



North Carolina Department of Environment and Natural Resources

Beverly Eaves Perdue
Governor

Dee Freeman
Secretary

MEMORANDUM

TO: ENVIRONMENTAL REVIEW COMMISSION
The Honorable David Rouzer, Chair
The Honorable Mitch Gillespie, Co-Chair
The Honorable Ruth Samuelson, Co-Chair

FROM: Kari Barsness
Director of Legislative and Intergovernmental Affairs

SUBJECT: 2011 Fishkill Annual Report

DATE: December 1, 2011 *KKB*

Pursuant to G.S. 143B-279.7 (c) the Department of Environment and Natural Resources is to provide to the Environmental Review Commission a report on fish kills by December 1st of each year. Please consider the 2011 Fishkill Annual Report attached as the formal submission of 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 Kari.Barsness@ncdenr.gov.

cc: Assistant Secretary Robin Smith
Coleen Sullins, Director, Division of Water Quality
Kristin Walker, Fiscal Research Division
Lanier McRee, Fiscal Research Division
Claire Hester, Fiscal Research Division
Mariah Matheson, Research Division



North Carolina Division of Water Quality Annual Report of Fish Kill Events 2011

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

December 2011

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Introduction

The reporting of fish kill activity across North Carolina is based on protocols established by the N.C. Division of Water Quality (DWQ) in 1996. The protocols were developed with assistance from DWQ Regional Office staff, N.C. 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 DWQ's Environmental Sciences Section (ESS) where the data are reviewed and compiled. 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 for the current year is posted weekly from June to November on the ESS website: <http://portal.ncdenr.org/web/wq/ess/fishkillsmain>. This 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 November 2011. The report is mandated under Session Law 1995-633.

2011 Fish Kill Event Summary

As of November 1, 2011, investigators have reported 33 fish kill events statewide for 2011 (Figure 1). Kill events were documented in coastal and inland waters across the state as far west as Mecklenburg County. Kill activity was documented during the year in nine of the state's 17 major river basins and nearly all reported events were in freshwaters.

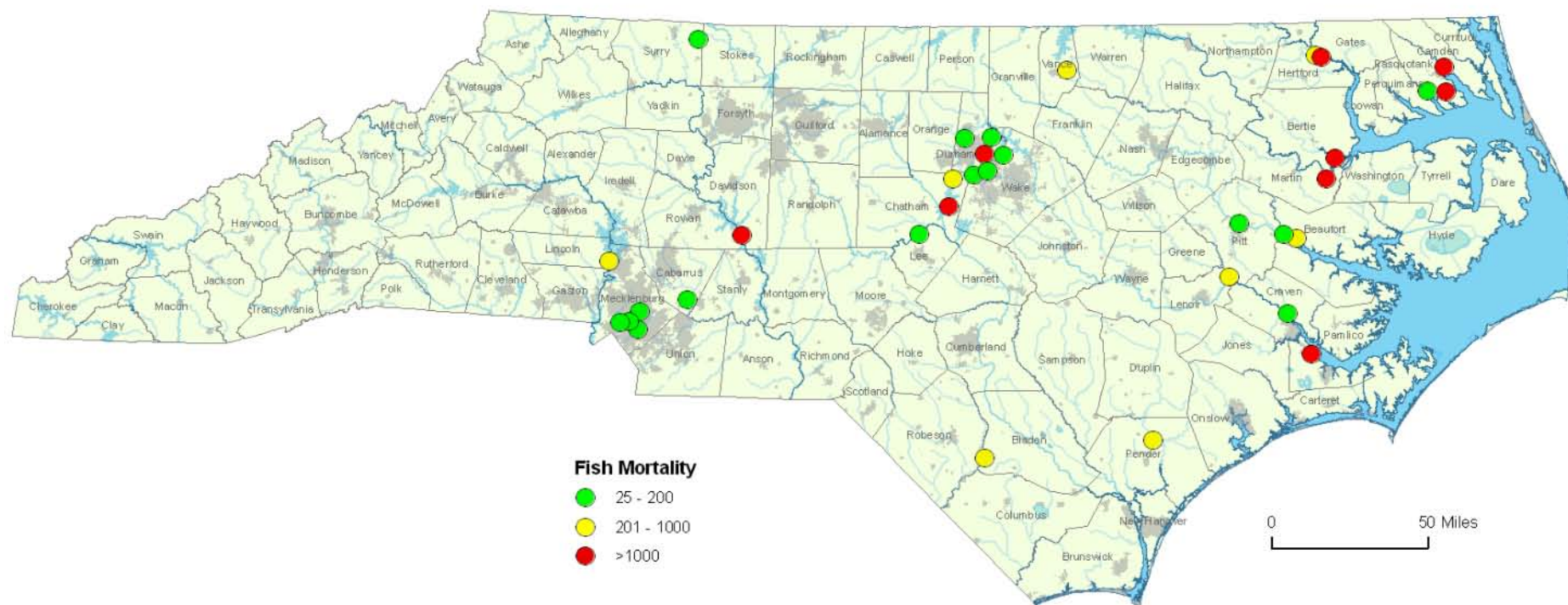
The most significant events reported in freshwaters included large kills of striped bass on Lake Jordan, Tuckertown Reservoir and Lake Norman. Investigators observed nearly 6,000 dead striped bass between the three waterbodies.

Aside from the striped bass kills, fish kill investigators reported sporadic fish mortality throughout the state prior to Hurricane Irene. As expected, an increase in fish kills and significant fish mortality was reported in the wake of the storm. According to DWQ investigations, the total statewide mortality for the year was approximately 135,000 fish. Investigators acknowledge, however, that fish mortalities in the aftermath of Irene were considerably higher than numbers documented. Mortality totals for individual events in 2011 ranged from 25 to around 50,000.

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 2011	33
• Freshwater Kills	31
• Estuarine Kills	2
• Ocean Kills	0
• Reported Fish Mortality for 2011	135,000
▪ <i>Estuarine Mortality</i>	<i>2,200</i>
▪ <i>Freshwater Mortality</i>	<i>132,800</i>
• Report Mortality Range	26 to 50,000
• River Basins with Kill Activity	9 (of 17)

**Figure 1: Fish kill events and observed mortality reported to DWQ
January 1, 2011 – November 1, 2011**



Basin Activity

Investigators reported fish kill events in nine of the state's major river basins during the 2011 season (Figure 1, Table 1). Kill activity was most frequent in the Neuse, Cape Fear and Catawba basins. Reports of significant kill activity in the coastal estuaries were virtually absent during much of the 2011 season. The estuaries have historically experienced adverse environmental conditions such as low dissolved oxygen and high water temperatures that act as major factors in fish kill activity. Such conditions did not appear to be prevalent in the estuaries during the year and reports showed most kill activity associated with coastal areas occurred after Hurricane Irene. Activity in other river basins across the state remained sporadic and relatively small scale with the exception of significant striped bass kills on Lake Jordan (Cape Fear), Tuckertown Reservoir (Yadkin) and Lake Norman (Catawba).

Table 1: Fish kill events by basin, 1996 – 2011

** 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
1996	None	21	None	2	None	14	4	10	2	3	None	3	1
1997	None	16	3	2	2	12	3	2	None	6	None	3	10
1998	None	23	1	1	3	8	5	8	1	5	None	1	2
1999	1	14	3	1	1	16	None	2	None	11	1	3	1
2000	None	12	2	None	None	23	2	None	None	14	None	3	2
2001	None	5	4	1	None	37	None	1	None	23	None	3	3
2002	None	8	1	2	1	9	None	6	None	8	None	3	8
2003	None	3	None	2	1	21	2	2	2	6	2	None	2
2004	None	1	None	1	None	8	1	None	1	2	None	None	3
2005	None	2	None	1	None	9	1	2	1	1	None	1	1
2006	1	5	2	None	None	10	2	None	2	2	None	None	1
2007	1	1	2	1	3	10	None	1	1	5	None	None	2
2008	None	10	2	2	2	21	None	4	None	16	None	None	4
2009	None	3	None	2	None	15	None	None	None	11	None	None	2
2010	None	7	5	1	1	2	None	1	None	1	2	1	1
2011	None	5	5	2	None	8	1	3	2	4	None	None	3
Total	3	136	30	21	13	223	21	42	12	118	3	21	46

Fish Mortality

The 2011 season yielded a reported mortality total of just over 135,000 individuals. The majority of the 2011 mortality was reported from coastal waters in the aftermath of Hurricane Irene. The storm was responsible for all four of the largest events totaling over 117,000 fish and 86 percent of the year's reported mortality. The largest events were located in the lower Roanoke, Chowan and Pasquotank basins and adjacent to the path of Hurricane Irene. Large events involving nearly 6,000 striped bass were also reported

from three inland reservoirs, however, most events located inland and prior to Irene involved less than 1,000 fish.

Figure 3: Reported annual fish kill events, 1997 to 2011

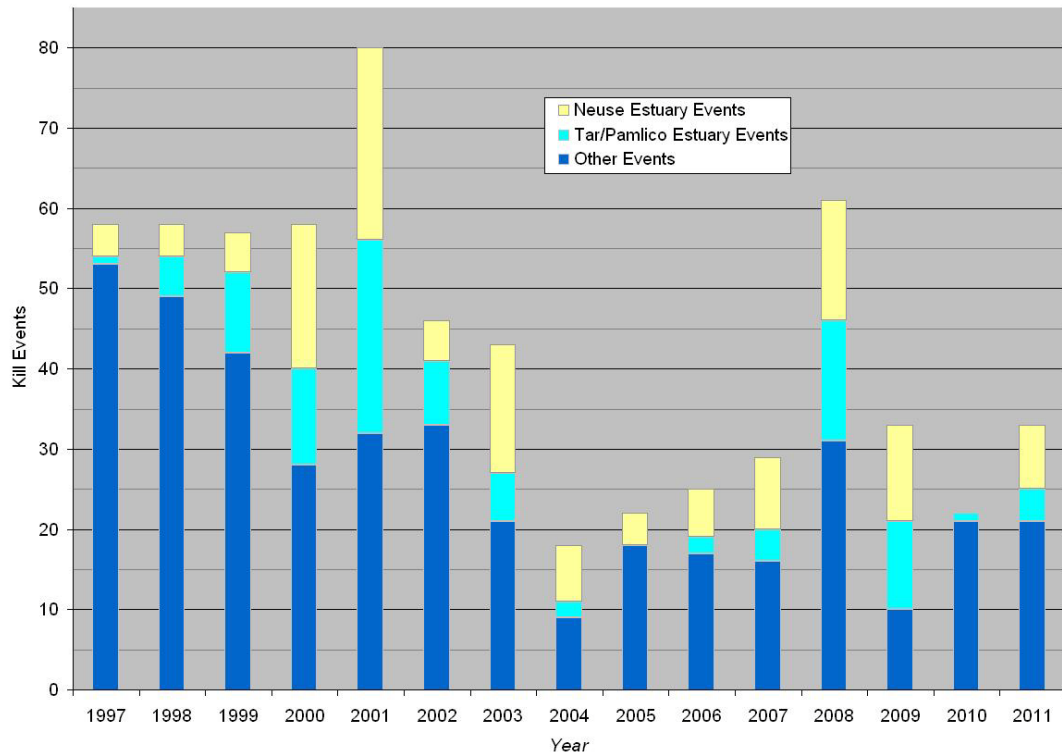
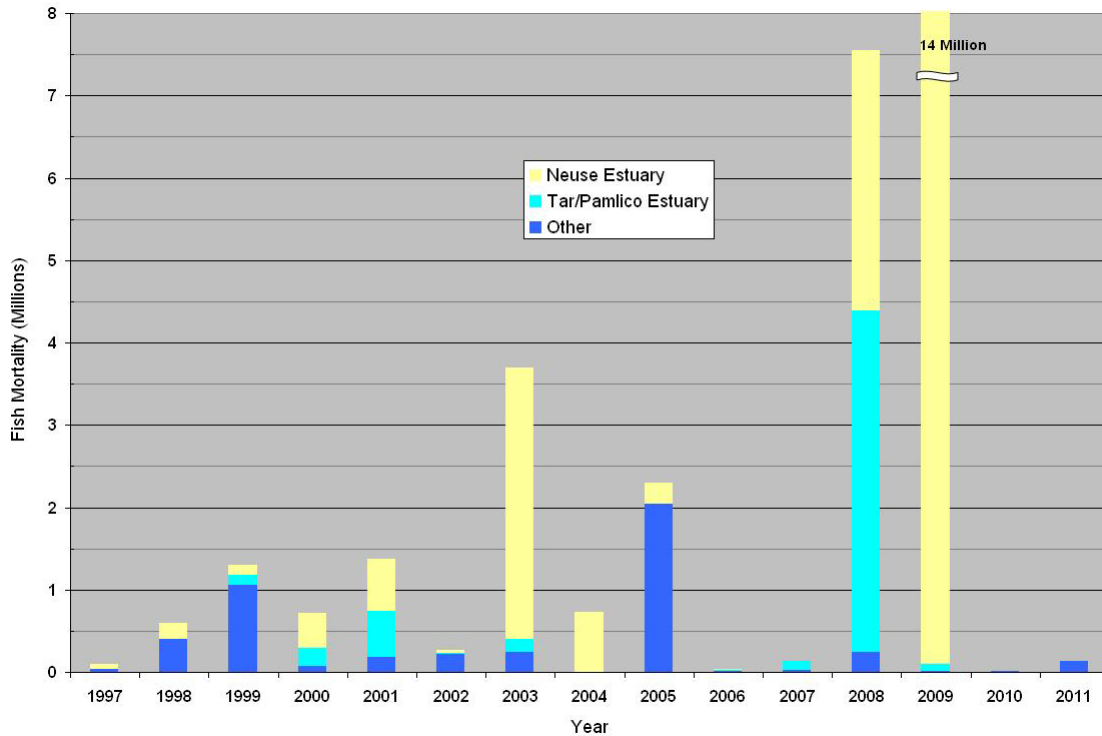


Figure 4: Reported annual fish kill mortality, 1997 to 2011



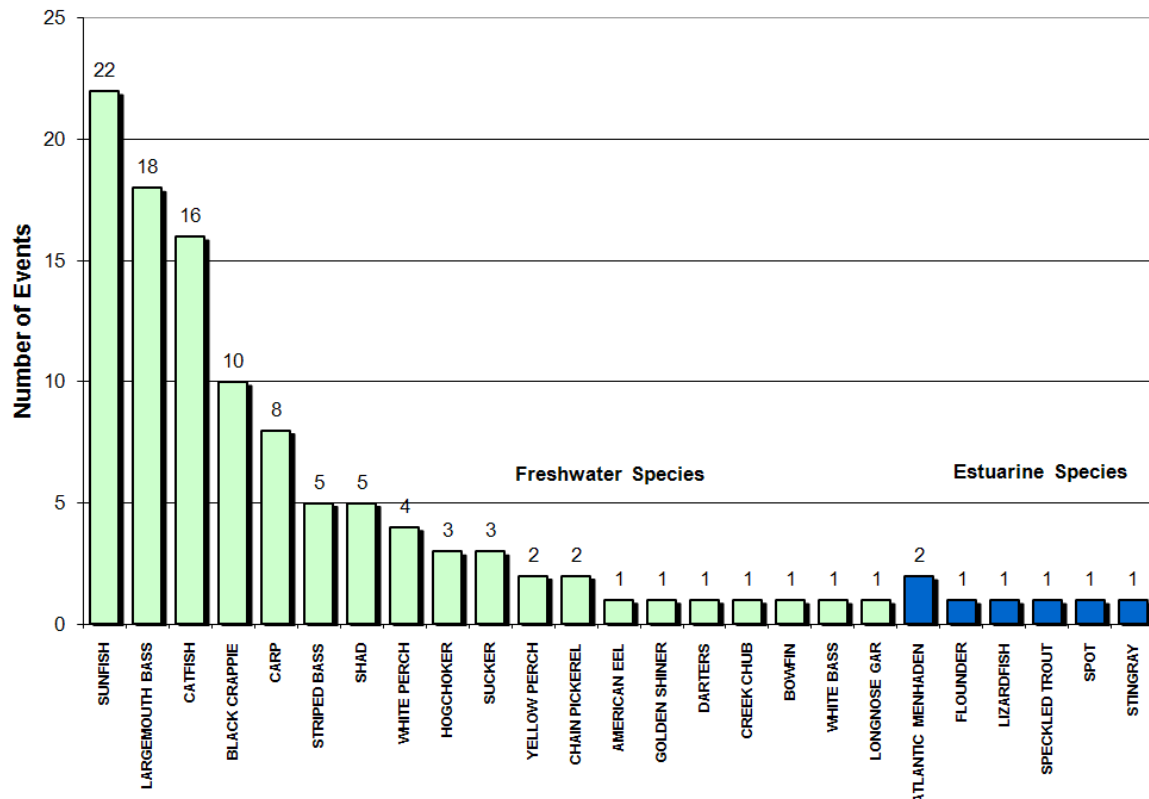
Finfish and Other Species Reported

Fish kill events in 2011 involved at least 25 species of fish (Figure 5). The majority of reported species were freshwater - only six estuarine species were observed. Freshwater species most frequently observed included sunfish, largemouth bass and catfish. Significant striped bass mortality was also observed in three inland reservoirs during the peak summer months. Striped bass are not native to southeastern lakes and are stocked by the N.C. Wildlife Resource Commission. This species is particularly susceptible to low dissolved oxygen (DO) levels and high water temperatures. Historical kills of striped bass related to DO depletion and summer heat have been well-documented in several inland reservoirs in North Carolina.

Atlantic menhaden were observed at both of the reported estuarine events although their numbers are considered small compared to counts from previous years. Menhaden have historically been frequent victims in North Carolina fish kills and have often comprised the majority of the annual finfish mortality.

Non-fish species were observed at four kill events during 2011. These included blue crab and Asiatic clams (*Corbicula*). Significant die-offs of Asiatic clams were observed in the Roanoke and Chowan rivers following Hurricane Irene, where investigators reported counts in the hundreds of thousands (see Appendix).

Figure 5: Finfish species and observed frequencies reported for 2011 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. Some are identified, but others remain unconfirmed or unclear due to latent reports or an investigation occurring hours or days after the actual event. Kill events may result from many environmental factors and sorting out the major reason(s) why a fish kill occurs is frequently a difficult and subjective task. Investigators generally monitor water quality and environmental conditions surrounding an event and are encouraged to submit this information in reports along with observations regarding a suspected cause. This information aids in evaluating potential water quality trends and problems, and assists investigators with formulating future courses of action. Reported causes should not be viewed as a definitive label for a particular event. Reported causes of 2011 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 2011 fish kill events

Reported Cause	Events	Mortality
Dissolved Oxygen Depletion	22	133,670
Unknown*	7	1,270
Spills	4	300

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

Dissolved oxygen depletion in North Carolina waters has historically been the major factor driving fish kill activity across the state. Low DO levels can occur under a variety of conditions but the depletion of DO is most prevalent during the warm summer months or following major storms and hurricanes. Consequently, in the wake of periods of hot weather and the arrival of Irene, low DO was the most frequently reported cause for fish kills during the 2011 season. DO stress was cited as a factor in nearly two-thirds of the year’s events and associated with nearly 98 percent of the year’s fish mortality. Large DO related events were most frequent in coastal waters after Irene and extended for days and weeks after the storm passed. DO depletion was also blamed for three large kills involving striped bass on Lake Jordan, Tuckertown Reservoir and Lake Norman in late July and early August. In the summer months, striped bass become stressed as a result of depletion of DO levels leading to a summer die-off. In addition striped bass prefer cooler water temperatures and become stressed as they seek deeper, cooler water with lower DO levels. The loss of cool, oxygenated water available to striped bass as the summer progresses is commonly referred to as “habitat squeeze.”

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 seven of the year's events. Kills with unknown causes occurred exclusively in inland freshwater streams and ponds during 2011. These events were generally small scale, with each kill involving less than 500 fish.

Spills may deplete DO levels in receiving streams or induce kills outright through physical or chemical toxicity. During 2011, investigators reported four events where the release of substances induced a fish kill. All events resulted from the release of sewage into small inland ponds and streams. All sewage related kills were small, involving approximately 100 fish or less.

Algal Blooms Associated With Fish Kills

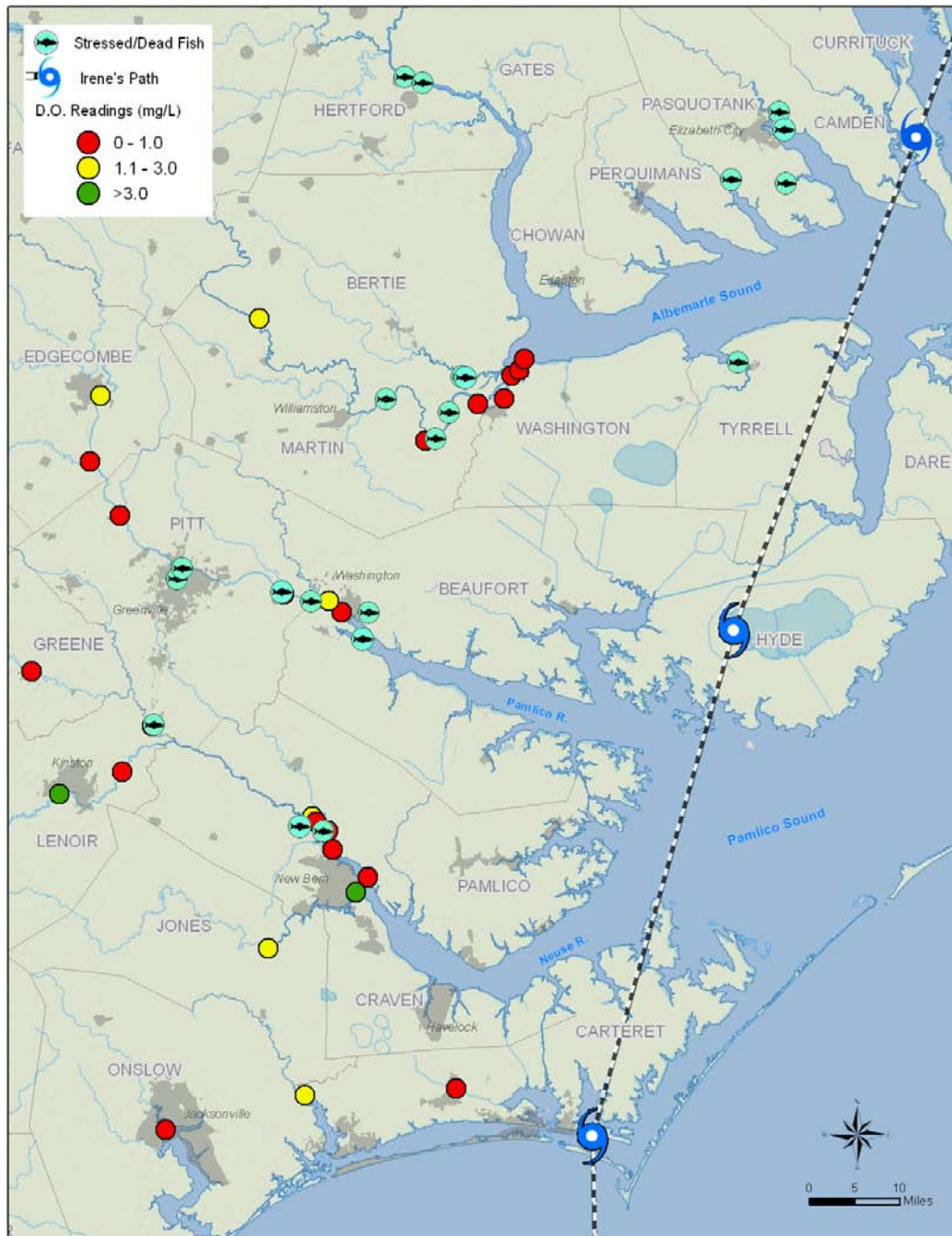
ESS staff members routinely examine water samples associated with kills for the presence of harmful algal species. Samples where significant amounts of potentially harmful algae are identified are sent to research laboratories throughout the state for further analyses and evaluation. The Center for Applied 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 evaluated between labs.

Algal samples were collected by investigators in conjunction with three fish kill events during 2011. Results indicated all algal species identified by DWQ staff were typical for local estuarine and fresh waters during the summer season and none were cited as a factor in any kill events.

Hurricane Irene

Hurricane Irene made landfall in North Carolina near Morehead City on August 27, 2011. It was the first hurricane to strike the state since Hurricane Isabel, nearly eight years ago. Irene came ashore with wind gusts of more than 85 mph, as well as heavy rains. The storm's path stretched over Pamlico Sound, north to Hyde and Tyrrell counties, over eastern Albemarle Sound, and finally over Currituck Sound to re-emerge into the Atlantic Ocean (see Figure 6). Although the storm remained close to the Outer Banks, the heaviest impacts were felt along the Inner Banks, sounds and central coastal plain. Furthermore, Irene proved to be a very large event with hurricane force winds and excessive rains extending 100 miles from the center. Precipitation totals from Irene in the region were extremely high, ranging between 10–14 inches. The intense rainfall over a short time resulted in excessive flooding in coastal waters, particularly those west of the path including the Tar/Pamlico, Roanoke and Chowan/Pasquotank basins.

Figure 6: Hurricane Irene's path and coastal impacts, August-September 2011



As with past hurricanes, the floods flushed swamps and backwaters as well as urban areas and washed contaminants, debris and organic matter into streams and estuaries. As the storm passed, DO levels in many systems were depleted to concentrations lethal to aquatic life. Monitoring in the wake of the storm revealed critically low DO levels in streams from the Neuse to the Chowan/Pasquotank basins (Figure 6).

Subsequent to the loss of adequate DO in coastal waters, reports of stressed and dying fish were soon received by DWQ regional offices and investigative teams. DWQ investigators produced 12 official reports of fish kill activity related to Irene. These events were documented in all major coastal basins from the Neuse to the Pasquotank and involved more than 120,000 fish. Additionally, regional investigators received numerous (as many as 30) anecdotal reports and sightings of dying fish throughout the affected region. These events could not be verified by DWQ due to either staff resource limitations or the dispersal of fish carcasses by wind and currents. Investigators acknowledge that the true effects of Irene on North Carolina fisheries as well as the fish mortality associated with the storm are considerably greater than what could be documented and remain unknown.

2011 Summary

Investigators reported fish kill events in nine of the state's major river basins during 2011. Kill activity was documented in the Coastal Plain and Piedmont as far west as Mecklenburg County. The number of fish kills reported during the year totaled 33, and DWQ reports placed the total statewide mortality figure for the year at more than 135,000 fish. All but two events occurred in freshwater locations. Historical trouble spots within the lower Neuse and Tar/Pamlico estuaries experienced little documented fish kill activity.

Investigators witnessed the reoccurrence of striped bass kills in three North Carolina reservoirs - Lake Jordan, Tuckertown Reservoir and Lake Norman. Nearly 6,000 dead fish were recorded between the three waterbodies. Striped bass kills in North Carolina lakes are not unusual in the summer as high temperatures deplete the oxygen in the middle and lower levels of the lake, often trapping bass that appear to be feeding or seeking refuge in lower depths.

Hurricane Irene struck the state on August 27, 2011, and followed a path over Pamlico and Albemarle sounds. Before exiting the state, Irene dumped excessive rains in coastal areas and caused severe flooding along the Inner Banks from the Neuse to the Chowan/Pasquotank basins. The storm's aftermath brought severe DO depletion in coastal waters that lasted for days and weeks. Twelve fish kills involving 120,000 fish were officially reported, but anecdotal information indicates that numerous kill events were not documented.

Appendix: 2011 Fish Kill Summaries Listed by County

Total 2011 Fish Kills: 33**Total 2011 Fish Mortality: 135244****2011 Fish Kill Events (by County)**

Date	Kill Number	Waterbody	Location	Mortality	Comments
Beaufort					
8/13/2011	WA11002	Jacks Creek	near Washington	1000	DWQ Surface Water Staff investigated this kill on August 13th. Approximately 1000 menhaden were estimated in a localized area 600 meters upstream from the mouth of Jack's Creek. Other species of fish were observed swimming in the kill area at that time. Water quality data recorded Monday August 15th in the kill area indicated very low DO (2.0mg/L). Water temperatures were near 27 degrees C, pH of 7.1. Low Dissolved Oxygen within this area may continue to be an issue if the weather continues to remain hot.
Total Kills for County: 1 Total Mortality for County: 1000					
Bertie					
9/1/2011	WA11009	Cashie River	Sans Souci Ferry	10000	This kill event was reported in the aftermath of Hurricane Irene. Low dissolved oxygen and stressed/dead fish were observed during investigation. Observations were made on 9/1/2011 when fish kills were just beginning. Additional reports of more dead fish were received after initial visit.
9/6/2011	WA11007	Chowan River	Tuscarora Beach	500	This kill event was reported in the aftermath of Hurricane Irene. Low dissolved oxygen and stressed/dead fish were observed during investigation. Fish were observed gasping along the shoreline.
Total Kills for County: 2 Total Mortality for County: 10500					
Bladen					
4/12/2011	FA11001	Bryant Swamp Canal	near Bladenboro	500	Cause of kill: unknown at time of investigation; DWQ personnel took several water quality samples and sent DWQ Chem Lab to be analyzed.
Total Kills for County: 1 Total Mortality for County: 500					
Cabarrus					
6/15/2011	MO11002	Private Pond	near Midland	100	Event attributed to a lack of DO from excessive algal growth and decay. Fish kill occurred in early morning hours prior to dawn. Copper sulfate added to control vegetation prior to kill.
Total Kills for County: 1 Total Mortality for County: 100					
Chatham					
7/29/2011	RA11006	Jordan Lake	Near US 64	5140	Fish mortality attributed to high temperatures and low dissolved oxygen levels in Jordan Lake. Numbers of observed fish are likely underestimated due to decomposition and dispersion. Most observed fish were striped bass. Striped bass die-offs are common in NC lakes/reservoirs during warm summer months. Fish mortalities are continuing at the time of this report.
10/10/2011	RA11011	Jordan Lake	near Farrington	260	Possible algal bloom (high dissolved oxygen saturation, and high pH) observed during investigation. Majority of dead fish were decayed, dried, or consumed by birds, only about 12 fresh dead fish were observed.

2011 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
					Total Kills for County: 2 Total Mortality for County: 5400
Craven					
8/2/2011	WA11001	Neuse River	near Fisher Landing	1200	The Estuarine Monitoring team investigated a fish kill near Fisher Landing on the Neuse River, August 4th. Over 1200 species including menhaden, spot, flounder, and blue crabs were estimated along the southern shoreline of the Neuse River from Fisher Landing extending downstream towards Flanner's Beach. The kill largely consisted of Menhaden (170-200 mm), Spot (50-70 mm), and Flounder (100-600 mm). A majority of blue crabs were less than 3 inches (carapace length). Physical data recorded near the fish kill indicated Dissolved Oxygen values near 4 mg/L (surface), falling to near zero below 1.0 meter. Salinities were ranged from 17 - 20 ppt respectively. Physical data recorded near Channel Marker 13 indicated DO values near 5 mg/L steadily dropping to near zero at 3 meters. Surface water temperatures were over 31 degrees C by noon. This event likely occurred 36-48 hours ago. High water temperatures had been consistent in this area for several days. It is likely that these fish succumbed to the stress of a combination of high temperatures and low Dissolved Oxygen.
8/31/2011	WA11004	Neuse River	New Bern to Spring Garden	70	This kill event was reported in the aftermath of Hurricane Irene. Low dissolved oxygen and stressed/dead fish were observed during investigation along the Neuse R. from New Bern to Spring Garden.
					Total Kills for County: 2 Total Mortality for County: 1270
Davidson					
8/9/2011	WS11002	Tuckertown Reservoir	Cabin Creek	2300	Many affected fish were striped bass and largemouth bass. Cabin Creek was choked with hydrilla and other aquatic vegetation and displayed a reddish surface film.
					Total Kills for County: 1 Total Mortality for County: 2300
Durham					
8/3/2011	RA11007	Private Pond	near Gorman	100	More than half of the pond was covered by duckweed. Dissolved oxygen measured 0.5 mg/L and water temperature measured 30 C at time of investigation.
8/29/2011	RA11008	UT to Lick Creek	near Durham	2000	Kill occurred in a pond along a UT to Lick Creek. Low dissolved oxygen reported at time of investigation. Fish seen gasping and lethargic during investigation. Construction activity observed upstream as well as a leaking swimming pool.
10/14/2011	RA11012	Ellerbe Creek	Hillandale Golf Course-Durham	75	On October 14th Durham Stormwater staff reported approximately 75 fish dead in the upper portions of Ellerbe Creek in City of Durham off of Hillandale Road. Durham staff reported that they identified on one occasion 0.5 mg/l of chlorine in the stream... The remaining chlorine samples were all below detection. Dave Parnell of the RRO investigated the area Friday evening and confirmed dead fish, but he only saw few individuals (n=5). Investigators, like the City of Durham staff, were not able to identify a point source. There is a nearby water treatment plant, but RRO confirmed their discharge is connected to the collection system and does not discharge to surface waters. There had also been a sanitary sewer overflow in the area but Durham City explained that they had recovered the product. RRO and Durham Stormwater staff were unable to confidently identify the cause of the fish kill.
					Total Kills for County: 3 Total Mortality for County: 2175

2011 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
Hertford					
9/8/2011	WA11012	Chowan River	near Winton	50000	This kill event was reported in the aftermath of Hurricane Irene. Low dissolved oxygen and stressed/dead fish were observed during investigation. Fish counts were only taken by investigators in a few places, but many more dead fish were seen throughout entire Chowan River from Va state line to Holiday Island and in the Meherrin River upstream of Murfreesboro to the Chowan confluence. Many dead fish were likely washed into floodplain due to high water and south winds. Decomposition had begun on some fish, some were freshly dead and some were gasping at the surface. Fish kill was caused by dissolved oxygen crash following Hurricane Irene.
Total Kills for County: 1 Total Mortality for County: 50000					
Lee					
9/28/2011	RA11009	Deep River	US 15-501	100	Heavy rainfall caused and increased turbidity was reported prior to the event.
Total Kills for County: 1 Total Mortality for County: 100					
Martin					
9/13/2011	WA11013	Roanoke River	near Jamesville/Plymouth	50000	This kill event was reported in the aftermath of Hurricane Irene. Low dissolved oxygen and stressed/dead fish were observed during investigation. Observations made on 8/31, 9/1/2011, and 9/13/2011. Fish counts were only taken in few places mostly on 8/31 and 9/1, but many more dead fish were seen throughout Roanoke River a few miles above Williamston to the river mouth. Decomposition had begun on some fish, some were freshly dead and some were gasping at the surface. Fish kill was caused by dissolved oxygen crash following Hurricane Irene.
Total Kills for County: 1 Total Mortality for County: 50000					
Mecklenburg					
5/24/2011	MO11001	Edwards Branch	Charlotte	27	Fish kill caused by sewer overflow at 5900 Greenbrook Drive.
7/13/2011	MO11003	Private Pond	Charlotte	116	A sewer main leaked upstream of the pond on July 13, 2011 and was immediately repaired by Charlotte Mecklenburg Utilities ; however some of the sewage flowed into the pond. Pond was continuously flushed from nearby fire hydrants for two days to improve water quality.
7/29/2011	MO11004	Lake Norman	near Dam	360	Observed fish were all striped bass and in multiple stages of decay. The event marks the third consecutive year for a striped bass summer kill in Lake Norman. Water temperatures in July were high and suitable habitat in the lake hypolimnion was reported as essentially gone around the time of the investigation with maximum DO concentrations at 0.76 mg/L. Striped bass die-offs are common in NC lakes/reservoirs during warm summer months.
8/15/2011	MO11005	Trib to Briar Creek	Charlotte	110	Initial investigation occurred on 8/15/11. 100+ dead fish were observed in the stream channel. Living fish were observed as well, but appeared to be lethargic. The stream was slightly cloudy in deeper pool areas. There was a slight chemical odor detected. Investigation occurred until night fall. Investigation ensued the following morning, 8/16/11. No source was identified. The living fish in the stream channel seemed to recover on 8/16. No additional dead fish were observed.

2011 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
9/21/2011	MO11006	Private Pond	Charlotte	100	Investigators reported sewage spill and algal bloom prior to kill. Most affected fish were large.
					Total Kills for County: 5 Total Mortality for County: 713
Pasquotank					
9/1/2011	WA11006	Halls Creek	near Woodville	200	This kill event was reported in the aftermath of Hurricane Irene. Low dissolved oxygen was observed during investigation. Investigators suspected may more fish were affected than those reported. Many fish were dispersed from wind and currents.
9/2/2011	WA11010	Newbegun Creek	Weeksville	7000	This kill event was reported in the aftermath of Hurricane Irene. Low dissolved oxygen and stressed/dead fish were observed during investigation.
9/6/2011	WA11011	Pasquotank River	Elizabeth City	1900	This kill event was reported in the aftermath of Hurricane Irene. Low dissolved oxygen and stressed/dead fish were observed during investigation.
					Total Kills for County: 3 Total Mortality for County: 9100
Pender					
9/9/2011	WL11001	Ut to NE Cape Fear River	near Burgaw	500	This kill event was reported in the aftermath of Hurricane Irene. Low dissolved oxygen was observed during investigation. Low dissolved oxygen reported throughout region especially in blackwater and swamp systems after hurricane.
					Total Kills for County: 1 Total Mortality for County: 500
Pitt					
8/31/2011	WA11003	Tar River	Washington to Grimesland	50	This kill event was reported in the aftermath of Hurricane Irene. Low dissolved oxygen and stressed/dead fish were observed during investigation throughout the section of the Tar River from Washington to Grimesland.
9/1/2011	WA11005	Tar River	Greenville Town Commons	200	This kill event was reported in the aftermath of Hurricane Irene. Low dissolved oxygen and stressed/dead fish were observed during investigation.
9/6/2011	WA11008	Contentnea Creek	Grifton	350	This kill event was reported in the aftermath of Hurricane Irene. Low dissolved oxygen was observed during investigation. All fish were in the parking lot and on the boat ramp where the water had receded the previous week. All dead fish were out of water and dried up on the shore.
					Total Kills for County: 3 Total Mortality for County: 600
Surry					
5/13/2011	WS11001	Dotson Pond (Private)	near Woodville	26	No extensive bloom was noted during the investigation and the owner of the pond did not remember any indication of one occurring prior to the fish kill. Results of phyto analysis: Algae densities in the pond were around 50,000 units/ml indicating extreme levels (>30,000 units/ml) of algae which is not unusual for small pasture ponds in summer. The dominant forms of algae were Ankistrodesmus (≈ 41,000 units/ml) and Euglena (≈9,000 units/ml). Water was observed as muddy with cows having pond access.

2011 Fish Kill Events (by County)

Date	Kill Number	Waterbody	Location	Mortality	Comments
					Total Kills for County: 1 Total Mortality for County: 26
Vance					
6/6/2011	RA11005	Private Pond	near Henderson	500	Low DO suspected as cause for the fish kill. Low DO was observed at time of investigation. The owner of the mobile home park was also concerned that the chemicals applied on the nearby farm land might have entered the pond via stormwater.
					Total Kills for County: 1 Total Mortality for County: 500
Wake					
6/8/2011	RA11002	Kit Creek	near Lake Betz	200	Fish likely exited through the Lake Betz outlet structure and were trapped in a pool of water that was not connected to Kit Creek due to dry conditions, and no flow through the lake dam at the time of the investigation. Pool water measurement for DO was 2.40 and saturation was 13.2%. A few (2-3) living fish remained in the pool, and WRC was contacted regarding options.
6/9/2011	RA11004	Upper Barton Creek	near Raleigh	60	This incident is related to the sanitary sewage overflow (SSO) from Hawthorne Collection System. Low DO and possibly high ammonia may have caused the fish kill. Aqua N.C. owns the responsible station. The event prompted a violation notice, which outlined what Aqua had to do to return the stream to a condition suitable for aquatic life and bring oxygen levels back to state guidelines to allow fish life to survive.
8/23/2011	RA11010	Brier Creek Reservoir	Near RDU	200	Fish kill appeared complete at the time of investigation. High water temperature suspected as a cause for the kill.
					Total Kills for County: 3 Total Mortality for County: 460