2015 Fish Kill Summary

Maryland Department of the Environment
Science Services Administration
Fish Kill Investigation Section

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Purpose

A special responsibility mandated by Environmental Article Section 4-405C requires management and control agencies to investigate the occurrence of damage to aquatic resources, including, but not limited to, mortality of fish and other aquatic life. The investigations should determine the nature and extent of each occurrence and endeavor to establish the cause and sources of the occurrence. If appropriate, findings shall be acted upon to require the reparation of any damage done and the restoration of the water resources affected, to a degree necessary to protect the best interest of the state.

Until 1984, fish kill investigations in the state were the responsibility of the Department of Natural Resources. In 1984, this function was transferred to the Office of Environmental Program's Division of Water Quality Monitoring within the Department of Health and Mental Hygiene. Effective July 1, 1987, the Office of Environmental Programs became part of the Maryland Department of the Environment (MDE).

The MDE Field Evaluation Division coordinates an on-call interagency staff to ensure that all reports of fish kills in the state are promptly addressed. While MDE attempts to investigate all reported events, reports with fewer than 25 dead fish, those for which there is a priori information or incidents that are reported more than 72 hours after they occurred are not always investigated. Information obtained by interviewing the complainant, knowledge of fisheries, and or scientific activity and historical data from the vicinity occasionally eliminates the need to investigate reports.

A summary report of fish kills is prepared annually. A database has been established and is available for all reported incidents occurring since 1984.

Acknowledgements

Many organizations and individuals contribute to the efforts necessary in the field and office to bring this report to completion each year. To those inadvertently not cited, your efforts are greatly appreciated.

2015 After Hours fish kill duty roster: Nick Kaltenbach, Chris Luckett, and Charles Poukish.

Others who participated in 2015 investigations:
Ken Benson (VA-DCR), Brett Coakley (DNR-FS), Steve Doctor (DNR-FS), Geoff Donohue (MDE-ERD), Mark Ecker (MDE WMA), Jeremy Kazio (VA-DEQ), Alan Klotz (DNR-FS), Ed Livengood (DNR-FS), John Mullican (DNR-FS), Kimberly Reese (VIMS), Barbara Santana (MDE-FOP), Dan Seal (Frederick City-DPR), Alex Torella (MO-DEP), Adam Wose (MDE-FOP)

Cooperating agencies:

- MDE- Environmental Assessment and Standards Program
  - Field Operations Program
  - Emergency Response Division
  - Office of Communications and Digital Strategy
  - Science Services Administration
  - Water Management Administration- Compliance Program
- DNR- Fisheries Service
  - Natural Resources Police
  - Oxford Cooperative Lab, Fish & Wildlife Health Program
  - Tidewater Ecosystem Assessment Division
  - MANTA-Annapolis Field Office
  - Wildlife and Heritage Program
- MDA- Animal Health Laboratory
  - Pesticide Regulation Division
- University of Maryland
  - Institute for Marine and Environmental Technology
  - Veterinary Services
- USGS-Fish Health Branch
- City of Frederick Departments of Parks and Recreation and Public Works
- Montgomery County Department of Environmental Protection

Thanks also go to the concerned citizens of Maryland for alerting us to and providing vital initial information regarding fish kills throughout the state; and to any individual or agency inadvertently omitted from this list.

Summary

This report contains a summary of fish kills reported to Maryland Department of the Environment in calendar year 2015. Many reported fish kills are investigated by MDE biologists or cooperating professionals in other State and county agencies. After the completion of investigations and/or communications with witnesses or knowledgeable officials, a probable cause is usually determined for fish kills. The data presented were gathered from field investigations and discussions with reporting persons and officials.

Number of Events

A total of 86 fish kills were reported in 2015, and 50 were considered significant enough to warrant on-site investigation. This represents the fifth lowest number of reports received for a year since 1985, which was 78% of the historic average of 110 reports per year. Most fish kills occur in tidal waters during warmer months when waters become warm and stratified, and hypoxia becomes more common. Eighty-one percent of reported kills occurred during the six month period between March 1 and August 31 (Figure 1). Fifty-six percent occurred during the four month period of May 1 through August 31.

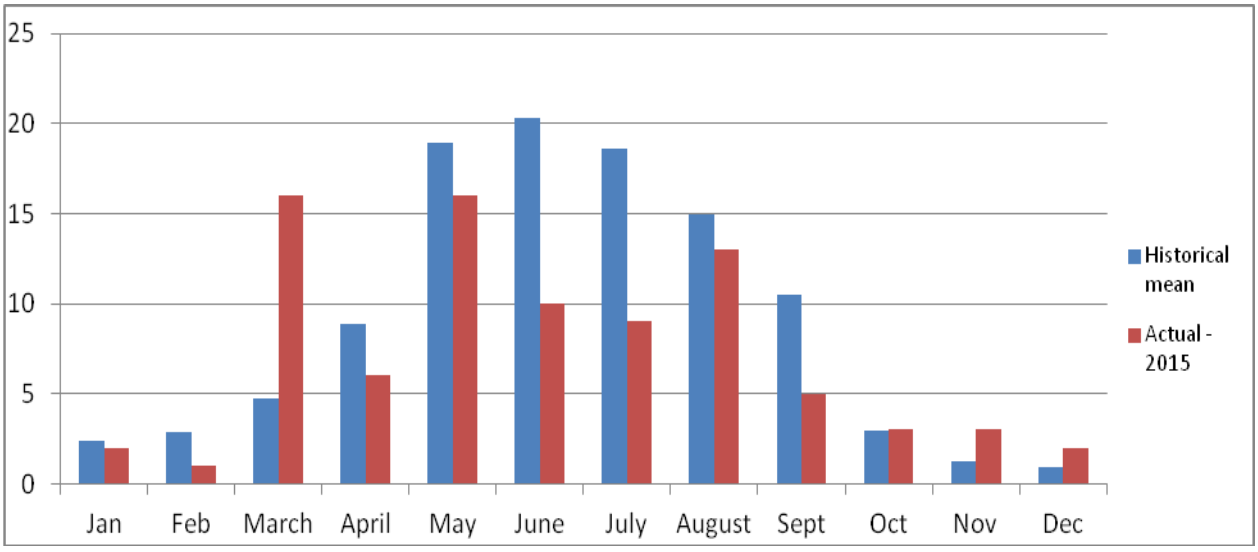


Figure 1. Fish kill reports received by month.

The early months of 2015 were characterized by very cold weather and later than normal thawing. This resulted in several winter stress kills involving gizzard shad (a common occurrence in some years) which were not discovered until March when ice melted. Spring and early summer was characterized by frequent but moderate rainfall. The absence of prolonged dry, hot spells reduced water quality issues and resulted in a shrunken summer “dead zone” in the Chesapeake Bay and its tributaries (EPA Bay Program). Late summer and into fall, rainfall became scarcer and salinity rose in the upper Chesapeake Bay and its tidal tributaries. Air and water temperatures were warm into December. This pattern resulted in fewer fish kills during the warmest months and initiated a few large algae blooms of estuarine species in November and December. Most did not involve fish kills.

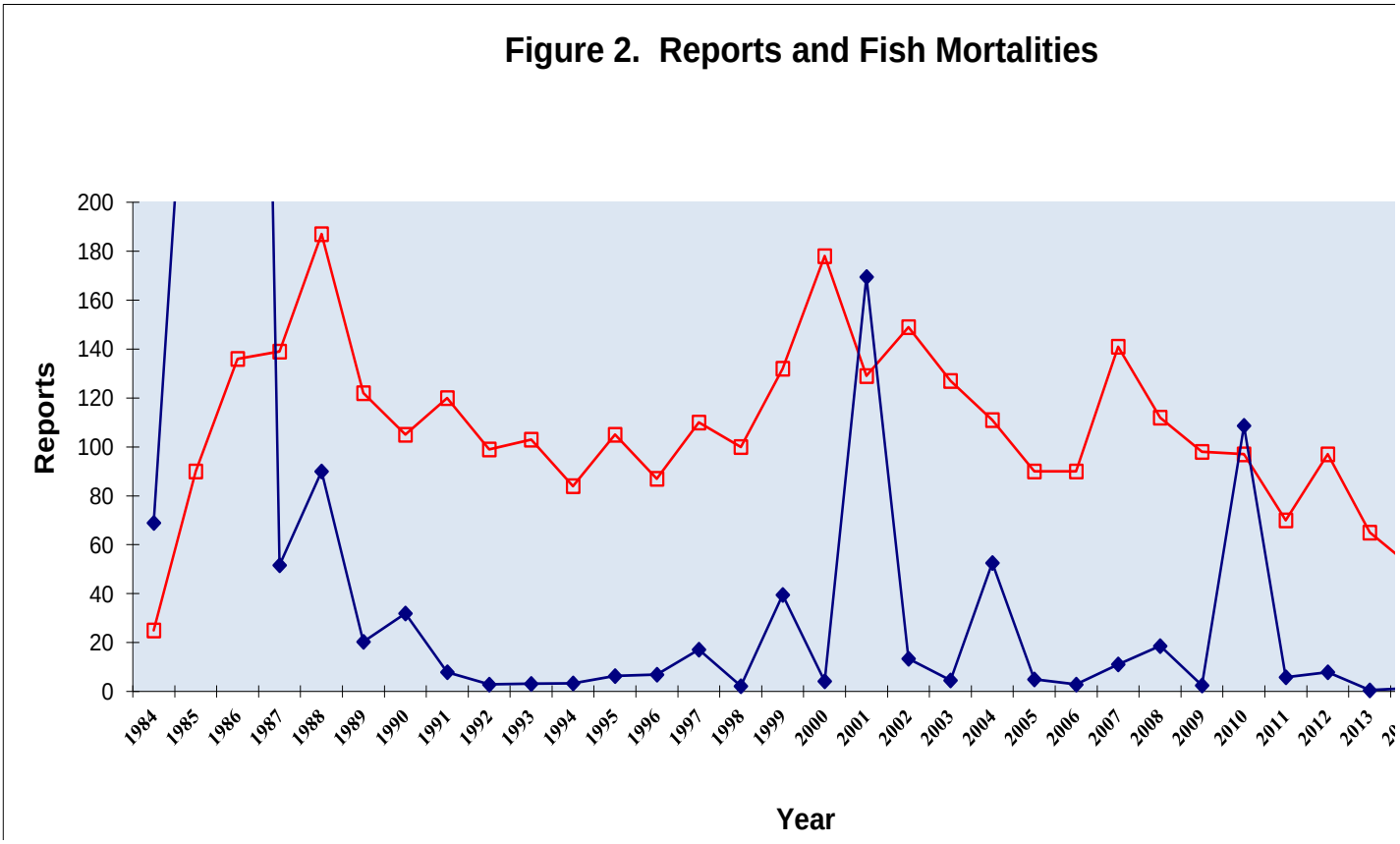
Fish kill events typically vary from year-to-year depending upon rainfall, water quality, temperature, ice cover, variations in fish populations, and disease outbreaks.

Teams consisting of two or more agencies conducted several of the investigations. MDE Fish Kill Investigation Section personnel conducted 35 investigations. The Maryland DNR-Fisheries Service participated in seven. Other MDE groups participated in eight: three by the Water Management Administration, four by the Field Operations Program-Shellfish Compliance Division, and one by the Emergency Response Division. The University of Maryland’s Institute of Marine and Environmental Technology participated in two. The Montgomery Department of Environmental Protection participated in three. The City of Frederick participated in one. One event in the Potomac River, included investigators from Virginia Department of Environmental Quality, the Virginia Institute of Marine Science, and the Virginia Department of Conservation and Recreation.

Magnitude of Events

MDE estimates the number of fish and other animals involved in each reported event. Single events may dominate the total number of fish killed in a year. For instance, in the 1980's large schools (in the millions) of young-of-year menhaden were involved in several very large kills as a result of corralling in shallow, oxygen depleted headwaters. These events strongly skew the long-term average. As schools of menhaden became smaller and less plentiful in the Chesapeake Bay, the number and magnitude of menhaden kills has dropped. The total fish mortalities in Maryland for 2015 (254,421) is only 19.5 percent of the 32-year average of 1,301,230. However, it was the fifteenth highest annual total recorded since 1984.

Figure 2. Reports and Fish Mortalities



Distribution of Fish Kills

Every county except Dorchester was affected by fish kills in 2015 (Table 1). The highest number (12) occurred in Baltimore County. Anne Arundel County had the second highest occurrence with 10. Prince George's had the third highest with 8 and Montgomery was fourth with 7. Other counties with notable numbers of events were Saint Mary's and Charles with 5 each. Of these six jurisdictions, all rank in the top ten for historical reports. Anne Arundel County has had the most reported kills (632) since 1984. Baltimore County ranks second highest with 356. Counties with abundant tidal shoreline and high population densities experience the most fish kill reports. These factors increase the likelihood of reports being made and typically exemplify localized anthropogenic impact. Additionally, Anne Arundel County historically is at the center of the highest densities of toxic dinoflagellates (e.g. *Karlodinium veneficum*), with fifteen reported incidents historically. Fish kills attributed to Karlotoxin (either alone or in concert with low Dissolved Oxygen, or high

Table 1: Fish Kill Reports by County.

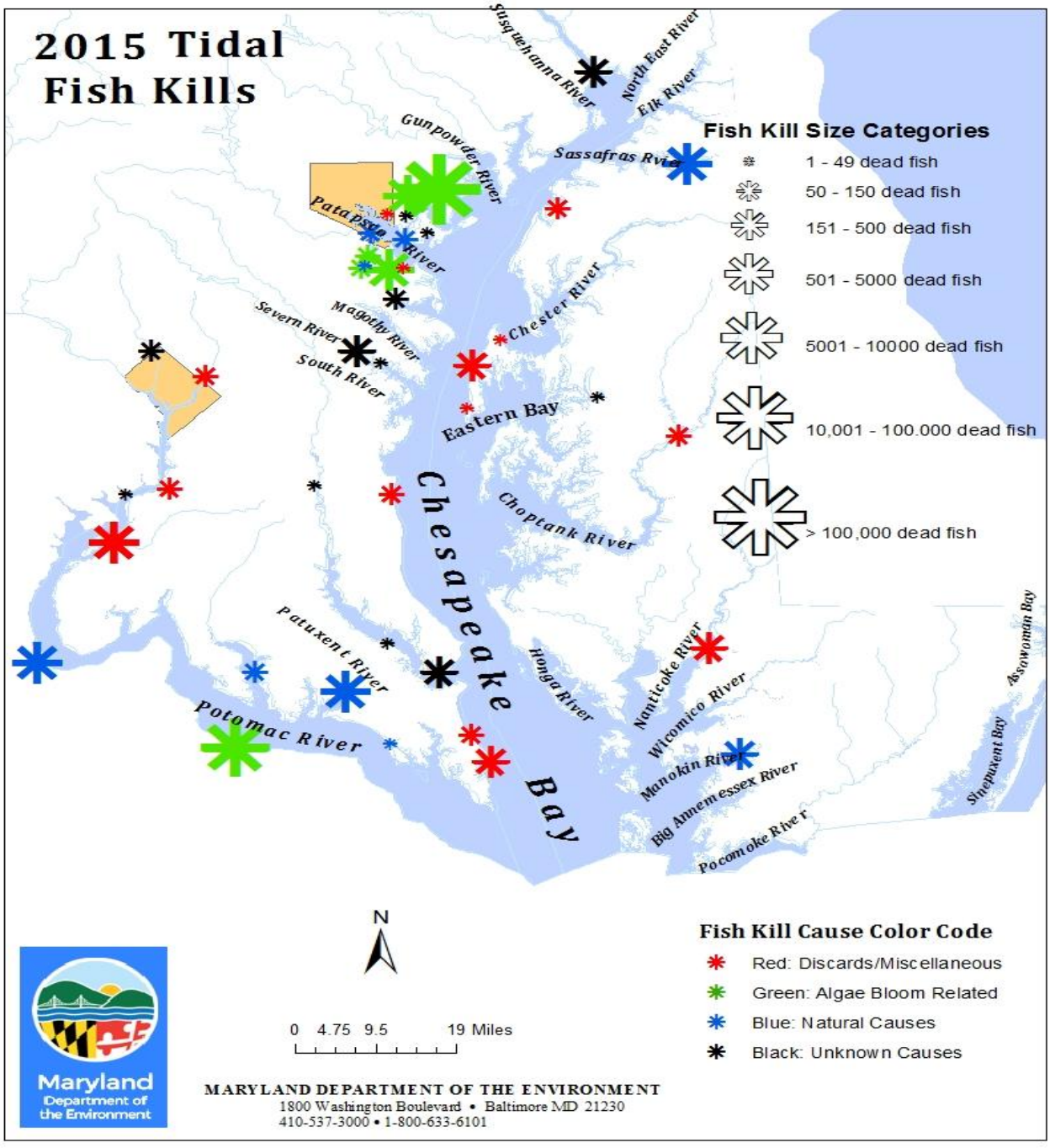
County	# Reports (2015)	# Reports (1984-2015)
Allegany	2	33
Anne Arundel	10	632
Baltimore	12	356
Baltimore City	3	103
Calvert	2	166
Caroline	3	66
Carroll	1	100
Cecil	2	203
Charles	5	121
Dorchester	0	65
Frederick	1	108
Garrett	1	42
Harford	2	165
Howard	1	77
Kent	2	114
Montgomery	7	145
Prince Georges	8	154
Queen Anne's	4	149
Somerset	2	61
St. Mary's	5	179
Talbot	2	92
Washington	2	58
Wicomico	2	104
Worcester	4	91
TOTAL*	83	3384

**Totals do not include kills reported out of state.*

salinity) have accounted for 37 fish kills since 2002. Two fish kills attributable to *Karlodinium veneficum* were observed in 2015.

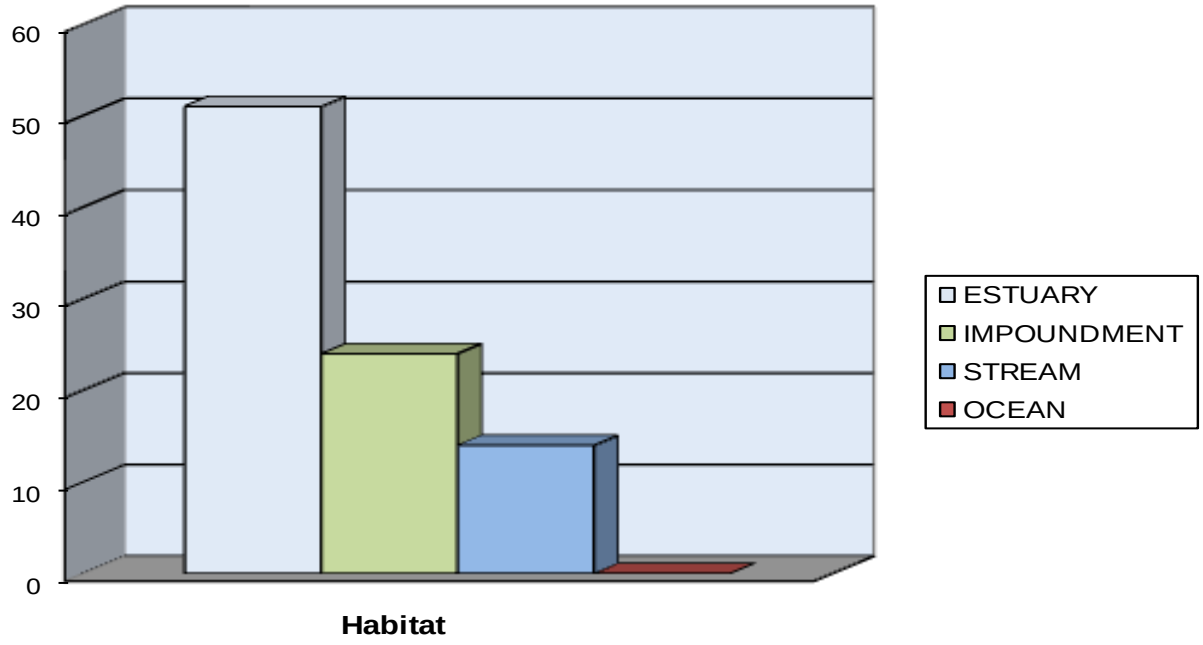
Figure 3 shows the geographical distribution, and magnitude of tidal fish kills, including the causes attributed to them in 2015.

Figure 3: Distribution of fish kills throughout Maryland tidal waters.



Reported fish kills occurred in various aquatic habitats. There were twenty-three reported from impoundments, thirteen from free flowing streams, and fifty from estuarine waters (Figure 4). The number of reports from all environments was below average.

Figure 4. 2015 Fish Kills by Environment



Causes of Fish Kills

Of the 86 events reported, 72 were classified as fish kills. Fourteen were determined to be a non-kill or insignificant events where no dead fish were found.

Probable cause was determined in 54 of the 72 fish kills (Table 2). Natural causes were implicated in 28 events, including 13 cases of oxygen depletion, 11 cases of winter/seasonal/spawning stress, two cases of stranding during subfreezing conditions, and two cases of toxic algae. The remaining events included 12 caused by fishing

discards, 8 pollution cases, two cases of entrapment after insufficient dam discharge reduced water levels, two cases of stocking stress, two cases of pond mismanagement, and 18 cases where the cause was undetermined.

Table 2: Probable causes of fish kill reports, 2015.

Probable cause	**2015 Only**	***Percent of Annual Total***	**# of Reports 1984-2015**	***Percent of Historic Total***
Natural	28	32.56%	1407	40.96%
Disease	0		234	
Low dissolved O_2	13		821	
Seasonal / Spawning stress	11		219	
Stranding	2		61	
Salinity shock	0		3	
Thermal shock	0		28	
Toxic algae bloom	1		21	
Toxic algae/water quality synergism	1		16	
Storm surge	0		1	
Bird predation	0		3	
Pollution	8	9.30%	281	8.18%
Agriculture	0		32	
Municipal sewage	0		46	
Industrial discharge	0		52	
Swimming pool discharge	0		19	
Fuel/Oil spills	1		30	
Unidentified source	6		54	
Construction	1		11	
Municipal discharge	0		24	
Pond Management chemicals	0		13	
Miscellaneous	18	20.93%	709	20.64
Discards	12		491	
Entrapment	2		146	
Stocking stress, pond Mgmt.	4		64	
Scientific discards, exotic species control	0		8	
Unknown	18	20.93%	794	23.11%
Non-kill	14	16.28%	244	7.10%
TOTAL	**86**		**3435**	

In 2015, after five years without such a kill, two fish kills were attributed to toxins from blooms of the toxic dinoflagellate, *Karlodinium veneficum*. This algae is a long term resident of Chesapeake Bay. Although previously thought to be non-toxic, aka. *Gyrodinium estuariale*, it was associated with fish kills for many years. Around 2002, researchers at the University of Maryland corrected the misidentification and isolated potent ichthyotoxins (i.e. Karlotoxins) released by *K. veneficum*. Bioassay experiments performed at UM demonstrated the specific dose response associated with Karlotoxin. Since then, this office has worked to combine pertinent data from fish kill investigations (phytoplankton identification and enumeration, water quality, UM Karlotoxin analysis and dose response data) to diagnose kills caused by Karlotoxin. Since then, 37 Karlotoxin associated kills have involved 458,475 fish mortalities. No known human health effects are associated with these phenomena.

Other nuisance algae species (e.g. *Prorocentrum minimum, Gyrodinium uncatenum*) are not known to be toxic in Maryland, but may occasionally bloom to high enough levels to cause fish kills resulting from high Bio-chemical Oxygen Demand (B.O.D).

Events by Number of Fish Involved

Approximately 254,421 fish mortalities were confirmed in 2015. An additional 1,032,742 invertebrates and other aquatic animals were involved in incidents totaling 1,287,163 aquatic animals killed in 2015.

In an average year approximately 5-10 fish kills in excess of 10,000 fish are noted. Two kills involved more than 10,000 fish in 2015.

The largest kill (#215082) occurred November 8th in seven contiguous tributaries in the headwaters of Middle River (Baltimore County). Approximately 201,789 fish (sixteen

species) died when an unseasonably late bloom of the toxic dinoflagellate, *Karlodinium veneficum*, occurred. It is believed that the coincidence of rising salinity, nutrient availability from the encroaching salt wedge, and warm temperatures triggered the bloom. Toxin levels were high enough to damage gill tissue over exposure periods in the range of hours. Most of the affected fish were freshwater species. The estuarine species (white perch, brown bullhead, striped bass, Atlantic menhaden) likely fled into saltier water and were largely unaffected by the event. It is believed that rising salinity concentrated most of the freshwater species into the fresher headwaters of the tributaries and the combined effects of Karlotoxin and osmotic stress killed them. This event was extensively investigated. Compliance issues at some local businesses were enforced, but there was no evidence that these issues caused the kill. A comprehensive report was published by MDE on this event.

The second largest event (#215041) occurred May 22nd in the Potomac River, along the Virginia shoreline from the mouth of Popes Creek to Stratford Hall. Approximately 16,000 fish (eight species but mostly Atlantic menhaden) died when a bloom of the toxic dinoflagellate concentrated along the shoreline. Toxin levels in the water were high enough to kill fish in less than an hour.

The third largest kill (#215064) occurred August 8th at the Bear Creek Trout Hatchery near Friendsville (Garrett County). Approximately 15,000 Rainbow Trout died during the installation of a monitoring guage when an accidental release of wet concrete slurry entered some of the trout holding areas. Historically, the caustic effects of lime have caused several fish kills in Maryland.

The fourth largest kill (#215033) occurred May 16th in Sligo Creek in Takoma Park (Montgomery County). Approximately 4,578 fish (8 species) died after a small storm

passed through the area. This event was the largest of five similar fish kills that occurred simultaneously throughout some of the more developed areas in the state (Montgomery, Prince Georges, and Baltimore County). The kills were preceded by several days of warm, dry weather culminating in approximately 0.25" of rainfall. It is believed that the small amount of rainfall produced a "first flush" of runoff that was not significantly diluted. During investigation, dissolved oxygen was depressed but not lethally low. It is believed that the undiluted first flush of pollen, soil, and non-point source pollutants (fertilizer, detergent, brake dust, etc.) entered the stream, depressed oxygen levels, and may have occluded the gills of aquatic organisms. MDE Compliance and Montgomery County Department of Environmental Protection participated in this investigation. No evidence of release was found from nearby construction work on the areas sanitary sewer system.

The fifth largest kill (#214034) occurred May 16th in Long Branch in Takoma Park (Montgomery County). Approximately 2,899 fish (5 species) and 1,710 Northern two-lined salamanders died after a small storm passed through the area. MDE Compliance and Montgomery County Department of Environmental Protection participated in this investigation. No evidence of release from nearby construction work on the areas sanitary sewer system was discovered. This event was the second largest of five similar events that occurred simultaneously throughout Prince Georges, Montgomery, and Baltimore Counties. The causal scenario used for the Sligo Creek fish kill applies to this event and the others, which occurred in Rock Creek in Montgomery County and in the tidal headwaters of the Anacostia and Back Rivers.

A noteworthy mortality that did not involve fish occurred when approximately 1,000,000 dark false mussels, *Mytilopsis leucophaeta*, died on January 20th in the Port Tobacco River near Chapel Point Park (Charles County). Investigation revealed that

many thousands of shells both empty and with tissue, had washed ashore. Others were still in the shallows at low tide and the dead tissue of thousands was also suspended in the water. Air temperatures had been in the single digits in late winter. It is believed that these mussels died due to a combination of stranding and cold stress.

Pollution Caused Events

Intense local pollution or other direct anthropogenic causes were implicated in eight Maryland events, killing approximately 23,476 fish. Approximately eight pollution caused kills occur in a typical year. All of the confirmed or suspected pollution-caused kills were referred to the appropriate enforcement agencies for follow-up procedures. These kills are presented below, ranked from highest to lowest magnitude of fish mortalities:

- (#214064) occurred August 8th at the Bear Creek Trout Hatchery near Friendsville in Garret County. Approximately 15,000 rainbow trout died due a release of wet concrete (see above).
- (#215033) occurred May 16th in Sligo Creek in Takoma Park, Montgomery County. Investigation revealed that 4,578 fish (8 species) died after a small rain event pushed urban runoff into the stream (see above).
- (#214034) occurred May 16th in Long Branch in Takoma Park, Montgomery County. Investigation revealed that 2,899 fish (5 species) and 1,710 eastern two-lined salamanders died after a small rain event pushed urban runoff into the stream (see above).
- (#215037) occurred May 16th in the tidal headwaters of the Back River in Baltimore County. Investigation revealed that 689 fish (5 species) died after a small rain event pushed urban runoff into the river.

- (#215036) occurred May 16th in the tidal headwaters of the Anacostia River in Prince George's County. Investigation revealed that 140 fish (4 species) died after a small rain event pushed urban runoff into the river.
- (#215057) occurred July 20th in Sligo Creek in Hyattsville, Prince George's County. Investigation revealed that 123 fish (7 species) and 1000 oligochaete worms died after an unknown toxin entered a small unnamed tributary of Sligo creek. The kill was traced upstream to where the tributary came out of the ground from pipes. No discrete source was found.
- (#215038) occurred May 16th in Rock Creek in Kensington, Montgomery County. Investigation revealed that approximately 25 fish (2 species) died after a small rain event pushed urban runoff into the stream.
- (#215011) occurred March 17th in an unnamed tributary of Colgate Creek in Baltimore City. Investigation revealed that 22 fish (2 species) died after 200 gallons of gasoline were spilled during delivery to a station in Dundalk. Much of the spill was contained and recovered by MDE Emergency Response Division personnel.

Species Involved

Fish kills in 2015 affected at least 40 species of fish, representing 18 families and 11 orders (Table 3). Non-piscine species affected were: unidentified turtles (3), unidentified frogs (8), northern two-lined salamander (1,710), blue crab (21), dark false mussel (1,000,000), and unidentified oligochaete worms. Approximately 650 fish were unidentified.

Table 3: Species and Numbers of Individuals Affected by Fish Kills in 2015.

Annelida	
Oligochaeta	
Lumbricidae-Unidentified oligochaete worms	**31,000**
Mollusca	
Bivalvia	
Dreissenidae	
***Mytilopsis leucophaeta*-dark falsemussel**	**1,000,000**
Arthropoda	
Decapoda	
Portunidae	
***Callinectes sapidus*-blue crab**	**21**
Chordata	
Amphibia	
Plethodontidae	
Eurycea bislineata-Northern two-lined salamander	**1,710**
Ranadae-Unidentified frogs	**8**
Reptilia	
Testudines-Unidentified turtle	**3**
Chondrichthyes	
Myliobatiformes	
Rhinopteridae	
***Rhinoptera bonasus*-cownose ray**	**4**
Osteichthyes	
Unidentified bony fish	**650**
Anguilaformes	
Anguilidae	
***Anguilla rostrata*-American eel**	**196**
Atheriniformes	
Cyprinodontidae	
***Fundulus heteroclitus*-mummichog**	**20**
Atherindopsidae	
***Menidia beryllina*-inland silversides**	**2**
Clupeiformes	
Clupeidae	
***Alosa aestivalis*-blueback herring**	**100**
***Alosa pseudoharengus*.-alewife**	**20**
***Alosa sp.* unidentified shad**	**50**
***Brevoortia tyrannus*-Atlantic menhaden**	**18,180**
***Dorosoma cepedianum*-gizzard shad**	**11,807**
Engraulidae	
***Anchoa mitchilli*-bay anchovy**	**350**
Mugiliformes	
Mugilidae	
***Mugil cephalus*-striped mullet**	**100**
Salmoniformes	
Esocidae	

***Esox niger*-chain pickerel**	**2,000**
Salmonidae	
***Oncorhynchus mykiss*-rainbow trout**	**15,098**
***Salmo trutta*-brown trout**	**1**
Cypriniformes	
Cyprinidae	
Unidentified minnows	**100**
***Carassius auratus*-goldfish**	**7**
***Cyprinella* sp.-shiner species**	**10**
***Cyprinus carpio*-common carp/koi**	**1,178**
***Notemigonus crysoleucas*-golden shiner**	**3,500**
***Notropis hudsonis*-spottail shiner**	**4,700**
***Pimephales notatus*-bluntnose minnow**	**1**
***Rhinichthys atratulus*-blacknose dace**	**3,210**
***Rhinichthys cataractae*-longnose dace**	**742**
***Semotilus atromaculatus*–creek chub**	**660**
Catostomidae	
***Catostomus commersoni*-white sucker**	**189**
***Moxostoma erythrurum*-golden redhorse**	**20**
Siluriformes	
Ictaluridae	
Unidentified catfish	**100**
***Ameiurus natalus*-yellow bullhead**	**10**
***Ameiurus nebulosus*-brown bullhead**	**300**
***Ictalurus furcatus*-blue catfish**	**10**
***Ictalurus punctatus*-channel catfish**	**12**
Perciformes	
Centrarchidae	
***Lepomis auritus*-redbreast sunfish**	**274**
***Lepomis gibbosus*-pumpkinseed**	**131,000**
***Lepomis macrochirus*-bluegill**	**3660**
***Lepomis sp*.-unidentified sunfish**	**735**
***Micropterus salmoides*-largemouth bass**	**2240**
***Pomoxis nigromaculatus*-black crappie**	**5338**
Percidae	
***Etheosoma olmstedi*-tesselated darter**	**2**
***Perca flavescens*-yellow perch**	**50,000**
Percopsiformes	
Moronidae	
***Morone americana*-white perch**	**1,115**
***Morone saxatilis*-striped bass**	**740**
Sciaenidae	
***Micropogonus undulatus*-atlantic croaker**	**5**
Plueronectiformes	
Paralichthyidae	
***Paralichthys dentatus*-summer flounder**	**10**
Achiridae	
***Trinectes maculatus*-hogchoker**	**5**