



North Carolina Department of Environment and Natural Resources

Pat McCrory
Governor

John E. Skvarla, III
Secretary

November 10, 2014

MEMORANDUM

TO: THE ENVIRONMENTAL REVIEW COMMISSION
The Honorable Mike Hager, Co-Chair
The Honorable Ruth Samuelson, Co-Chair
The Honorable Brent Jackson, Co-Chair

FROM: Neal Robbins, Director of Legislative Affairs

SUBJECT: Fish Kills Report

DATE: November 10, 2014

Pursuant to G.S. 143B-279.7(c), the Department of Environment and Natural Resources shall report annually to the Environmental Review Commission no later than December 1 of each year. This report shall include a summary of all fish kill activity within the last year, an overview of any trend analyses, a discussion of any new or modified methodologies or reporting protocols, and any other relevant information. Please consider the attached as the formal submission this report.

If you have any questions or need additional information, please contact me by phone at (919) 707-8618 or via e-mail at neal.robbs@ncdenr.gov.

cc: Mitch Gillespie, Assistant Secretary for Environment, NCDENR
Tom Reeder, Director of Water Resources, NCDENR

North Carolina Division of Water Resources Annual Report of Fish Kill Events 2014



Multi-species fish kill, Neuse River at Cherry Branch Ferry, September, 2014.

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

October 2014

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2014 Fish Kill Summary

As of October, 2014, investigators have reported 18 fish kill events statewide for the 2014 season (Figure 1). Kill activity was documented during the year in six of the state's 17 major river basins and in nine counties. Kill events were reported in coastal waters, as well as inland, as far west as Catawba and Lincoln counties.

Fish kills reported from inland waters were generally small in nature. Most inland kill activity occurred in the Charlotte area and resulted from waste and chemical releases into urban waterbodies. All totaled, the Charlotte area (Mecklenburg Co.) kills involved less than 3000 fish.

Coastal events followed a familiar pattern seen in late September and early October with relatively large kills of Atlantic menhaden reported from the Neuse and Tar-Pamlico estuaries and associated tributaries. These events contributed nearly all (99%) of the year's fish mortality estimate and exhibited the familiar symptoms of fish stress, lesions, and subsequent water mold (*Aphanomyces invadans*) infection.

According to DWR reports, the total statewide mortality for the year was over 659,000. WSS 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.

Fish kill information for the current year is posted weekly from June to November on the DWR fish kill website: <http://portal.ncdenr.org/web/wq/ess/fishkillsmain>. This report will also be available on the DWR website after approval.

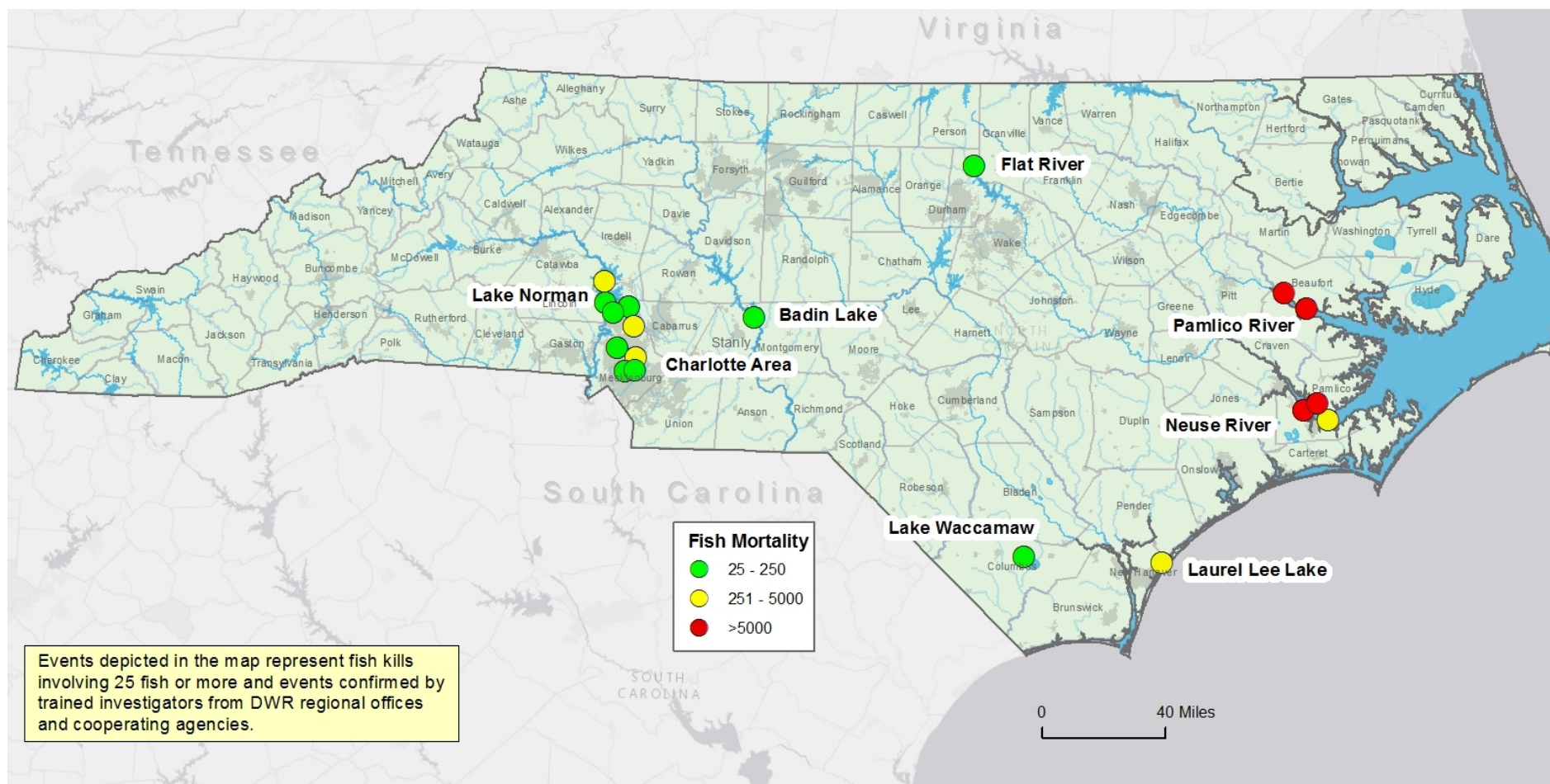
• Total Reported Events for 2014	18
• Freshwater Fish Kills	13
• Estuarine Fish Kills	5
• Ocean Kills	0
• Reported Fish Mortality for 2014	659,210
▪ <i>Estuarine Mortality</i>	<i>655,000</i>
▪ <i>Freshwater Mortality</i>	<i>4,210</i>
• River Basins with Kill Activity	6 (of 17)
• Counties with Kill Activity	9

Introduction

The reporting of fish kill activity across North Carolina is based on protocols established by the North Carolina Division of Water Resources (DWR, formerly Division of Water Quality) in 1996. The protocols were developed with assistance from DWR 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 DWR's Water Sciences Section (WSS) where the data are compiled and reviewed. Fish kill investigation forms, laboratory test results, and supplemental information regarding fish kill events are sent to the WSS and entered into a central database where the information can be managed 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 fish kill events.

This document is a summary of fish kill events reported to the DWR from January to October, 2014. The report is mandated under NC General Statutes §143B-279.7 (c).

Figure 1 : Fish kill events and observed mortality reported to NCDWR during 2014



Reports by Basin

Investigators reported fish kill events in six of the state's major river basins during the 2014 season (Figure 1). Reports of kill activity in coastal waters were received from the Tar/Pamlico and Neuse River estuaries. Reported activity in other river basins across the state was sporadic with most events occurring in the Catawba and Yadkin basins around the Charlotte area. Reported events for all basins in 2014 totaled 18, among the lower figures observed in the last decade (Figure 2).

2014 Fish Mortality

The 2014 season yielded a reported mortality total of over 650,000 fish. Nearly all of the year's mortality (99%) was composed of Atlantic menhaden observed in the Neuse and Tar-Pamlico estuaries during late September and October. Fish mortality reports during 2014 follow similar patterns observed in past years where relatively small events occur inland throughout the summer, followed by large coastal menhaden kills occurring late in the season that comprise the majority of the year's mortality figure.

Figure 2: Reported annual fish kill events, 2004 to 2014

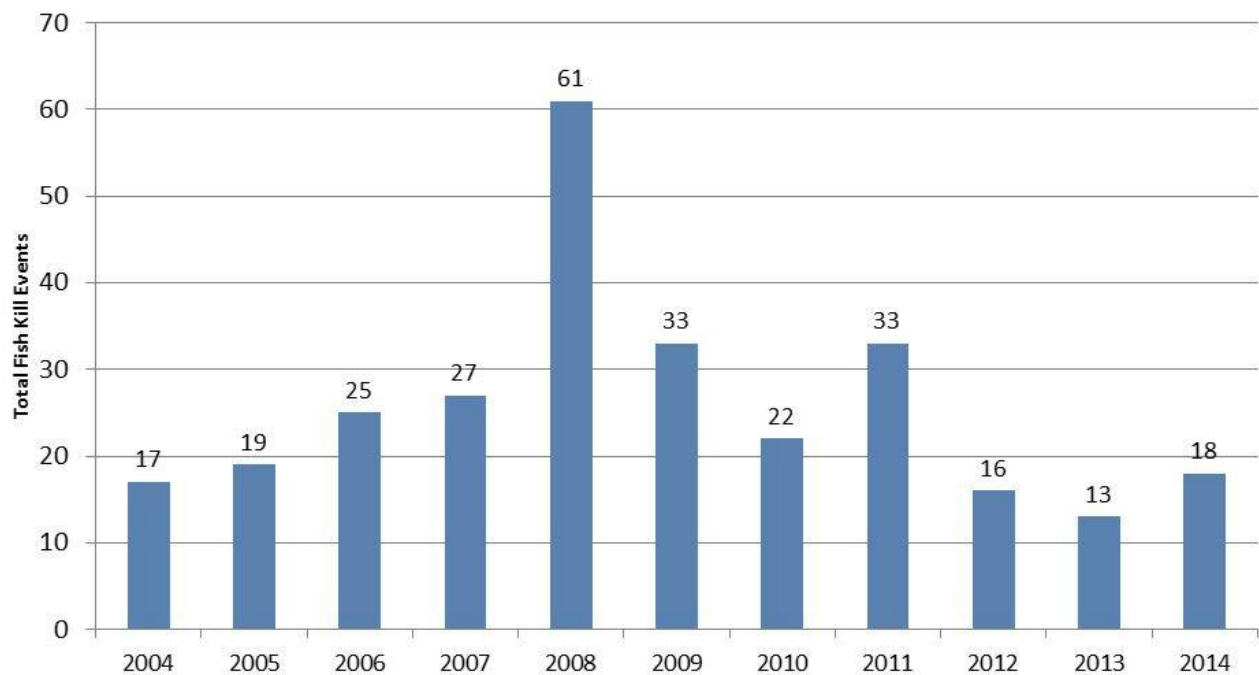
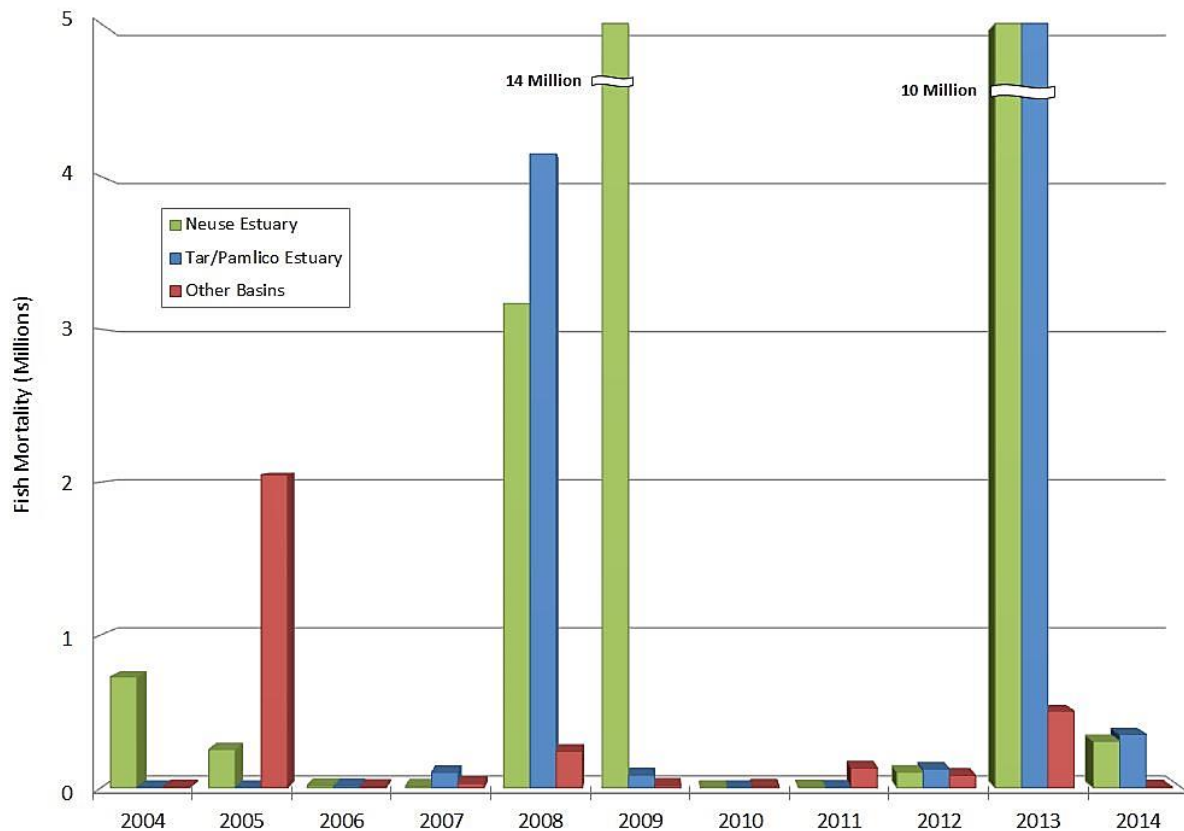


Figure 3: Reported annual mortality for fish kill events, 2004 to 2014



Fish Species Reported

Fish kill events in 2014 involved at least 16 species of fish both freshwater and estuarine. (Table 1). Freshwater species most frequently observed included largemouth bass and sunfishes. Atlantic menhaden were observed as the principle species of extended kills on both the Neuse and Tar-Pamlico estuaries during September and October, 2014. Menhaden have historically been the principal species in coastal North Carolina fish kills and often comprised the majority of the annual finfish mortality. Menhaden seem to be particularly sensitive to fluctuating estuarine conditions. The fall season marks the end of the period that young fish mature in the rivers and begin to migrate to the sea. Fish that have not migrated by late September and October may be less hardy and may be more susceptible to changes in water temperature or oxygen levels, invasive pathogens and other stress factors.

Table 1: Finfish species involved in 2014 fish kill events in order of report frequency

SUNFISH
LARGEMOUTH BASS
ATLANTIC MENHADEN
BULLHEAD CATFISH
WHITE SUCKER
STRIPED BASS
SHAD
CARP
MINNOW SPECIES
BLUE CATFISH
BLUEGILL SUNFISH
FLOUNDER
GREEN SUNFISH
SPECKLED TROUT
SPOTTED BASS
LONGNOSE GAR

Harmful Algal Blooms and Lesions Associated With Fish Kills

Algal samples were collected by investigators in conjunction with a number of fish kill events during 2014. Results indicated all algal species identified by DWR staff were typical for local estuarine and freshwaters during the summer season and none were cited as a major factor in any kill events. A number of algal species identified in North Carolina waters have the potential to produce toxins capable of harming aquatic life. None of these toxins were identified, isolated or cited as a cause for fish kill events in North Carolina during 2014.

Lesions were reported on Atlantic menhaden involved in kills on the Neuse and Tar-Pamlico estuaries during the late Summer and Fall. These injuries have been observed in conjunction with menhaden kills and have been documented frequently throughout North Carolina's fish kill record. Work by numerous investigators beginning in the 1980s has shown the majority of lesions in fish collected from North Carolina estuaries were due to infection from the species of water mold, *Aphanomyces invadans*. This conclusion has been confirmed since 2006 using a species-specific molecular assay developed by Vandersea et al. (2006).

2014 Summary

Freshwaters:

Kill activity reported from inland North Carolina waterbodies was sporadic and small in scale during the 2014 season - a pattern observed during the previous two years. Most inland events were clustered around the Charlotte area and were mainly the result of chemical or sewage releases to urban streams and ponds.

Badin Lake (Montgomery Co.) and Lake Norman (Lincoln Co.) experienced periods of stratification and low dissolved oxygen that resulted in small kills of striped bass, catfish and shad. Historical reports describe similar events in reservoirs across North Carolina. High summer temperatures deplete oxygen in the middle and lower levels of the waterbodies, trapping bass and other species that appear to be feeding or seeking refuge. The Badin and Norman events remained small in scale with each involving 200 fish or less. Lake Norman also experienced a small kill of largemouth bass related to stress incurred on the fish after a catch and release bass tournament (see Appendix 1).

Coastal Events:

The majority (99%) of the reported fish mortality for 2014 occurred within the Neuse and Tar-Pamlico estuaries beginning in September as a result of five relatively large events. All coastal kills involved Atlantic menhaden that displayed red sores/lesions in most instances. Lesions have been observed in similar historical events and were documented as Ulcerative Mycosis caused by the water mold *Aphanomyces invadans*. This species of fungus tends to reproduce more frequently as falling temperatures begin to cool river temperatures. It is ubiquitous in fresher waters worldwide and has been documented as a significant factor in North Carolina coastal fish kills.

The lower Neuse, as well as the lower Pamlico estuary, have historically experienced adverse environmental conditions such as low dissolved oxygen, high water temperatures, and fluctuating salinities. Consequently, these areas often produce some of the more severe kills events reported annually.

More information regarding DWR fish kill reporting as well as updates for events occurring during the remainder of the year can be found at the DWR website:

<http://portal.ncdenr.org/web/wq/ess/fishkillsmain>

Appendix 1: 2014 Fish Kill Summaries
Listed by County

Total 2014 Fish Kills: 18

Total 2014 Fish Mortality: 659,210

2014 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
Beaufort					
10/9/2014	WA14004	Pamlico River	near Bath and Goose Creeks	100,000	DWR Estuarine Monitoring Team staff recorded phone calls related to dead menhaden, catfish, and crabs on Pungo Creek, Bath Creek, Goose Creek, and the Pamlico River nears Mauls Point during the week of October 6th-10th, 2014. These creeks are located on the north side of the Pamlico River. Over 100,000 dead and dying fish- mainly menhaden (4-7 in) were estimated along the Pamlico River and the adjacent tributaries mentioned. All menhaden exhibited red sores along the dorsal, pectoral, and anal regions and were in various stages of decay. Staff also observed fish actively dying. Physical parameters recorded on October 8th during routine ambient monitoring indicated stratified hypoxic bottom waters and bloom-like conditions within the surface waters. Surface water temperatures are cooling down, which typically promotes the growth of the slime mold, Aphanomyces invadans. This mold can create secondary stress on migrating fish during the fall months and may have been a contributing factor in the observed fish kills.
10/15/2014	WA14005	Jacks Creek	Washington	250,000	DWR Estuarine Monitoring staff were contacted originally for a foam complaint on Jack's Creek. This tributary of the Pamlico River drains a large portion of the City of Washington's stormwater. It reaches the Pamlico River just downstream of the City. Staff observed dead menhaden fish being actively blown across the surface from the Pamlico River upstream towards the mouth of Jack's Creek. Foam build up was observed along the surface of Jack's Creek throughout the week as the south easterly winds were consistent and strong. Ambient physical data recorded dissolved oxygen levels from 6 - 8 mg/L. Salinities ranged from 1 - 3.3 ppt. All decaying fish exhibited red sores. The sores were suspected as being the result of infection from the slime mold Aphanomyces invadans. EMT staff estimated the Pamlico River fish kill to be approximately 250,000. No samples were collected as there was no indication of an active algal bloom.
Total Kills for County: 2 Total Mortality for County: 350,000					
Catawba					
9/15/2014	MO14008	Lake Norman	Marshall Steam StationN	500	An estimated 300-500 dead shad (mostly threadfin) were collected on Marshall Steam Station's (MSS) intake screens during the week of 9/15-9/17. There were also 10 dead catfish, 5 striped bass, and 1 carp. No unusual conditions/operations at MSS appeared to contribute to the mortalities. The deeper water at MSS's submerged intake wall was hypoxic at the time of the investigation. As seen in prior years, it is possible that the fish succumbed to the hypoxic conditions and were drawn via flow to MSS.
Total Kills for County: 1 Total Mortality for County: 500					

2014 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
Columbus					
2/27/2014	WL14002	Lake Waccamaw		150	The fish kill involved shad that appeared dead for 2-3 days so actual number of dead fish uncertain. Prevailing winds blew scattered fish along ~4 miles of shoreline. No fish were observed in the main body of the lake. Investigators saw a few fish struggling near the dam. North Carolina usually experiences one or two kills involving shad every year during the winter (winter kill). Waccamaw is a relatively shallow waterbody making shad populations susceptible to cold temperatures.
Total Kills for County: 1 Total Mortality for County: 150					
Craven					
9/1/2014	WA14001	Neuse River	Flanners Beach, Carolina Pines	100,000	DWR Estuarine Monitoring staff recorded anoxic conditions below the area photic zone for several weeks prior to this report. Staff received reports about dead menhaden (200-500 mm) from Flanner's Beach towards Carolina Pines and also in Slocum Creek near Havelock during the first week of September. Travis Graves, Neuse Riverkeeper indicated mortality counts could be in the six digits if the event continued over the following week. Water quality data indicated similar conclusions regarding hypoxic conditions. Analysis of algal samples did not find any toxin producing species during the event timeframe.
9/11/2014	WA14002	Neuse River	Cherry Branch Ferry Terminal	5,000	Staff investigated a fish kill complaint within the cherry branch ferry terminal mid morning. Only a few remaining decaying fish were observed in the terminal area. A majority of which were most likely picked off by birds. Ferry staff observed struggling (gulping air from the surface) activity within the past 72 hours. Dead and dying fish species included all sizes of flounder, striped bass, trout, mullet, and menhaden. It was noted that staff only saw this kill localized within the terminal area. Physical data within the terminal area indicated high salinity levels (near 11 parts per thousand). Oxygen levels were recorded to be less than 2 mg/L at 2 meters from the surface. Upstream reference sites indicated slightly lower salinity levels. Oxygen levels remained low near Carolina Pines and Flanner's Beach area at 2 meters from the surface. No dead fish were observed within that area during this investigation. Investigators also observed the impacts of recent fresh pulses of stormwater entering the system near New Bern within the watershed. These pulses may have affected dissolved oxygen levels and created localized hypoxic areas. No samples were collected, as there was no indication of algal bloom activity at the time.
10/9/2014	WA14003	Neuse River	near Beard Creek	200,000	DWR EMT staff investigated a fishkill on Beards Creek October 9th, 2014. The creek is located on the north side of the Neuse River. Over 200,000 dead and dying menhaden (4-7 in) were estimated along an 8.8 square mile stretch from Beards Creek into the Neuse proper and upstream into Upper Goose Creek. All menhaden exhibited red sores along the dorsal, pectoral, and anal regions and were in various stages of decay. Staff also observed fish actively dying. Physical parameters indicated algal bloom conditions in Beard Creek. Phytoplankton samples were taken and will be sent to WSS's Laboratory Section for further analysis.
Total Kills for County: 3 Total Mortality for County: 305,000					

2014 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
Durham					
10/14/2014	RA14001	Flat River	below Lake Michie	75	Fish mortality was confined to tailrace channel below Lake Michie Dam. Multiple species and sizes of fish at various rates of decay. Smaller fish, especially catfishes, preyed upon and only skeletal structures/parts remained. Instantaneous field test of Ammonia (as Nitrogen) < 1 mg/L, Soluble Copper 3-4 mg/L. Small pockets of potential copper precipitate on and around decaying flesh. Laboratory results yielded less than 1 mg/L of ammonia, and 0.26 mg/L of copper.
Total Kills for County: 1 Total Mortality for County: 75					
Lincoln					
8/4/2014	MO14007	Lake Norman	near Govenors Island, Markers 6&7	60	On August 4, 2014, Duke Energy-Environmental Services collected approximately 60 dead catfish on Lake Norman around markers 6 & 7 near Governor's Island. Markers 6 & 7 are approximately 3 - 4 miles up lake from Cowans Ford Dam. The fish exhibited characteristics associated with oxygen deprivation. Summer fish die-offs occur as oxygen is depleted in the middle and lower levels of lakes due to stratification. On Lake Norman, predatory fish are often trapped in deep, low oxygen water while feeding on forage fish (i.e., alewife).
Total Kills for County: 1 Total Mortality for County: 60					
Mecklenburg					
3/3/2014	MO14001	Stewart Creek	Charlotte	250	A field test for ammonia indicated a discharge between 3 and 4 mg/L still occurring from an outfall located at 4180 Pompano Road. A worker at the facility informed investigators that a contractor working on the refrigeration system on Saturday, March 1, 2014 had a discharge or spill occur of an unknown product and was adding water to it. The discharge occurred into an area that is always saturated due to the condensate discharge from rooftop chillers and leads directly to a storm drain pipe. When the rain event occurred on Monday, March 3 the illicit discharge was pushed into the tributary, the same day that the kill occurred.
5/30/2014	MO14002	Briar Creek	Charlotte	1,400	The creek was extremely hypoxic and was caused by a Charlotte-Mecklenburg Utilities (CMU) sanitary sewer overflow into Briar Creek that was quickly identified.
6/26/2014	MO14003	Private Pond	River Run Golf Course	40	Fish kill located on River Run Golf Course after Solitude Lake Management sprayed Captain XTR (an algaecide) on 1/3 of the lake at the lowest recommended concentration. Spraying occurred on Monday, June 23 and the fish kill occurred on Wednesday, June 25. Contractor contacted NCDENR per requirements of permit. The shallow pond did not allow a refuge for fish and high temperatures mixed with the loss of respiration from the dying algae created hypoxic conditions.
8/27/2014	MO14004	Briar Creek	Edwards Branch	100	Two personnel from Mecklenburg County's Water Quality Program (MCWQP) observed a fish kill In Briar Creek and tracked it 3.3 miles to an outfall that was discharging sewage. The personnel contacted Charlotte-Mecklenburg Utilities (CMU) immediately and they quickly responded. CMU employees retrieved the dead fish from the creek near the outfall, but did not cover the entire 3.3 mile reach of affected water. A total of 96 redbreast sunfish were identified.

2014 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
9/2/2014	MO14005	McCullen Creek	near Charlotte	125	Personnel from Mecklenburg County's Water Quality Program (MCWQP) responded to a citizen call about the smell of sewage and a gray creek. MCWQP staff tracked the sewage discharge to a manhole parallel to McMullen Creek in Sharon Memorial Park. Charlotte-Mecklenburg Utilities were notified and personnel promptly arrived and removed the blockage. No water quality parameters in McMullen Creek were obtained at the time of the spill.
9/4/2014	MO14006	Dream Lake	Charlotte	700	Results of an algae analyses done in-house by MCWQP showed an estimated algal density of 26,000 units/ml. The phytoplankton density was dominated by small cells of green algae (83.8%) followed by diatoms (14.4%), blue-greens (1.3%) and Euglenophytes (0.5%). The diatoms consisted mainly of a fairly large centric taxa (Cyclotella spp.) which may have dominated the phytoplankton biovolume. A combination of late summer time water temperatures, recent rainfall, and a large algal bloom likely contributed to this fish kill event. No evidence of other pollutants was observed.
10/7/2014	MO14009	Lake Norman	Near Cornelius	160	Mecklenburg County Water Quality Program (MCWQP) responded to a citizen request for dead bass in Lake Norman at 16800 Lake Shore Drive in Cornelius. MCWQP surveyed 2.5 miles of shoreline in the area and collected 166 bass. All bass collected were >14" and no other species were observed dead. MCWQP contacted NCWRC, NCDENR, and B.A.S.S. (officials for a tournament that was held the weekend prior to the tournament) to inform them of the fish kill. BASS officials responded that given the timing and location of the dead fish there is little doubt that the kill was related to the tournament, however, they could not point to a particular breach in protocol, inadequate equipment, or any other controllable action on the part of tournament staff and participants that could cause the fish mortality. Reports documented a mortality figure of 166 which is 9.8% of the total number of bass weighed in the tournament.

Total Kills for County: 7 Total Mortality for County: 2,775

Montgomery

7/3/2014	FA14001	Badin Lake	near Dam	150	Kill is similar to kills that have occurred in previous years. Striped Bass tend to congregate in the lower end of the reservoir by mid-summer and some of these fish become trapped in an area with decreasing dissolved oxygen and ultimately perish. These kills almost always occur during the first half of July and typically last about one week.
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Total Kills for County: 1 Total Mortality for County: 150

New Hanover

6/30/2014	WL14001	Laurel Lee Lake	near Wilmington	500	Water Quality measurements were taken on 06/30/2014 and elevated DO and pH were observed. Investigators suspected an algal bloom played a role.
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Total Kills for County: 1 Total Mortality for County: 500

Appendix 2 : Reported Fish Kill Events Summarized By Basin

Annual Fish Kill Totals By Basin 1996-2014*

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
2010	None	7	5	1	1	2	None	1	None	1	2	1	1	22
2011	None	5	5	2	None	8	1	3	2	4	None	None	3	33
2012	None	2	3	None	None	2	None	None	None	7	None	1	1	16
2013	None	2	1	None	1	4	1	None	1	2	None	None	1	13
2014	None	None	7	None	None	4	1	None	None	2	None	1	3	18
Basin Total	3	140	41	21	15	233	23	42	13	129	5	23	51	739

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

Fish Kill Totals By Basin 1996-2014*

