/12/2009	WA09002	Neuse River	Carolina Pines	25640	The Neuse River Response Team investigated a fish kill on the Neuse River that extended 7.5 river miles between Flanners Beach and Slocum Creek on May 12 and 13, 2009. The initial report was given to the NRRT from a citizen in the Carolina Pines subdivision on May 12, 2009. Total mortality for this event was 25,647 and was exclusively Atlantic Menhaden. These Menhaden ranged from 1-5 inches long and were approximately 24 hours old at the time of the initial investigation. Lesion prevalence on the Menhaden involved in this event was 90% and was observed on only the larger individuals (which made up the vast majority of the total mortality). Algae bloom conditions were observed at the time of investigation. Water and fish tissue samples were collected for analysis by the Division of Water Quality's Environmental Sciences Section and other interested parties. Continuous water quality monitors in the area did not indicate any unusual hydrologic events that may have led to this fish kill. The event appeared to be completed at the time of investigation and several schools of fish were observed swimming in shallow water near shore along the length of the kill. Water samples were collected at the fish kill site and sent to Raleigh's ESS for further analysis. The samples collected contained a bloom of small round diatoms and the chain forming diatom Chaetoceros. Some dinoflagellates and a few clumps of the diatom Pseudonitzschia were also present. Almost all of the algae found in the sample are typical for local estuarine rivers. The Pseudonitzschia may have been blown into the area by recent storm activity.

2009 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
5/13/2009	WA09003	Slocum Creek	Southwest Prong	241	A fish kill was reported and investigated by the NRRT in the headwaters of Slocum Creek on May 13, 2009. NC Wildlife Resources referred a call that was received from a private citizen about dead fish and a suspected wastewater spill in Slocum Creek. NRRT staff counted 241 dead freshwater species fish during the investigation. Channel catfish, Longnose gar, Largemouth Bass, Chain Pickeral, Bluegill, and various sunfish were involved. All fish appeared to be at least 48 hours old. Physical measurements recorded very low oxygen levels from surface to bottom in the area of the kill. The creek was very stratified with surface salinities less than one ppt and bottom salinity at 10 ppt. It appears as though recent rains led to headwater swamp areas draining into the Southwest Prong of Slocum Creek. This, in turn, created a high level of biological activity that consumed most of the oxygen in the creek and produced a septic smell when bottom waters were disturbed by boating activities.
5/17/2009	WA09004	Neuse River	Wilkinson Point	100	The Neuse River Rapid Response Team (NRRT) began a fish kill investigation at Wilkinson Point on the Neuse River during the afternoon of Sunday, May 17, 2009. The kill was reported to the NRRT the same afternoon by a homeowner that lives in the vicinity of the kill area. The kill was ongoing during the investigation and was exclusively juvenile Atlantic Menhaden (Menhaden). The Menhaden involved in this kill were either 1inch in length (from this year's recruitment class) or 4-5 inches in length (most likely 2008's recruitment class). Approximately 100 Menhaden were counted during the initial investigation but weather and daylight constraints prevented NRRT staff from determining the total mortality and extent of the kill the same day. None of the smaller 2009 young of the year Menhaden involved in the kill had visible lesions. The larger Menhaden from the 2008 recruitment class (which made up the majority of the kill and those observed actively dying) had nearly 100% visible lesioned. Physical parameters and visual characteristics of the water during the investigation did not indicate an active bloom and real-time water quality monitors in the area did not indicate any unusual hydrologic events that may have led to this kill. Water samples were collected for interested parties. The NRRT continued the fish kill investigation from the Wilkinson Point area on the Neuse River on Monday, May 18, 2009. The tide during Monday's investigation was high (versus a low tide during Sunday's investigation). No additional dead fish were found during Monday's investigation. Schools of jellyfish, shrimp, and Menhaden were observed swimming in the area where the dead and dying Menhaden were found on Sunday. No additional samples were collected.
6/17/2009	WA09007	Hawks Pond	near New Bern	680	NRRT received a report of a fish kill in Hawk's Pond off the Trent River in New Bern on 6/16/09. Staff investigated the area and counted 680 freshwater fish. Individual species included Largemouth Bass, Bluegill, White Crappie, Gizzard shad, Longnose Gar, and Grass Carp. Conditions observed at the time of investigation showed dissolved oxygen levels below 1 mg/L. Numerous live fish were observed gasping for air near the surface throughout the pond. Although no bloom activity was observed during staff investigation, the reporting party described what could be considered a bloom several days prior to investigation. This would coincide with the estimated time of the fish kill based on the decomposition level of the dead fish. This event has been attributed to hypoxic/anoxic conditions related to an algae bloom and possible stagnant (low D.O.) water draining into the pond from adjacent wetlands. This event may continue for several days with continued low oxygen levels.

2009 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
6/26/2009	WA09011	Neuse River	Fisher Landing Point	19900	The Neuse Response Team responded to a fishkill call Friday afternoon June 26th 2009. The Neuse Riverkeeper Foundation relayed information regarding a multiple species fishkill near Fisher Point (in between Johnson Point and Flanner's Beach) on the Neuse River. Once on site, the team recorded slight bloom conditions. DO levels were over 6 mg/L, salinities near 14ppt. The fishkill zone extended for approximately 0.2 miles of shoreline downstream from Fisher Point. NRRT counted a total of 19,902 fish with a majority of these consisting of juvenile spot and croaker (30-100 mm). Other fish counted included flounder, southern stingray, blue crab, speckled trout, and pinfish. No lesions were observed. Schooling fish were seen swimming in the fishkill zone. Based on NCSU's water quality and meteorological profiles on the 25th, near Carolina Pines and across the River at Kennels Beach, there may have been an upwelling event due to a shift in wind direction and strength from the north to the southwest sometime between 6 and 9pm. This shift would have brought low oxygen waters to upwell near Fisher Landing Point.
7/2/2009	WA09013	Neuse River	Carolina Pines	7700	The Neuse River Rapid Response Team (NRRT) investigated a fish kill near Carolina Pines on the Neuse River the afternoon of July 2, 2009. The kill was reported to the NRRT the same afternoon by the lower Neuse River Riverkeeper, Larry Baldwin. Team members calculated the total mortality of this kill at 7,783, although this number is biased low as numerous birds were observed eating dead fish from the kill area. The kill was approximately 12-18 hours old at the time of investigation and was comprised of multiple species, primarily Atlantic menhaden, croaker, and spot. No lesions were observed. Dissolved oxygen (DO) and pH measured at the kill site during the investigation were elevated (DO 126% and pH 8.0) indicating a mild algal bloom in progress. Water quality data from NCSU's water quality profile at Carolina Pines did not indicate a drop of DO concentration below 6.6 mg/L during the estimated time of the kill (DO concentration below 2.5 mg/L is considered stressful). Nutrients and phytoplankton samples were collected and were analyzed by the DWQ's Environmental Sciences Section in Raleigh. Additional water was collected and is available for interested parties upon request. Samples contained a bloom of small round diatoms with some dinoflagellates. All of the algae found in the sample are typical for local estuarine rivers.
8/21/2009	WA09017	Neuse River	Flanners Beach to Slocum Creek	3400000	The Neuse River Response Team investigated a mixed-species fish kill in the Neuse River on August 21, 2009. The kill extended 4.0 river miles from Flanners Beach to Slocum Creek on the south side of the river and from Beard Creek to Kendall Point on the north side of the river (14 square miles of open water). Total mortality from this kill event was 3,407,715, primarily Atlantic Menhaden. No visible lesions were observed. During the investigation, a strong upwelling was evident in the area of the kill based on water color, physical measurements, and the strong smell of hydrogen sulfide. Dissolved oxygen was low (less than 0.8 mg/L) along the southern shoreline of the river while an algae bloom was present along the north shoreline of the river, resulting in DO concentrations greater than 10 mg/L. It is likely that the kill occurred along the southern shoreline and some of the fish were blown to open water and to the northern shoreline by relatively strong south to southwest winds. Water quality conditions (i.e. low DO concentrations) may result in additional fish mortality through the weekend. Algae bloom sample were collected from multiple locations and were sent to the Environmental Sciences Section for analysis. Extra sample water was also collected for interested parties. The samples contained blooms of the flagellated raphidophyte Chattonella and the dinoflagellates Gyrodinium and Scrippsiella. All of the algae found in the sample are typical for local estuarine rivers during summer.

2009 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
9/4/2009	WA09025	Neuse River	Black Beacon Point to Carolina Pines	1900000	The Neuse Response Team responded to several phone calls concerning dead fish along the south side of the Neuse River. Upon investigation, the team estimated over 1.9 million juvenile menhaden (2-6") washed up along the shoreline. The kill area extended approximately 10 miles, from Black Beacon Point downstream to Carolina Pines. Based on observation, there were two sets of fish wrack lines along the shoreline and two stages of fish decay. The oldest wrack line seemed to be at least 2-3 days old. The second set was near the waterline and was estimated near 24 hours old. No sores or lesions were observed. Initial physical parameters did not indicate low or hypoxic DO conditions. Surface DO values were from 6.8 to 8.0 mg/L (from Black Beacon to Flanner's Beach). DO was observed to steadily increase as the sun became stronger during the investigation. Fish continued to float towards the shoreline from the north side of the River. Based on the time of death of these fish, it is highly likely that this event was similar to the August 21st fishkill, as wind velocities averaged from 10-25 mph and continued from a northerly direction for the previous 4 days. Strong, consistent northerly winds may have caused an upwelling event on the north side of the River, killing these fish and pushing them to the south River shoreline.
9/16/2009	WA09023	Neuse River	New Bern	7350000	The Neuse River Response Team investigated an ongoing fish kill in the Neuse River and Northwest Creek area on Wednesday 9/16/09. This large scale fish kill involved only juvenile Atlantic Menhaden, none of which had lesions. At most areas there was no dissolved oxygen from one meter below the surface down. A high percentage of the dead and dying fish were observed with bloodshot or missing eyes. Very large, dense schools of live menhaden were also observed along the entire length of the kill. Fish near New Bern appeared lethargic, while schools observed farther downstream from New Bern were more active and healthier in appearance. Mortality estimates were made for the the Neuse River (12 river miles). Estimates of fish killed from the previous 48 hours in the Neuse River from New Bern to Carolina Pines were 5.8 million. Samples were collected at areas where algae blooms were observed. These samples coincide with samples collected from the same areas earlier in the week. The high mortatlity number in this event appeared in part due to the massive schooling behavior of menhaden in areas that were highly stratified and hypoxic below 1 meter in depth. Fish in this area were being exposed to very stressful and potentially lethal low oxygen levels. Additional fish counts were made on 9/23 upstream from Neuse River into Lawson Cr in New Bern and along the shoreline and open water areas of a 11.4 mile stretch of the Neuse Between New Bern and Carolina Pines. Additional fish counts brought the mortality total for the extended event to over 7.3 million. Water samples analyzed by ESS staff were dominated by the chain-forming diatom Leptocylindrus.
9/16/2009	WA09024	Northwest Creek	Fairfield Harbor	658000	The Neuse River Response Team investigated an ongoing fish kill in Fairfield Harbor and Northwest Creek area on Wednesday 9/16/09. This large scale fish kill involved only juvenile Atlantic Menhaden, none of which had lesions. During investigation, algae bloom conditions were present at the surface, and low oxygen levels were present below 2 meters. Fish were observed actively dying and many had bloody or missing eyes, bloody nasal areas, and red fin roots. This is characteristic of exposure to low dissolved oxygen conditions. Separate mortality estimate methods were used in Northwest Cr. and Fairfield Harbor Marina due to differing waterbody types. These estimates were then totalled to 657,808 fish dead in the area.
					Total Kills for County: 11 **Total Mortality for County: 1.3E+07**
Dare					
8/12/2009	WA09015	Pamlico Sound	near Oregon Inlet	150	Investigators measured water quality parameters in 2 locations: Dissolved O was 7.7, Salinity 30.1ppt, Temp. 21.6. Fish were in equal stage of decomposition. No disease was noted.

2009 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
					Total Kills for County: 1 Total Mortality for County: 150
Gates					
7/2/2009	WA09012	Bennetts Creek	below Merchants Millpond Dam	500	Extremely low dissolved oxygen was the likely cause of this fish kill and most likely due no water flow over the dam and ambient conditions associated with hypoxia. During these conditions, fish in pools below millponds are subject to fish kills and thus, this situation was likely unavoidable.
7/9/2009	WA09014	Merchants Millpond		600	Dense matS of mosquito fern and duckweed nearly covered entire millpond and most likely contributed to the anoxic conditions. Estimates of number of dead fish may be low as the dense mat of vegetation limited visibility of dead fish as well as smaller fish that did not break through the mat. Although severly limited, D.O levels near the aeration unit nearest the visitor center were 0.6 to 0.8 mg/L. Decomposition of aquatic plants and dead fish continued to decrease available refugia and numbers of dead fish associated with this event probably increased after investigation.
					Total Kills for County: 2 Total Mortality for County: 1100
Harnett					
8/18/2009	FA09001	Private Pond	Matthews Millpond Rd	2000	The pond water level was approximately 3 feet lower than normal. There was a heavy rain approximately 5 days prior to the fishkill. Algal samples were submitted to ESS for analysis. ESS staff identified the samples as the colonial blue green alga Microcystis aeruginosa.This alga is common throughout North Carolina and is known to form blooms in the summer, especially during hot weather.
					Total Kills for County: 1 Total Mortality for County: 2000
New Hanover					
5/19/2009	WL09001	UT Smiths Creek	Stormwater Pond	106	Water samples collected in ditches around N Kerr Indusrial Park. Possible spill incident but unconfirmed at time of investigation.
7/23/2009	WL09002	Airlie Gardens Pond	Pond 2	1000	Investigators reported large amounts of surface algae and macrophytes at time of investigation. Fish appeared dead for 1-2 days. Samples submiitted to ESS staff showed the euglenoid Trachelomonas and possiblty blue-green algae Cylindrospermopsis. Trachelomonas is associated with poor water quality.
					Total Kills for County: 2 Total Mortality for County: 1106

2009 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
Pamlico					
9/29/2009	WA09026	Broad Creek	near mouth	333000	The Neuse River Response Team (NRRT) conducted an investigation and performed fish counts on Broad Creek the afternoon of September 29, 2009. The kill extended from the mouth of the creek upstream 2.1 river miles. A total of 333,000 deceased Atlantic menhaden (menhaden) were counted and the kill was ongoing during the investigation. No other species of dead fish were observed and very few menhaden were observed with lesions (<1%). Several of the fish had bloodshot or missing eyes and/or red splotches on various parts of the body. Several very large, dense schools of live menhaden were observed both inside and outside the kill area. Within the kill area itself, these schools ranged from active and healthy in appearance (dark, normal coloration) to lethargic and unhealthy in appearance (light coloration, red splotches on body). Dissolved oxygen (DO) concentrations were measured at 1.8 mg/L or less throughout the water column along the western shoreline of Broad Creek from the mouth to approximately 0.5 miles upstream of the Blackbeard Sailing Club marina. DO measured throughout the rest of the creek was considered to be at healthy concentrations (4.7 to 9.8 mg/L). The area of low DO water along the western shoreline may have been the result of upwelling, fish behavior, or both. Strong westerly winds began blowing the day prior to the investigation and during the investigation and given the general north to south orientation of Broad Creek, upwelling may have occurred. The schools of menhaden observed in the creek, and particularly those in Blackbeard Sailing Club marina and downstream to the mouth, were incredibly large and dense. The marina itself was almost entirely filled with live menhaden. The number and density of menhaden alone may have been enough to consume the majority of oxygen in the water column in the kill area. **Total Kills for County: 1 Total Mortality for County: 333000**
Person					
5/29/2009	RA09001	Pine Lake	near Roxboro	100	This pond is near town, commericial and industrial area, Pump Station and old residential septic discharging systems (most old and unpermitted) are scattered in the area. The pond receives SW as well as stream flow. Over the years it apppears sediment has filled the pond and the depth of the pond has decreased. The shallow state of the pond coupled with the pollution loading and the heavy rain event is suspected to be the cuase of the fish kill. The specific septic system identifed that is leaking into upstream is being investigated. The system was recently dug up and repaired, but is not permitted by the state and is still leaking based on the fecal results obtained at the site. **Total Kills for County: 1 Total Mortality for County: 100**
Rowan					
10/27/2009	MO09002	High Rock Lake	Tributary to Second Creek Arm	1000	Initial call on 10/25/09 to DWQ Emergency Management was made by Wildlife Resource Commission (WRC) Enforcment Officer. Witness on 10/27 stated to DWQ that on 10/26 a few fish that were gasping for air were transferred to High Rock Lake from the affected cove and some were able to recover. This indicates there was probably low dissolved oxygen in the cove. Cove only has small connection with High Rock Lake which would preclude good mixing of water between the two waterbodies. Data collected from the temperature sensors nearby indicate a rapid decrease in temperature days before the event followed by a near stabilization of water temperature at 3 meters below the surface, suggesting a possible turnover of lake water around the fish kill location. **Total Kills for County: 1 Total Mortality for County: 1000**

2009 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
Union					
5/13/2009	MO09001	Private Pond off Crooked Creek	near Fairview	400	At the time of the investigation multiple species of fish, both large and small, were dead and decomposing. The largest fish was approximately 10" and the smallest was approximately 1". No fish were seen dying at the time of the inspection. The farmer's field remained unplanted. A small amount of ground water containing iron oxidizing bacteria was seen entering Pond 1 from the farmer's field. According to Mark Clontz, Jerry Clontz's brother, Pond 1 had been completely drained and dredged 3-4 years ago. The water was discolored with a reddish tint. Pond 1 was about .75 acres with an overflow pipe that leads to Pond 2. Pond 2 was about 1.25 acres with spillway that discharged to an unnamed tributary (UT) to Goose Creek. No water had discharged from Pond 2 to the UT. Pond 2 was slightly discolored with a reddish tintand appeared to be more shallow than Pond 1. The fish kill strted in Pond 2 then moved to Pond 1. Two adult and 4 baby Canada geese were observed at the ponds.
					Total Kills for County: 1 **Total Mortality for County: 400**
Wake					
8/13/2009	RA09002	MacGregor Lake	Cary	100	Fish Kill reported on third of sucessive 99 degree F days. Possibility of thunderstorm during the afternoon of 8-11-09. Dead fish were at bottom of spillway which was dry on the inspection date (8-13-09).
					Total Kills for County: 1 **Total Mortality for County: 100**
Wayne					
8/14/2009	WA09020	Raintree Lake	near Goldsboro	9500	The Neuse River Response Team investigated a fish kill on Friday, August 14, 2009. The team was notified of this kill by a citizen the afternoon of August 13, 2009. This kill occurred in a 55 acre impoundment located on West Bear Creek near Hood Swamp. Approximately 9,500 finfish were killed during this event. Species affected were largemouth bass, gizzard shad, bluegill, catfish, and grass carp. These fish were primarily adults. Physical conditions in the impoundment indicated an algal bloom in the decomposition phase. Dissolved oxygen concentrations measured during the investigation were 3.8 mg/L or less. With heavy rains several consecutive days prior, it is believed that nutrients associated with stormwater runoff resulted in an intense algal bloom in the impoundment. This event may have been ongoing during the investigation and continued after the investigation based on visual observations of an intense algal bloom, relatively low dissolved oxygen measurements throughout the water column, and observations of live fish swimming near the surface. Nutrients, chlorophyll, and phytoplankton samples were collected and sent to the DWQ's Environmental Sciences Section in Raleigh. Additional water has been collected and is available for interested parties upon request. Water samples showed phytoplankton too concentrated to analyze even after a 50% dilution. The algal assemblage was extremely diverse with several different species from 5 different algal groups. No one species or group dominated the bloom. The taxa seen are common in the state's fresh waters during summer.
					Total Kills for County: 1 **Total Mortality for County: 9500**