2018 Fish Kill Summary

Maryland Department of the Environment
Water and Science Administration
Bioregulatory Monitoring and Response Division
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 Bioregulatory Monitoring and Response 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.

2018 After Hours fish kill duty roster: Nick Kaltenbach, Chris Luckett, and Charles Poukish.

Others who participated in 2018 investigations:
Kate Ansalvish (MDE-WSA-CP), James Bailey (DNR-TEA), Kathleen Basset (MDE-FSP), Kevin Brittingham (BA-DEP), Gabrielle Cantor (MDE-WSA-CP), Steve Doctor (DNR-FS), Mark Ecker (MDE-WSA-CP), Gretchen Eckstrom (MO-DEP), Mary Groves (DNR-FS), Greg Hazard (MDE-WSA-CP), Brenden Hogan (MDE-WSA-CP), Roman Jessian (MD-CBP), Oladapo John (MDE-WSA-CP), Kevin Kelly (DNR-NRP), Ken Mack (MO- DEP), Mark Matsche (DNR-FWHP), Amanda Penafiel (MES), Ken Staver (WYE), Steve Tubman (VA-DEQ), Robin Tyler (DNREC), Ed Watson (MDE-WSA-CP), Adam Wose (MDE-FSP)

Cooperating agencies in 2018:

MDE- Emergency Response Division (ERD)
Office of Communications and Digital Strategy
Water and Science Admin-Compliance Program (MDE-WSA-CP)
Water and Science Admin-Field Services Program (FSP)
Water and Science Admin-Wetlands & Waterways Prog. (MDE-WWP)

DNR- Fisheries Service (DNR-FS)
Natural Resources Police (DNR-NRP)
Oxford Cooperative Lab, Fish & Wildlife Health Program (DNR-FWHP)
TEA-Tidewater Ecosystem Assessment Division
MANTA-Monitoring and Non-Tidal Assessment Division
Annapolis Field Office
Coastal Bays Program (MD-CBP)

MES- Maryland Environmental Service
MDA- Pesticide Regulation Division
University of Maryland- Institute for Marine and Environmental Technology (IMET)
DNREC-Delaware Department of Natural Resources & Environmental Control
Virginia Department of Environmental Quality (VA-DEQ)
Virginia Department of Health, Division of Shellfish Sanitation (VDH-DSS)
Baltimore County Department of Environmental Protection (BA-DEP)
Montgomery County Department of Environmental Protection (MO-DEP)
WYE- Wye River Research and Education Center

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 2018. 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.

Teams consisting of two or more agencies conducted several of the investigations. MDE Fish Kill Investigation Section personnel conducted 37 investigations, and all investigations were coordinated through this office. Other MDE groups participated in ten: seven by the Water and Science Administration (Inspection and Compliance) and three by the Field Services Program-Shellfish Compliance Division. The Maryland DNR-Fisheries Service participated in four investigations. The DNR Fish and Wildlife Health Program, Tidal Ecosystems Assessment Division, Maryland Natural Resources Police, and The Maryland Coastal Bays Program participated in one each. The Maryland Environmental Service, Wye River Research and Education Center, and both Montgomery and Baltimore County Departments of Environmental Protection participated in one each. The Delaware Department of Natural Resources and Environmental Control participated in two investigations. One event originating in Virginia was investigated by the Virginia Department of Environmental Quality.

Number of Events

Fish kill events typically vary from year-to-year depending upon rainfall, water quality, temperature, ice cover, variations in fish populations, and disease outbreaks. A total of 82 fish kills were reported in 2018, and 56 were considered significant enough to warrant on-site investigation. This represents the sixth lowest number of reports received for a year since 1985, and was 78% of the historic average of 106.8 reports per year. Most fish kills occur in tidal waters during warmer months when waters become warm and stratified, and hypoxia becomes more common. Sixty-seven percent of reported kills occurred during the five month period between April 1 and August 31 (Figure 1). Sixty percent occurred during the four month period of April 1 through July 31.

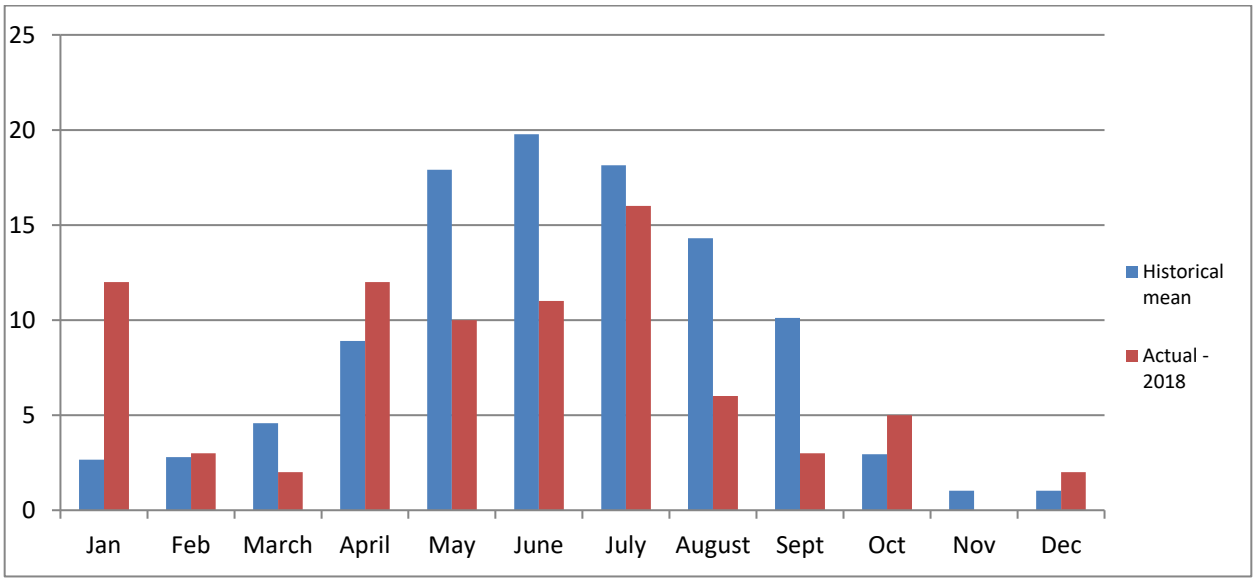


Figure 1. Fish kill reports received by month.

The early weeks of 2018 were characterized by bitterly cold weather. A number of fish kills occurred under ice, especially in shallow wetland areas where more than two million minnows, primarily Fundulus spp and Cyprinodon variegatus (sheepshead

minnow) were frozen into ice in several events on the eastern shore. Winter salinities were about average throughout the Chesapeake Bay. This trend continued until May, when a higher than normal precipitation trend began. From May thru the end of the year, monthly precipitation was above normal and the year became the wettest on record for most of the region (>72 inches at BWI). Accordingly, freshwater input was at or below normal until May. Chlorophyll levels were close to average throughout most of the bay and its tributaries (MD-DNR monitoring data). 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). This pattern resulted in fewer fish kills during the warmest months. Water temperatures remained warm into December.

One water quality related issue contributed to a significant fish kill scenario in the Chesapeake Bay in 2018. Beginning in June, striped bass were concentrated in the bay in the vicinity of Love Point (mouth of Chester River) to Tolchester Beach (Kent County). There was immense recreational fishing pressure in the area. From late June to late July, there were numerous reports of dead striped bass that were stressed from being hooked and fought before ultimately being discarded in a moribund state. Dead striped bass were observed floating in this region of the bay and being deposited on various shorelines. Often there were 400 or more legal size dead fish (> 19 inches) observed floating on a single day. DNR water quality data in July suggested that the fish were suffering from “low dissolved oxygen/temperature squeeze”. This is a phenomenon where fish were concentrated in shallow surface water containing sufficient dissolved oxygen with stressfully high water temperature. Cooler, more tolerable water temperature was present near the bottom layer in the region but it was critically low in dissolved oxygen. This

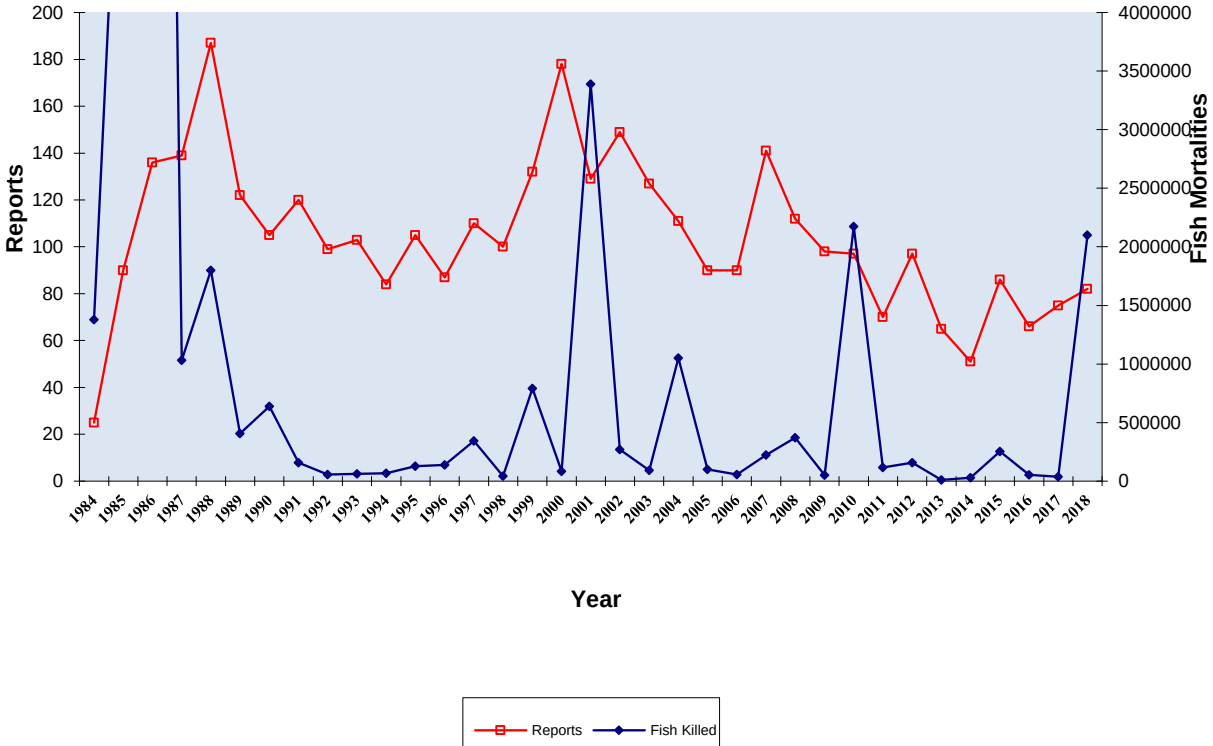
created a one-two punch of stressful water quality and intense recreational angling resulting in approximately 5,000 striped bass mortalities.

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 (Figure 2). 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. Similarly, the icing over of shallow wetland areas in late December 2017 through January 2018, resulted in large mortalities of shoreline fish species, accounting for the vast majority of this year's total.

The total fish mortalities in Maryland for 2018 (2,099,931) is 168 percent of the 35-year average of 1,252,290 (the median is 158,680). It was the fifth highest annual total recorded since 1984.

Figure 2. Reports and Fish Mortalities



Distribution of Fish Kills

Every county except Allegheny, Carroll, Garrett, and Wicomico was affected by fish kills in 2018 (Table 1). The highest number (17) occurred in Anne Arundel County. Baltimore and Calvert Counties had the second highest occurrence with 8. Worcester County had the fourth highest with 6. Saint Mary's was fifth highest with 5. Montgomery, Prince George's, and Somerset were sixth highest with 4. Of these five jurisdictions, all but Worcester rank in the top five for historical reports. Anne Arundel County has had the most reported kills (673) since 1984. Baltimore County ranks second highest with 379. 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 historical incidents. Fish kills attributed to Karlotoxin (either alone or in concert with low Dissolved Oxygen, or high salinity) have accounted for 38 fish kills since 2002. No fish kills attributable to *Karlodinium veneficum* were observed in 2018.

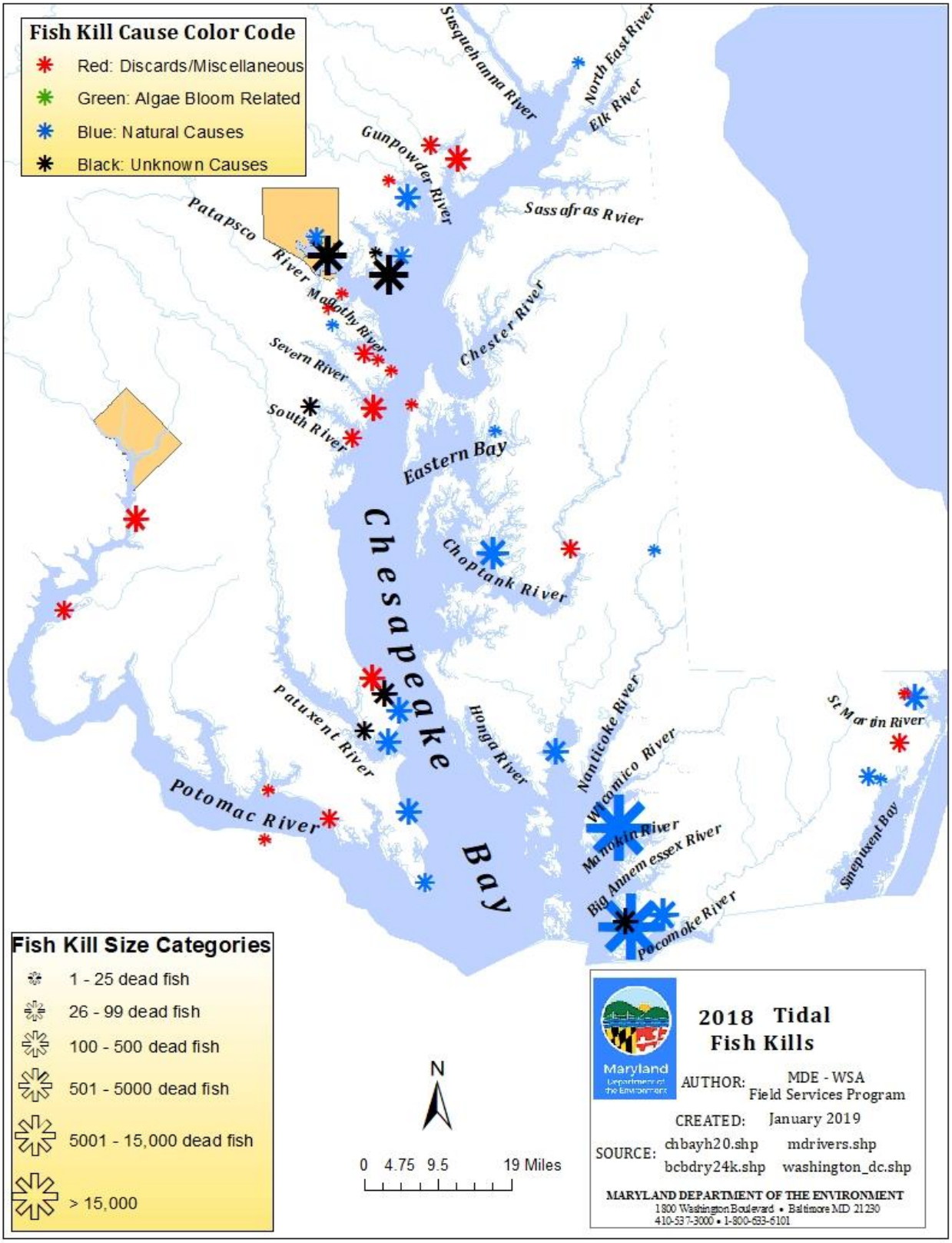
Figure 3 shows the geographical distribution, and magnitude of tidal fish kills, including the causes attributed to them in 2018.

Table 1: Fish Kill Reports by County.

County	# Reports (2018)	# Reports (1984-2018)
Allegany	0	35
Anne Arundel	17	673
Baltimore	8	379
Baltimore City	3	110
Calvert	8	183
Caroline	1	69
Carroll	0	101
Cecil	2	211
Charles	3	133
Dorchester	2	70
Frederick	2	113
Garrett	0	45
Harford	3	178
Howard	1	81
Kent	2	120
Montgomery	4	156
Prince Georges	4	161
Queen Anne's	3	158
Somerset	4	65
St. Mary's	5	192
Talbot	1	96
Washington	1	62
Wicomico	0	104
Worcester	6	107
TOTAL*	80*	3602

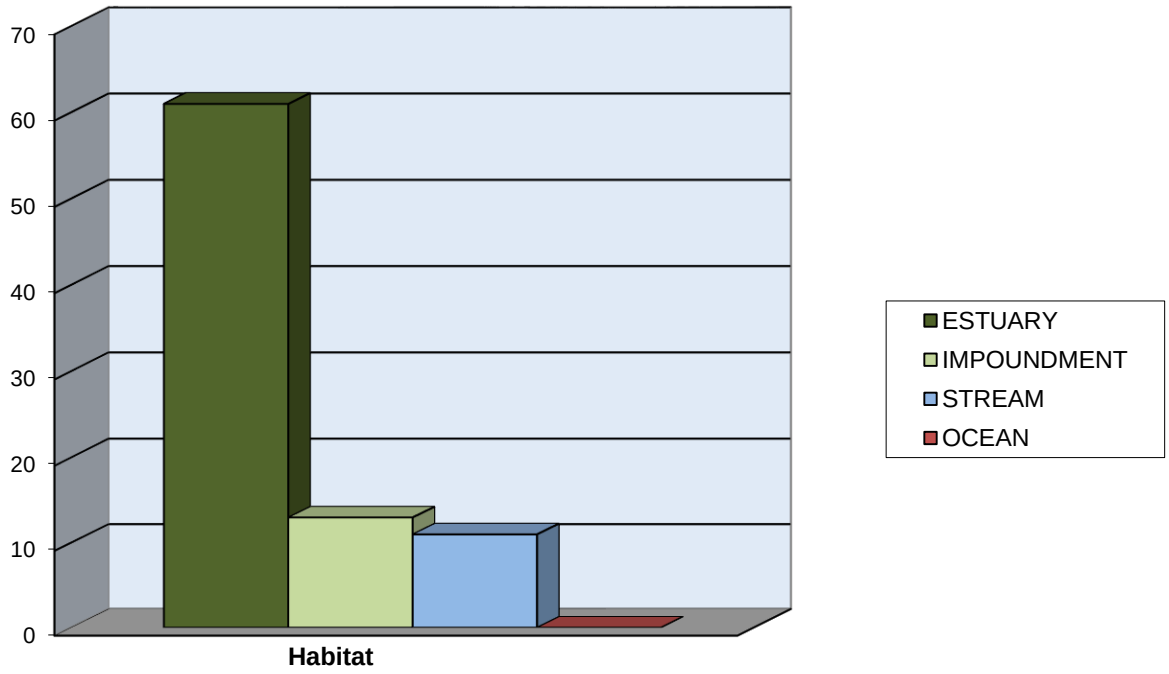
**Totals do not include kills reported out of state or statewide events.*

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



Reported fish kills occurred in various aquatic habitats. There were twelve reported from impoundments, ten from free flowing streams, and sixty from estuarine waters (Figure 4). The number of reports from estuarine waters was at the historic average. The number of reports from streams and impoundments was below average.

Figure 4. 2018 Fish Kills by Environment



Causes of Fish Kills

Of the 82 events reported, 71 were classified as fish kills. Eleven were determined to be a non-kill or insignificant events where no dead fish were found.

Probable cause was determined in 53 of the 71 fish kills (Table 2). Natural causes were implicated in 24 events, including 7 cases of oxygen depletion, 13 cases of winter/seasonal/spawning stress, 2 cases of stranding, and one each of disease and bird

predation. The remaining events included 21 caused by fishing discards, 1 case of entrapment in man-made structures, and 7 pollution cases. There were 18 cases where the cause was undetermined.

Table 2: Probable causes of fish kill reports, 2018.

Probable cause	**2018 Only**	***Percent of Annual Total***	**# of Reports 1984-2018**	***Percent of Historic Total***
Natural	24	29.27%	1477	40.38%
Disease	1		237	
Low dissolved O_2	7		851	
Seasonal / Spawning stress	1		230	
Stranding	2		69	
Salinity shock	0		4	
Thermal shock/Freezing	12		41	
Toxic algae bloom	0		22	
Toxic algae/water quality synergism	0		16	
Storm surge	0		1	
Lightning Strike	0		1	
Predation	1		5	
Pollution	7	8.54%	295	8.06%
Agriculture	1		33	
Municipal sewage	0		46	
Industrial discharge	1		56	
Swimming pool discharge	0		19	
Fuel/Oil spills	1		31	
Unidentified source	3		57	
Construction	1		13	
Municipal discharge	0		25	
Pond Management chemicals	0		15	
Miscellaneous	22	26.83%	781	21.35%
Discards	21		556	
Entrapment	1		152	
Stocking stress, pond Mgmt.	0		65	
Scientific discards, exotic species control	0		8	
Unknown	18	21.95%	834	22.80%
Non-kill	11	13.41%	271	7.41%
TOTAL	**82**		**3658**	

In 2018, no fish kills were attributed to toxins produced by the 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, 38 Karlotoxin associated kills have involved 479,028 fish mortalities. No known human health effects are associated with these phenomena.

Other nuisance algae species (e.g. *Prorocentrum minimum, Gyrodinium uncatenum, G. instriatum*) are not known to be toxic in Maryland, but 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 2,099,931 fish mortalities were confirmed in 2018. An additional 2,403 invertebrates and other aquatic animals also died totaling 2,102,334 organisms for the year.

In an average year approximately 5-10 fish kills in excess of 10,000 fish are noted. Four kills involved more than 10,000 fish in 2018.

The largest kill (#218019) occurred January 23rd in ditches and wetlands in Deal Island Wildlife Management Area (Somerset County). Approximately 2,000,000 fish (three species) died when the late December/early January cold snap resulted in the rapid freezing over of shallow habitats. Many fish, shoreline species, were trapped and frozen in ice.

The second largest event (#218009) occurred January 22nd in a ditch in Crisfield (Somerset County). Approximately 50,000 fish (three species) died when the late December/early January cold snap resulted in the rapid freezing over of shallow habitats. Many fish, shoreline species, were trapped and frozen in ice.

The third largest kill (#218026) occurred April 27th in the lower Back River around Wildwood Beach and Rocky Point Park (Baltimore County). Approximately 15,000 Atlantic menhaden died in this event that occurred simultaneously with a similar kill in the Patpasco River (#218027).

The fourth largest kill (#218027) also occurred April 27th in The Patapsco River. The dead fish were first observed floating from the Key Bridge into the inner Harbor (Baltimore County and City). Approximately 15,000 Atlantic menhaden died in an event that occurred simultaneously with a similar kill in the Back River (#218026).

A multi-agency effort was unable to determine the cause of these two events. An irritant was implied during histopathology analysis. The events occurred and ended very quickly and only one species was involved. No harmful algae blooms, compliance violations, or commercial fishing activities were noted in these areas at the time. Water quality was acceptable. No site of a potential stranding or entrapment was located.

Pollution Caused Events

Intense local pollution or other direct anthropogenic causes were implicated in seven Maryland events, killing approximately 7,454 fish. Approximately eight pollution caused kills occur in a typical year. All pollution-caused kills were referred to the appropriate enforcement agencies for follow-up procedures.

- (#218078) (and the fifth largest kill of the year) occurred October 9th in Cattail Branch, a tributary of the Monocacy River in Emmetsburg (Frederick County). Approximately 5,314 fish died after a mis-application of manure entered the stream, resulting in high BOD and low dissolved oxygen.
- (#218012) occurred January 28th in a private pond in Rising Sun (Cecil County). Approximately 2,000 bluegills died after a fuel oil spill entered the pond.
- (#218021) occurred April 4 in Stony Run in Baltimore City. Approximately 45 fish (4 species) died when an unknown toxin entered the stream. It is suspected that the toxin was chlorine from a swimming pool.
- (#218006) occurred January 19th in and unnamed tributary and in Rock Run in Potomac (Montgomery County). Approximately 25 fish (6 species) and two turtles died after a golf course pond was lowered, discharging a heavy load of sediment and many of the ponds fish into the streams.
- (#218065) occurred July 20th in Beaver Dam Creek in Union Bridge (Frederick County). A cement truck overturned at the bridge over the creek and lost much of its load. Investigation revealed that at least 18 fish (5 species) died in the high pH plume that resulted. Heavy rains after the event prevented an accurate damage assessment.

- (#218069) occurred August 12th in an unnamed tributary to the Patuxent River in Columbia (Howard County). Investigation revealed that approximately 25 fish (2 species) died when an unknown toxin entered the stream. It is suspected that the toxin was chlorine from a nearby community pool.
- (#218029) occurred April 29th in a Stony Run in Baltimore City. Approximately 18 blacknose dace died when an unknown toxin entered the stream. It is suspected that the toxin was chlorine from a swimming pool.

Species Involved

Fish kills in 2018 affected at least 37 species of fish, representing 18 families and 12 orders (Table 3). Non-piscine species affected were: turtles (2), unidentified tadpoles (2,000), unidentified frogs (5), penaeid shrimp (200), blue crab (189), horseshoe crab (5), and common bottlenose dolphin (1). Approximately 5,867 fish were unidentified.

Table 3: Species and Numbers of Individuals Affected by Fish Kills in 2017.

Arthropoda	
Xiphosura	
Limulidae	
***Limulus polyphemus*-horseshoe crab**	**6**
Decapoda	
Portunidae	
***Callinectes sapidus*-blue crab**	**189**
Penaeidae (unidentified commercial shrimp)	**200**
Chordata	
Amphibia-	
Unidentified frog	**5**
Unidentified tadpole	**2,000**
Reptilia	
Testudines-Unidentified turtle	**2**
Mammalia	
Delphinidae	
***Tursiops truncatus*-common bottlenose dolphin**	**1**
Osteichthyes	
Unidentified bony fish	**5,867**
Anguillaformes	
Anguillidae	
***Anguilla rostrata*-American eel**	**46**
Batrachoidiformes	
Batrachoididae	
***Opsanus tau*-oyster toadfish**	**31**
Cyprinodontiformes	
Fundulidae	
***Fundulus* sp. unidentified killifish**	**50**
***Fundulus diaphanus*-banded killifish**	**440,100**
***Fundulus heteroclitus*-mummichog**	**1,207,500**
Lucania parva-rainwater killifish	**7,500**
Cyprinodontidae	
***Cyprinodon variegatus*-sheepshead minnow**	**401,100**

Myliobatiformes	
Rhinopteridae	
***Rhinoptera bonasus*-cownose ray**	**12**
Tetraodontiformes	
Tetraodontidae	
***Sphoeroides maculatus*-northern puffer**	**1**
Clupeiformes	
Clupeidae	
***Alosa sp*-unidentified shad**	**12**
Alosa aestivalis-blueback herring	**1**
***Brevoortia tyrannus*-Atlantic menhaden**	**30,341**
***Dorosoma cepedianum*-gizzard shad**	**709**
Engraulidae	
***Anchoa mitchilli*-bay anchovy**	**200**
Beloniformes	
Belonidae	
Strongylura marina.-Atlantic needlefish	**1**
Siluriformes	
Ictaluridae	
Unidentified catfish	**45**
***Ameiurus nebulosus*-brown bullhead**	**231**
***Ictalurus punctatus*-channel catfish**	**3**
Esociformes	
Esocidae	
***Esox niger*-chain pickerel**	**1**
Cypriniformes	
Cyprinidae	
***Campostoma anomalum*-central stoneroller**	**2**
***Carassius auratus*-goldfish**	**3**
***Cyprinus carpio*-common carp/koi**	**57**
***Exoglossum maxilingua*-cutlips minnow**	**8**
***Rhinichthys atratulus*-blacknose dace**	**61**
***Rhinichthys cataractae*-longnose dace**	**4**
***Semotilus atromaculatus*–creek chub**	**6**
Catostomidae	
***Catostomus commersoni*-white sucker**	**1**
Plueronectiformes	
Paralichthyidae	
***Paralichthys dentatus*-summer flounder**	**10**
Achiridae	
***Trinectes maculatus*-hogchoker**	**400**

Perciformes	
Centrarchidae	
***Lepomis auritus*-redbreast sunfish**	**5**
***Lepomis cyanellus*-green sunfish**	**100**
***Lepomis macrochirus*-bluegill**	**3,937**
***Lepomis sp.*-unidentified sunfish**	**157**
***Micropterus salmoides*-largemouth bass**	**56**
***Pomoxis sp.*-unidentified crappie**	**150**
Moronidae	
***Morone americana*-white perch**	**288**
***Morone saxatilis*-striped bass**	**885**
Percidae	
Unidentified darter	**7**
***Etheostoma flabellare*-fantail darter**	**3**
***Etheostoma olmstedi*-tessellated darter**	**0**
***Perca flavescens*-yellow perch**	**0**