North Carolina Department of Environment and Natural Resources

MEMORANDUM

TO: ENVIRONMENTAL REVIEW COMMISSION
The Honorable Mike Hager
The Honorable Ruth Samuelson
The Honorable Brent Jackson

FROM: J. Neal Robbins
Director of Legislative and Intergovernmental Affairs

SUBJECT: 2013 Fishkill Annual Report

DATE: December 1, 2013

Attached for your information is the Department of Environment and Natural Resources report on fish kills. This report is provided to you pursuant to G.S. 143B-279.7 (c) which states: "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." The attached study report is submitted to fulfill this requirement.

If you have any questions or need additional information, please contact me by phone at 919.707.8618 or via e-mail at neal.robbins@ncdenr.gov.

cc: Mitch Gillespie, Assistant Secretary for Environment, NCDENR
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North Carolina Division of Water Resources
Annual Report of Fish Kill Events
2013

Fish kill behind Masonboro Island, January, 2013.

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

October 2013

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2013 Fish Kill Summary

As of October, 2013, investigators have reported 13 fish kill events statewide for the 2013 season (Figure 1). Kill activity was documented during the year in eight of the state's 17 major river basins. Kill events were reported in coastal waters as well as inland westward to Henderson County.

Fish kills reported from inland waters were sporadic and small in nature. A number of events were reported from small private ponds and involved 200 fish or less. The most notable inland kill events were reported from Lake Twitty (Union County) and Leith Creek (Scotland Co.) and affected 500 fish or less.

Coastal fish kills followed a pattern seen in 2012 with extended kills of Atlantic menhaden reported from the Neuse and Tar-Pamlico estuaries and associated tributaries in late September and early October. These events comprised a vast majority of the 2013 mortality estimate and exhibited the familiar symptoms of fish stress, lesions, and subsequent water mold (*Aphanomyces invadans)* infection.

According to DWR investigations, the total statewide mortality for the year was over 20.6 million fish. It should be noted that the totals for the year's larger coastal events are grossly underestimated due to the extensive geographic areas and resource limitations of field staff charged with formally documenting the scope of the kill. Reported mortality totals for individual events in 2013 ranged from 75 to over 10 million.

DWR's Environmental Science Section (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.

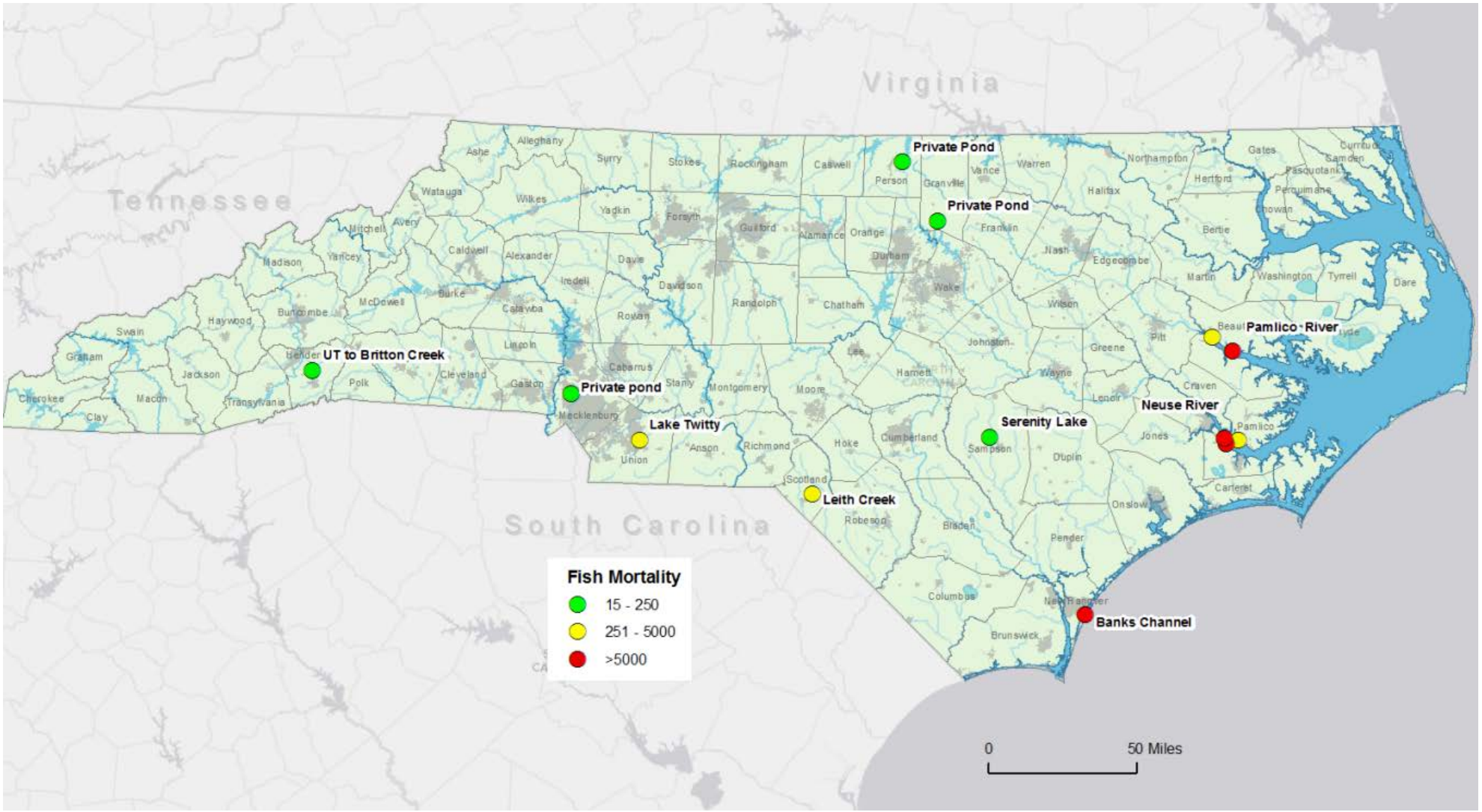
Fish kill information for the current year is posted weekly from June to November on the DWR fish kill website: **http://portal.ncdenr.org/web/wq/ess/fishkillsmain**. This report will also be available on the ESS website after approval.

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 Environmental Sciences Section (ESS) 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 ESS 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, 2013. The report is mandated under NC General Statutes §143B-279.7 (c).

Figure 1 : Fish kill events and observed mortality reported to NCDWR during 2013



Basin Activity

Investigators reported fish kill events in eight of the state's major river basins during the 2013 season (Figure 1, Table 1). Reports of kill activity in coastal waters were received from the Pamlico and Neuse River estuaries as well as the Cape Fear River basin near Wilmington. The estuaries have historically experienced adverse environmental conditions during warm months such as stratification, low dissolved oxygen, and high water temperatures that act as major factors in fish kill activity. Reported activity in other river basins across the state was sporadic or absent, and involved 500 or fewer fish. Total reported events for all basins numbered 13 and was among the lowest since 1996.

Table 1: Fish kill events by basin, 1996 – 2013*

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

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**
Total	**3**	**140**	**34**	**21**	**15**	**229**	**22**	**42**	**13**	**127**	**5**	**22**	**48**	**721**

Fish Mortality

Conversely, the 2013 season yielded a reported mortality total of over 20.6 million individuals. This estimate represents the largest total in the last ten years (Figure 3). Nearly all of the year's mortality was composed of Atlantic menhaden observed in the Neuse and Tar-Pamlico estuaries during late September and early October, 2013. Furthermore, information from investigators and calls from citizens suggest the total mortality reported for the estuarine events represents a significant underestimation of the numbers of fish that actually perished during the time period. As these events were protracted and widespread, DWR investigators could not verify the mortality total in many areas. Fish mortality during 2013 follows similar patterns observed in past years where relatively small events occur inland throughout the bulk of the season, followed by

large coastal menhaden kills occurring late in the season that comprise the majority of the year's mortality figures.

Figure 2: Reported annual fish kill events, 2003 to 2013

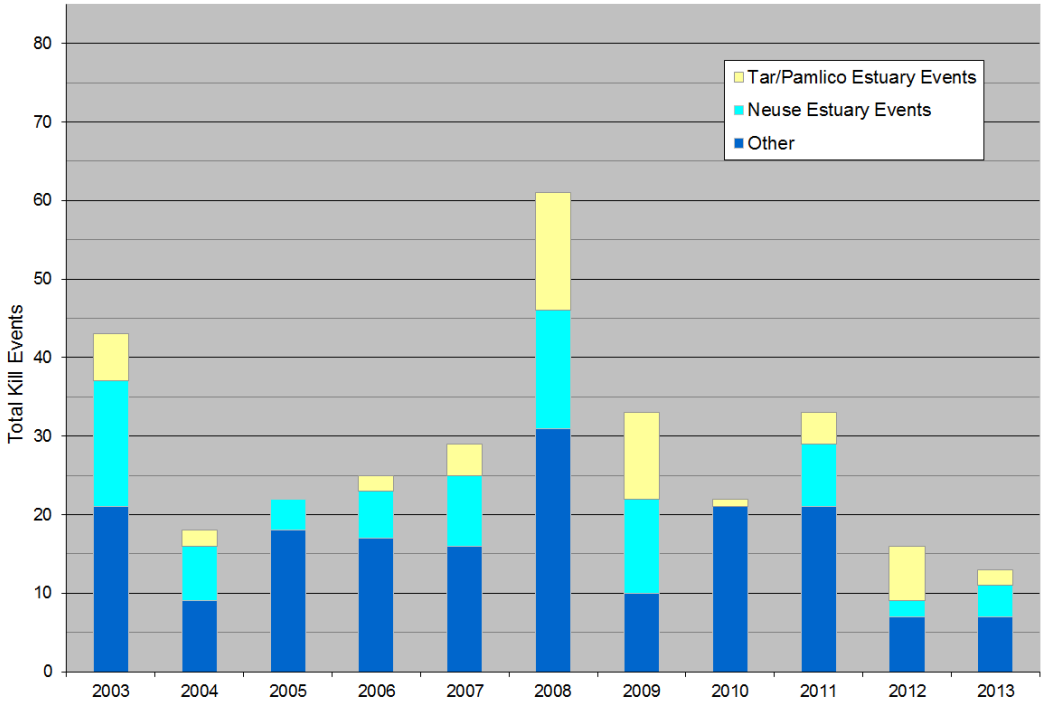


Figure 3: Reported annual fish kill mortality, 2003 to 2013

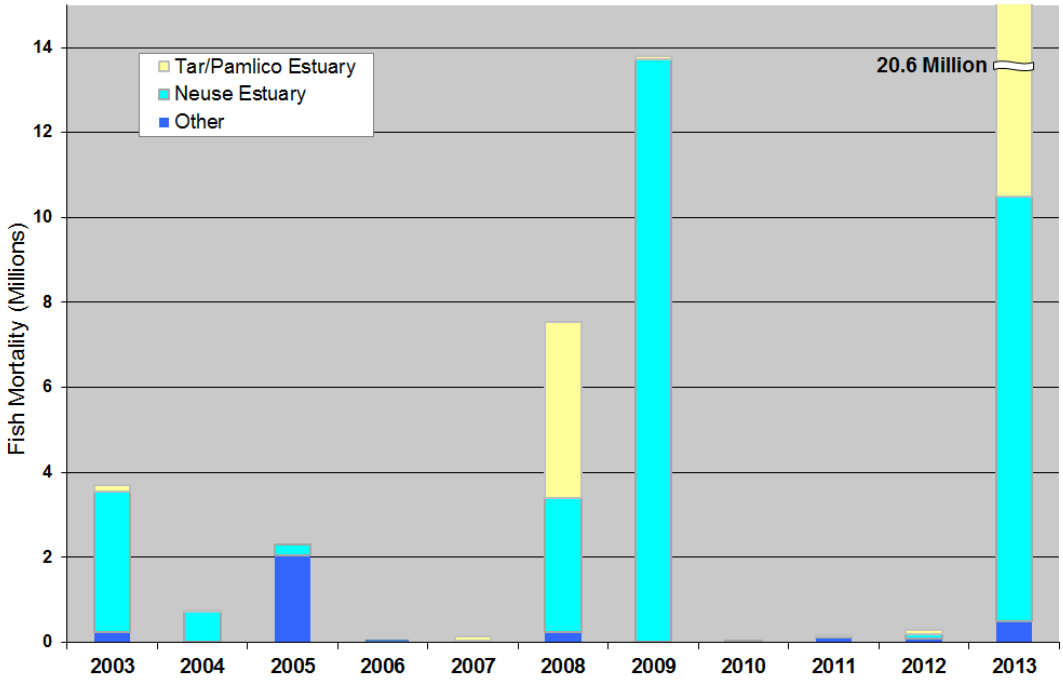


Table 2: Finfish species and observed frequencies reported for 2013 fish kill events

Species	Number of events	Waterbody Type
ATLANTIC MENHADEN	6	Estuary
CARP	1	Fresh
CROAKER	2	Estuary
LARGEMOUTH BASS	4	Fresh
PINFISH	1	Estuary
RIVER CHUB	1	Fresh
SCULPIN	1	Fresh
SHAD	2	Fresh
STONEROLLER	1	Fresh
SUNFISH	5	Fresh

Fish Species Reported

Fish kill events in 2013 involved at least 10 species of fish both freshwater and estuarine. (Table 2). 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, 2013. Menhaden have historically been the principal species in coastal North Carolina fish kills and have often comprised the majority of the annual finfish mortality.

Harmful Algal Blooms Associated With Fish Kills

Algal samples were collected by investigators in conjunction with three fish kill events during 2013. Results indicated all algal species identified by DWR staff were typical for local estuarine and fresh waters 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 2013. Lesions were reported on fish involved in kills on the Neuse and Tar-Pamlico estuaries, and fish samples were collected for submittal to experts from the NOAA marine lab in Beaufort. Unfortunately these samples could not be examined at the time of this report due to scheduling difficulties attributed to the federal government shutdown during October. Historically, experts at the NOAA lab have attributed lesion injuries to the water mold *Aphanomyces invadans.* Work by numerous investigators beginning in the 1980s has shown the majority of lesions in fish collected from North Carolina estuaries were due to *Aphanomyces invadans*. This conclusion has been confirmed since 2006 using a species-specific molecular assay developed by Vandersea et al. (2006).

2013 Summary

Freshwaters:

Kill activity reported from inland waterbodies was light and small in scale during the 2013 season. All inland events involved relatively small waterbodies and private ponds. The only notable events were reported from Lake Twitty (Union County) and Leith Creek (Scotland County) involving 500 and 300 fish respectively (See Appendix). Lake Twitty was the site of a multispecies fish kill in July 2012. The lake is located in an urban area and suffers from frequent algal blooms and effects from stormwater runoff.

Coastal Events:

The vast majority of the reported fish mortality for 2013 occurred within the Neuse and Tar-Pamlico estuaries beginning in late September and October. The lower Neuse, as well as the lower Pamlico estuary, have historically experienced adverse environmental conditions for fish populations such as low dissolved oxygen, high water temperatures, and fluctuating salinities. Consequently, these areas often produce some of the more severe kill events reported annually

The DWR Estuarine Monitoring Team responded to multiple fish kill calls from citizens and observed dead and dying menhaden from New Bern downstream to Slocum Creek in late September and October. The kills extended across the Neuse river in some areas, particularly in the Flanner's Beach and James City areas. Most of the menhaden observed (99%) had red sores/lesions. Lesions were observed in similar historical events and were documented as Ulcerative Mycosis caused by a slime mold *Aphanomyces invadens*. This species of fungus tends to reproduce more frequently as falling ambient 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 2013 Neuse events were protracted and widespread and thus difficult to enumerate. Best estimates put a total fish mortality at well over 10 million.

Similar conditions were also observed along the Pamlico River estuary and tributaries during the months of September and October. The Estuarine Monitoring Team received multiple phone calls regarding dead and dying menhaden among Chocowinity Bay, Blounts Creek, Blounts Bay, and the Pamlico proper downstream to the Pamlico Point area. The menhaden displayed similar lesion prevalence and the events were large and protracted.

A relatively large kill of Atlantic menhaden was also documented in Banks Channel, near Wilmington during January, 2013. Monitoring data suggested the menhaden appeared to fall victim to a sudden drop in dissolved oxygen levels, perhaps as a result of the school overcrowding. Lesions or injuries were not observed on the victims.

As of October 21, 2013, the events observed in the Neuse and Tar Pamlico waters are still considered to be ongoing. 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: 2013 Fish Kill Summaries
Listed by County

Total 2013 Fish Kills: 13

Total 2013 Fish Mortality: 20,608,452

2013 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
Beaufort					
9/30/2013	WA13002	Pamlico River	Washington Park	2,500	Minor fish kill in Washington Park over the weekend. 3-5 inch Menhaden DWR staff estimated around 2500 fish. All Menhaden had Ulcerative Mycosis (UM) lesions. Decay rates indicate around 24-36 hours old. Bloom samples taken even though physical data did not indicate active bloom. Most likely UM lesions weakened this small school of fish and high wind conditions over the weekend could have up-welled bad bottom water. The sample indicated a bloom of small round diatoms. The algal sample composition was typical for fall in local estuarine waters. Total algal sample density was 28,000 units/ml.
10/2/2013	WA13005	Pamlico River	Washington Park, Blounts Creek	10,000,000	The DWR EMT received multiple phone calls regarding dead and dying menhaden among Chocowinity Bay, Blounts Creek, Blounts Bay, and the Pamlico proper downstream to the Pamlico Point area. Three to five inch Menhaden were observed to be from several days old to recently dying and lethargic. Most of the menhaden observed (99%) had red sores/lesions. This has been observed in the past (almost exactly a year previous to date) and have been documented as Ulcerative Mycosis caused by a slime mold Aphanomyces invadens. Given the large extent of the kill, and the likelihood that it will continue to occur as water temperatures cool, it was difficult to enumerate the event. A best educated estimate would put mortality numbers into the tens of millions. **UDPATE** 10/09/2013 Recent cloudy and rainy weather may decrease the impact of oscillating DO from algal blooms. However, the slime mold may continue to cause secondary mortalities. Algal bloom reports indicate a mixture of raphidophyte algae (Chattonella and Heterosigma) were also present. Total algal sample density was 23,000 units/ml. Chattonella and Heterosigma are reported in the academic literature as capable of producing toxins, but there have been no known reports of health effects associated with them in North Carolina. Algal community composition was typical for fall in local estuarine waters.
					Total Kills for County: 2 **Total Mortality for County: 10,002,500**

2013 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
Craven					
8/14/2013	WA13001	Neuse River	Flanners Beach	100,000	EMT staff investigated a fish kill on Tuesday August 13th, at Flanner's Beach located on the south side of the Neuse River in New Bern. Staff was notified of this fish kill Monday. Observations indicated dead decaying menhaden and croaker along the shoreline near Flanner's Beach and extended towards Carolina Pines. Prior investigators indicated this kill extended downstream to Slocum Creek near Havelock area. Monday evening's weather included heavy rainfall, washing away most of the kill. Therefore a proper count could not be ascertained. Some Menhaden and Croaker were observed. Fish lengths varied from 100 mm to 600 mm with most of the larger sized fish being Menhaden. An overview of the historical weekend weather indicated calm, hot sunny days. It is possible that algal blooms were occuring during the weekend as water temps were near 33 degrees by 11:00 a.m. this week. Dissolved oxygen was near 9 mg/L and pH was near 8.0. Salinties were well over 23 ppt. Nightime die-off of these blooms and subsequent lack of DO, coupled with storm/wind activities could have contributed to this localized fish kill. Water quality samples were collected at the Flanner's Beach area and sent to The Division of Water Resources Laboratory in Raleigh for further investigation.
10/2/2013	WA13004	Neuse River	New Bern, Fishers Landing,	10,000,000	The DWR EMT responded to several fish kill calls from citizens residing from James city and Carolina Pines. EMT staff observed dead and dying menhaden near Union Point Park in New Bern all the way downstream to where the River meets the mouth of Slocum Creek. The kill extend across the river in some areas (particularly Flanner's Beach area and James City area), with densities of fish varying as the northerly winds push to the southern shore. Three to five inch Menhaden were observed to be from several days old to recently dying and lethargic. Most of the menhaden observed (99%) had red sores/lesions. This has been observed in the past (almost exactly a year previous to date) and was documented as Ulcerative Mycosis caused by a slime mold Aphanomyces invadens. Physical data recorded indicated algal bloom activity beginning mid morning. DO values ranged from 5.4 to 8.5 mg/L. Salinities were from 3 to 12 ppt. Algal bloom samples were collected and sent to DWR's chemical laboratory for further analysis. Dying fish with lesions were collected and will be frozen for further analysis by NOAA's Wayne Litaker et al when possible. Given the large extent of the kill, it is difficult to enumerate this situation. A best educated estimate would put these numbers into the tens of millions. **UDPATE** 10/09/2013 EMT staff continue to receive phone calls regarding dead fish. A resident of Northwest Creek (Fairfield Harbor area) called to report dead fish all the way up to its headwaters. So it should be expected to see adjaent tributaries affected by this slime mold and developing algal blooms during the days, paired with low DO events during the evenings. Recent cloudy and rainy weather may decrease the impact of oscillating DO from algal blooms. However, the slime mold may continue to cause secondary mortalities.

2013 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
					Phytoplankton samples near James City indicated a bloom of the harmless dinoflagellate, Polykrikos and small round diatoms. Total algal sample density was 12,000 units/ml. Downstream samples near Slocum Creek indicated a bloom of small round diatoms and the harmless chain diatom, Leptocylindrus. Total algal sample density was 16,000 units/ml. Algal community composition was typical for fall in local estuarine waters.
					Total Kills for County: 2 **Total Mortality for County: 10,100,000**
Granville					
8/19/2013	RA13002	Private Pond	Creedmoor	200	Fish kill was first observed by landowner on 8/17/13. Dying fish were observed on surface gasping for air. Stream that provided source for pond showed very high conductivity (380) and little flow. Sanitary sewer line reported upstream from pond. Nutrient and fecal coliform samples collected. Results pending.
					Total Kills for County: 1 **Total Mortality for County: 200**
Henderson					
4/2/2013	AS13001	UT to Britton Creek	Hendersonville	75	City employee allowed 8 to 10 gallons of a chlorine solution to enter a storm drain in the vicinity of the kill. Investigators suspected spill amount was enough to cause the event.
					Total Kills for County: 1 **Total Mortality for County: 75**
Mecklenburg					
7/16/2013	MO13001	Private pond	NW Charlotte	127	The main contributor to the kill appeared to be an upstream construction site that had recently completed the logging phase of the grading and then sat idle for a month due to recent rainfall. Grading activity restarted and a rainfall event occurred (~4" in less than 3 hours) that collected material into the site sediment basin. The sediment basin discharged extremely hypoxic water, sediment, and organic material into the pond where the fish kill occurred. In conjunction, a broken private sewer lateral was found and contributed to low DO levels and organic material in the pond.
					Total Kills for County: 1 **Total Mortality for County: 127**
New Hanover					
1/8/2013	WL13001	Banks Channel	near Masonboro Inlet	500,000	National Estuarine Research Reserve System monitoring station showed a DO drop around the time of the kill. Investigators Speculated that the fish school moved up the creek with the rising tide, became too crowded, suffocated, and then were washed out as the tide dropped.
					Total Kills for County: 1 **Total Mortality for County: 500,000**

2013 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
Pamlico					
9/16/2013	WA13003	Neuse River	Kennel Beach	4,500	This report is based off a Neuse Riverkeeper incident report. Call received from a citizen who estimated thousands of fish affected. UNC Marine Lab recorded low dissolved oxygen levels in the area of the incident prior to occurrence. Neuse Riverkeeper visited the site and estimated between 3 and 5 thousand fish affected. She forwarded observations and photos to the DWR EMT. Cause of kill was suspected to be a result of low dissolved oxygen.
					Total Kills for County: 1 Total Mortality for County: 4,500
Person					
7/5/2013	RA13001	Private Pond	near Roxboro	150	Fish kill was observed by landowner on 6/28/13. Over 2 days he observed nearly 100 bluegill and 50 largemouth bass dead or dying in the pond. Dying fish were near surface gasping for air. He took pictures and showed them to DWR personel. Second pond that recieves drainage was not affected. Prior to fish kill Roxboro had very heavy rainfall which was concluded to cause D.O. problems leading to the fish kill.
					Total Kills for County: 1 Total Mortality for County: 150
Sampson					
4/26/2013	FA13001	Serenity Lake	near Clinton	100	The water level in the five acre pond was down approximately five feet. Approximately 100 dead brim were positioned high on shore (approximately one to two feet). Live bass were seen in the pond, and appeared to be active and unaffected. The fish kill appeared to have finished. One of the residents admitted that he had sprayed the shoreline with Round-Up where the water had receded, approximately three weeks prior to the fish kill.
					Total Kills for County: 1 Total Mortality for County: 100
Scotland					
5/1/2013	FA13002	Leith Creek	Laurinburg	300	Approximately 200 to 300 dead fish first reported to FRO in Leith Creek at a location between 1st Street and 3rd Street in East Laurinburg. City of Laurinburg Utilities checked manholes and lift stations, and found no problems. Investigators observed a storm water tributary that flowed into Leith Creek (34° 47’ 35.44 N, 79° 27’ 42.26 W, Hwy 15 bridge McColl Road). The tributary had a white cloudy appearance with a small amount of foam on the surface. Water samples collected included BOD, COD, Pesticides, Herbicides, AmmoniaNitrate plus Nitrite, Phosphorus. Cause not determined and chemistries are still pending . BIMS Incident Number 201300927.
					Total Kills for County: 1 Total Mortality for County: 300
Union					
3/4/2013	MO13002	Lake Twitty	near Monroe	500	Heavy rain reported on Feb 26 and additional heavy rains reported 7 days prior.
					Total Kills for County: 1 Total Mortality for County: 500