2020 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.

2020 After Hours fish kill duty roster: Nick Kaltenbach, Chris Luckett, and Charles Poukish.

Others who participated in 2020 investigations:
Kathleen Basset (MDE-FSP), Kevin Bull (MDE-WSA-CP), Adriana Frangos (MDE-WSA-CP), John Holt (MDE-FSP), Thomas Johnson (MDE-WSA-CP), Rusty Mckay (MDE-FSP), Joe Miller (MDE-WSA-CP), Allison O'Hanlon (MDE-FSP), Ryan Snader (MDE-FSP)

Cooperating agencies in 2020:

MDE- Emergency Response Division (ERD)
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)
MEMA-Maryland Emergency Management Administration
MES- Maryland Environmental Service
MDA- Pesticide Regulation Division
University of Maryland- Institute for Marine and Environmental Technology (IMET)
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)

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 2020. 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 41 investigations, and all investigations were coordinated through this office. Other MDE groups participated in ten: five by the Water and Science Administration (Compliance Program) and five by the Field Services Program (Shellfish Compliance Division or Chemical and Biological Division.

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 73 fish kills were reported in 2020, and 45 were considered significant enough to warrant on-site investigation. This represents the fifth lowest number of reports received for a year since 1985 and was 69.4% of the historic average of 105.2 reports per year. Most fish kills occur in tidal waters during warmer months when waters become warm and stratified, and hypoxia becomes more common. In 2020, eighty-nine percent of reported kills occurred during the five-month period between May 1 and September 30 (Figure 1). Eighty-three percent occurred during the four-month period of May 1 through August 31.

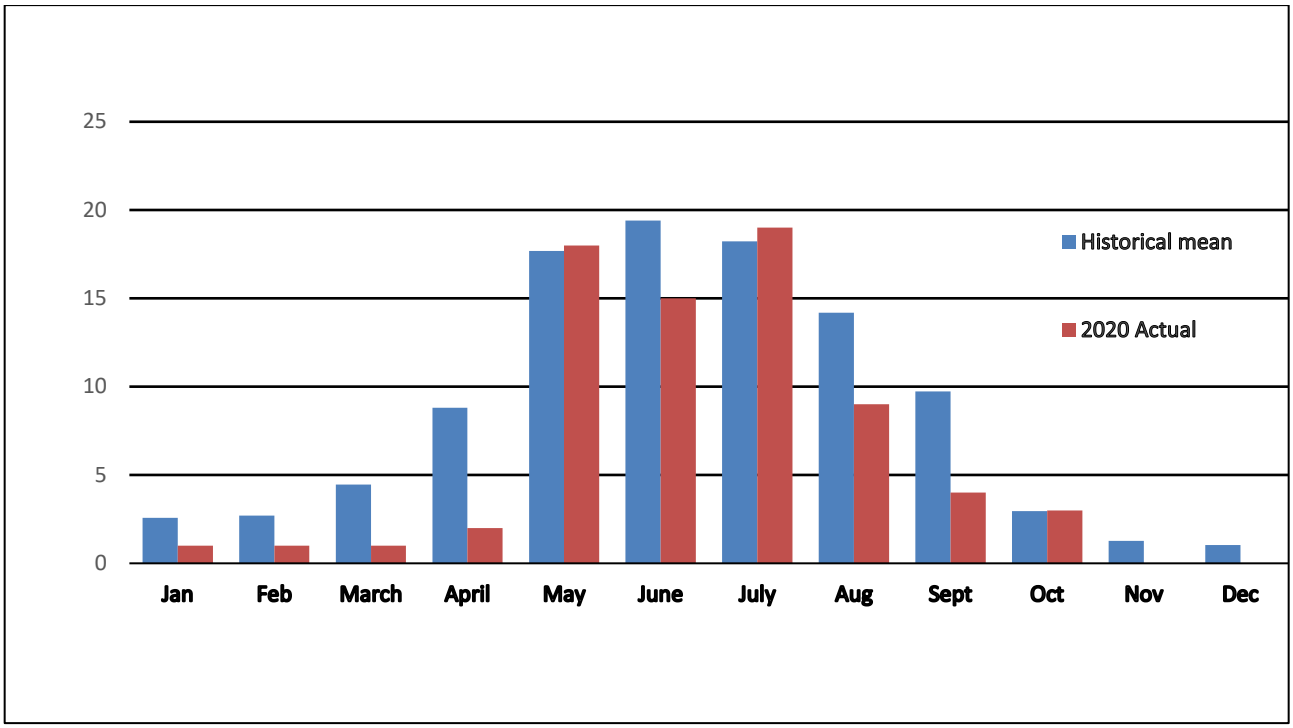

Figure 1. Fish kill reports received by month.

After having been unusually fresh for most of 2019, the Chesapeake Bay and many of its tributaries entered a dry and warm fall. By January and February 2020, tidal bay waters had generally returned to average or above average salinity. Spring rains briefly depressed salinities to below average in May. Then Chesapeake Bay area salinity returned to normal or slightly above for the rest of the year (MD DNR, Eyes on the Bay 2020).

Water temperatures in the Chesapeake Bay and many tributaries were well above average from January 2020 into May. Temperature was about normal from June to August, below average in September, then average to above average to finish the year (MD DNR, Eyes on the Bay 2020).

The Chesapeake Bay dead zone (the percentage of mainstem of the bay where Dissolved oxygen is below 2 mg/l) was below average in size all year except for a 3 to 4-week period from about July 7 to August 2 (MD DNR, Eyes on the Bay 2020).

High temperature, excess nutrients, and low dissolved oxygen were ultimately responsible for widespread fish kill events during late May and early August. Extensive heavy blooms of the dinoflagellate, *Prorocentrum minimum,* initially formed along the western shore from mid Calvert County north into the Patapsco River in early May. As the bloom began to die off from May 21-31 there were many color and foam complaints, followed by a series of surface water low dissolved oxygen fish kills in the Severn, Magothy, and Patapsco Rivers, accounting for approximately 100,000 fish mortalities.

Localized deep-water pockets of low dissolved oxygen formed on the western shore in July as surface water dissolved oxygen begin to stabilize. Windy conditions in early August caused deep hypoxic water to intrude onto the shoreline, resulting in three fish kills in the Severn River, accounting for just over 10,000 fish mortalities.

Magnitude of Events

MDE estimates the number of fish and other animals involved in each event. Single events may dominate the total number of mortalities 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 menhaden schools became smaller and less plentiful in Chesapeake Bay, the number and magnitude of these kills fell. Similarly, the sudden icing over of shallow wetlands in the winter of 2017-18, resulted in large mortalities of shoreline fish species that dominated the yearly totals for this period.

The total fish mortalities in Maryland for 2020 (140,721) is 11.83 percent of the 36-year average of 1,189,375 (the median is 158,3760). It was the eighteenth highest annual total recorded since 1984.

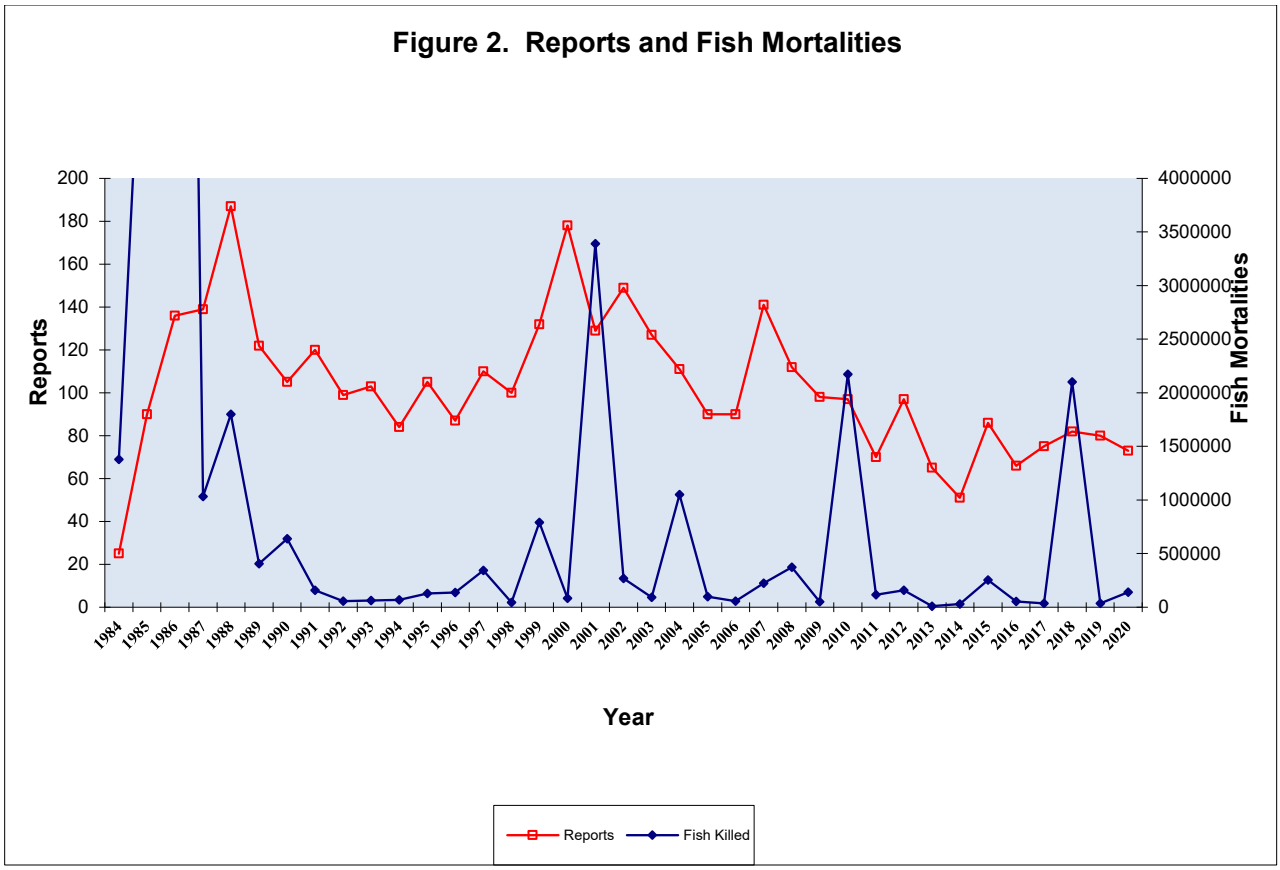
Figure 2. Reports and Fish Mortalities
Reports
Fish Mortalities
Year
Reports
Fish Killed
0
20
40
60
80
100
120
140
160
180
200
0
500000
1000000
1500000
2000000
2500000
3000000
3500000
4000000
1984
1985
1986
1987
1988
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2016
2017
2018
2019
2020

Distribution of Fish Kills

Every county except Carroll, Garrett, and Somerset was affected by fish kills in 2020 (Table 1). The highest number (20) occurred in Anne Arundel County. Saint Mary's had the second highest occurrence with 10. Baltimore County had the third highest occurrence with 6. Frederick County had the fourth highest with 5. Calvert County had the fifth highest with 4. Harford County and Baltimore City had the sixth highest with 3. Of these seven jurisdictions, all but Frederick and Baltimore City rank in the top six for historical reports. Anne Arundel County has had the most reported kills (704) since 1984. Baltimore County ranks second highest with 389. 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 2020.

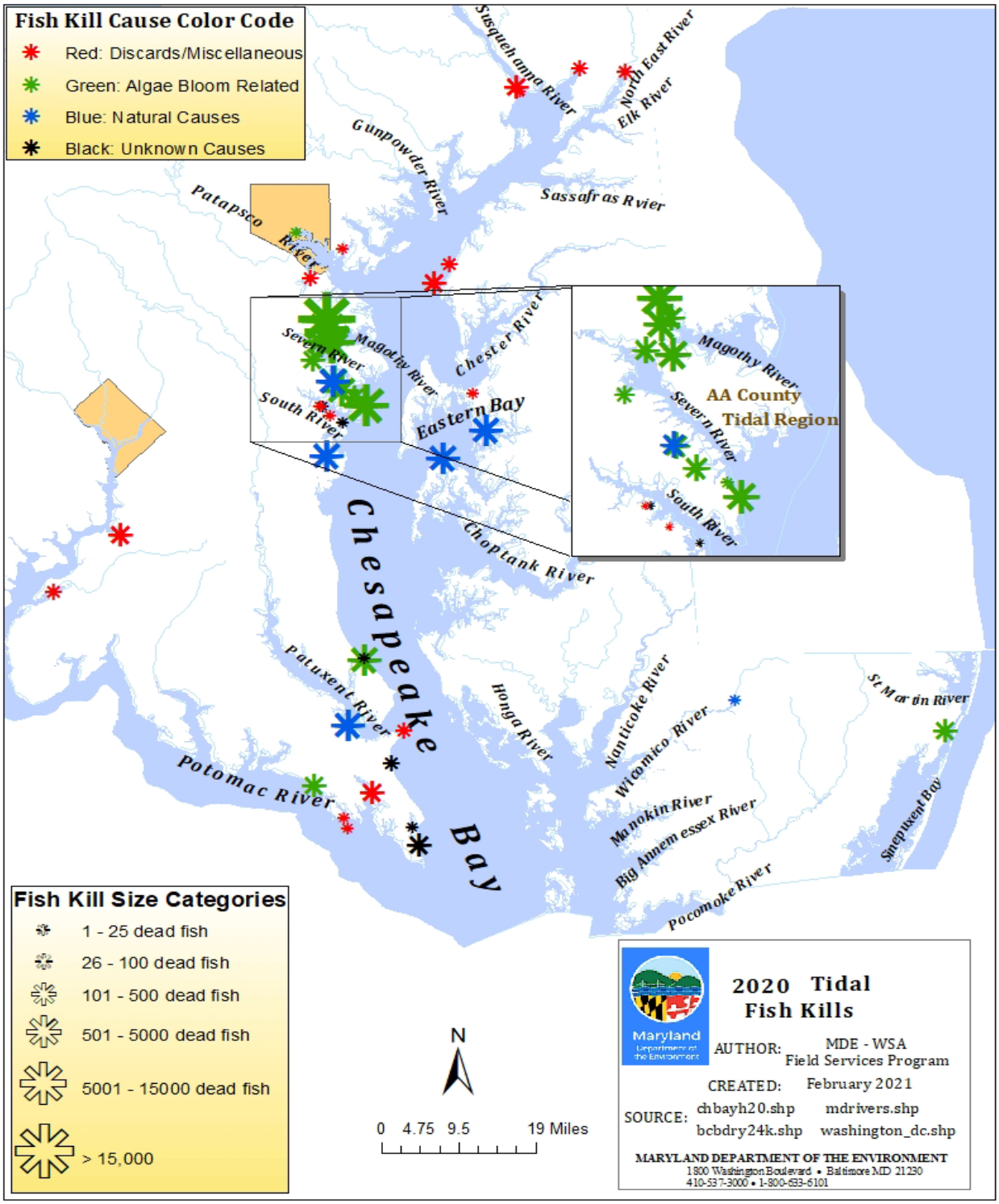
Table 1: Fish Kill Reports by County.

County	# Reports (2020)	# Reports (1984-2020)
Allegany	1	36
Anne Arundel	20	704
Baltimore	6	389
Baltimore City	3	116
Calvert	4	191
Caroline	2	74
Carroll	0	101
Cecil	2	216
Charles	2	137
Dorchester	1	73
Frederick	5	119
Garrett	0	45
Harford	3	183
Howard	1	82
Kent	3	129
Montgomery	1	161
Prince Georges	2	167
Queen Anne's	1	169
Somerset	0	65
St. Mary's	10	217
Talbot	2	100
Washington	1	63
Wicomico	2	107
Worcester	1	110
TOTAL*	73*	3754*

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

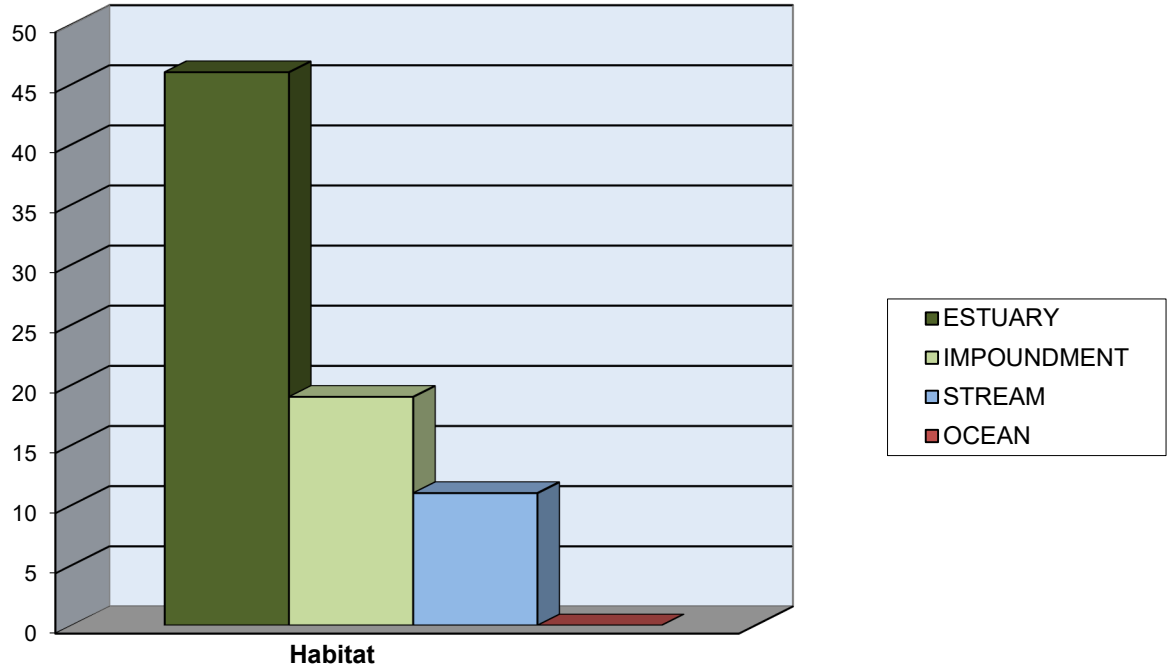
Figure 3 shows the geographical distribution, magnitude, and causes of tidal water fish kills that occurred in 2020.

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



Reported fish kills occurred in various aquatic habitats. There were eighteen reported from impoundments, ten from free-flowing streams, and forty-five from estuarine waters (Figure 4). The number of reports from estuarine waters was fourteen below the historic average. The number of reports from impoundments was ten below average. The number from streams was four below average. The percentage of fish kill reports from estuarine waters (61.64%) was about the historical average (59.49%).

Figure 4. 2020 Fish Kills by Environment



Causes of Fish Kills

Of the 73 events reported, 70 were classified as fish kills, and three were determined to be non-kills or insignificant events where no dead fish were found.

Probable cause was determined in 60 of the 70 fish kills (Table 2). Natural causes were implicated in 34 events, including 25 cases of oxygen depletion, and 3 cases of

seasonal spawning stress, three cases of salinity/osmotic stress, two cases of stranding, and one case of disease were determined. The remaining events included 12 caused by fishing discards, 8 cases of entrapment in man-made structures, and 6 pollution cases. There were 10 cases where the cause was undetermined.

Table 2: Probable causes of fish kill reports, 2020.

Probable cause	**2020 Only**	***Percent of Annual Total***	**# of Reports 1984-2020**	***Percent of Historic Total***
Natural	34	46.58%	1540	40.41%
Disease	1		238	
Low dissolved O_2	25		899	
Seasonal / Spawning stress	3		235	
Stranding	2		73	
Salinity/Osmotic shock	3		9	
Thermal shock/Freezing	0		41	
Toxic algae bloom	0		22	
Toxic algae/water quality synergism	0		16	
Storm surge	0		1	
Lightning Strike	0		1	
Predation	0		5	
Pollution	6	8.22%	303	7.95%
Agriculture	1		34	
Municipal sewage	0		46	
Industrial discharge	1		57	
Swimming pool discharge	0		19	
Fuel/Oil spills	1		32	
Unidentified source	0		57	
Construction	0		13	
Municipal discharge	3		30	
Pond Management chemicals	0		15	
Miscellaneous	20	27.40%	829	21.75%
Discards	12		592	
Entrapment	8		163	
Stocking stress, pond Mgmt.	0		66	
Scientific discards, exotic species control	0		8	
Unknown	10	13.70%	862	22.62%
Non-kill	3	4.11%	277	7.27%
TOTAL	**73**		**3811**	

In 2020, 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, Levanderia fissa (*formerly *Gyrodinium uncatenum and 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 140,721 fish mortalities were confirmed in 2020. An additional 12,209 invertebrates and other aquatic animals also died totaling 152,930 organisms for the year.

In an average year approximately 5-10 fish kills in excess of 10,000 fish are noted. One kill involved more than 10,000 fish in 2020.

The largest kill (#220021) occurred May 31st in the Magothy River, from the mouth of Cattail Creek to just below Magothy Bridge (Anne Arundel County). Approximately 78,720 fish (seven species) and 800 blue crabs died as a result of low dissolved oxygen at the onset of a die off of the dinoflagellate, *Prorocentrum minimum*. This year's spring bloom of P. minimum was especially widespread and intense.

The second largest kill (#220019) also occurred May 31st in Cattail Creek, from the mouth to the tidal head (Anne Arundel County). Approximately 7871 fish died (two species), also as a result of the seasonal *P. minimum* die off and resulting low dissolved oxygen.

The third largest kill (#220059) occurred August 5th at mouth of Lake Ogleton, a tidal embayment off the lower Severn River (Anne Arundel County). Approximately 7,000 Atlantic menhaden died after hypoxic bottom water intruded to the surface along the shoreline. This was the largest of three similar events that occurred in the Severn River over a 24-hour period.

Pollution Caused Events

Intense local pollution or other direct anthropogenic causes were implicated in six Maryland events that totaled approximately 13,634 fish. Approximately eight pollution caused fish kills occur each year. All six pollution related events were referred to the appropriate enforcement agencies for follow-up procedures.

- (#220005) occurred April 16th in Stony Run, a tributary of the Jones Falls (Baltimore City). Approximately 5,392 fish (11 species) and 597 salamanders died as a result of a water main break with high levels of chlorine. The fish kill continued from the site of the break for 1.44 miles to the confluence with Jones falls.
- (#220033) occurred June 24th in an unnamed tributary of Cattail Branch, a tributary of the Monocacy River in Emmitsburg (Frederick County). Approximately 5,000 fish (at least four species) and 100 crayfish died as a result of a manure discharge at a dairy farm in Pennsylvania.
- (#220055) occurred July 31st in Piscataway Creek in Clinton (Prince George's County). Approximately 2,347 fish (18 species) died after a discharge of aqueous film forming foam (AFFF) (fire retardant foam) occurred in a hangar at Joint Base Andrews. Investigation revealed that the material traveled to the creek and covered it in foam, depriving the fish of oxygen. AFFF contains per- and poly-fluoroalkyl substances, contaminants of emerging concern, as some are now linked to cancer. It is used in many substances, including cookware, carpet and fabric. When added to AFF, it's heat resistance, and rapid expansion can quickly extinguish fires by covering them and depriving them of oxygen.

- (#220073) occurred October 17th in Bynum Run in Forest Hill (Harford County). Approximately 780 fish (9 species) died after a fire at a nearby spice company. Runoff of water and spices from the fire suppression effort resulted in the kill. It is unknown whether the elevated turbidity (via gill occlusion), oxygen deprivation from elevated BOD, or acute toxicity of the runoff induced the kill.
- (#220070) occurred September 24th in Bear Branch Creek in MIllersville (Anne Arundel County). Approximately 111 fish (1 species) died after a discharge of aqueous film form forming foam (AFFF) occurred at the Anne Arundel Fire Training Academy. Investigation revealed that the material traveled to the creek and covered it in foam, depriving the fish of oxygen. Near the source and at other locations where there was significant agitation from stream flow (or stream blockages caused by fallen trees), the foam was as much as ten feet high.
- (#220003) occurred March 17th in Faulkner Branch, a tributary of the Marshy Hope Creek in Federalsburg (Caroline County). Approximately 2 fish (2 species) and 25 frogs died after a fuel oil leak from a nearby oil and gas company entered a wetland and the stream.

Species Involved

Fish kills in 2020 affected at least 48 species of fish, representing 18 families and 13 orders (Table 3). Non-piscine species affected included sea nettles, grass shrimp, blue crabs, crayfish, clams, salamanders, frogs, snapping turtles, red eared sliders, cormorants, and a bottlenose dolphin. Approximately 2,401 fish were unidentified.

Table 3: Species and Numbers of Individuals Affected by Fish Kills in 2020.

Cnidaria	
Scyphozoa	
Pelagiidae	
Chrysaora quinquecirrha – sea nettle	**40**
Arthropoda	
Decapoda	
Palaemonidae	
Palaemonetes sp. – grass shrimp	**9**
Portunidae	
***Callinectes sapidus* - blue crab**	**421**
Cambaridae (unidentified crayfish)	**100**
Mollusca	
Bivalvia	
Tellinidae	
***Macoma balthica*- baltic macoma**	**11,000**
Chordata-Amphibia	
Plethodontidae (unidentified salamanders)	**597**
Ranidae (unidentified frogs)	**25**
Chordata-Reptilia	
Chelydridae	
***Chelydra serpentina* – common snapping turtle**	**2**
Emydidae	
***Trachemys scripta elegans* – red-eared slider**	**2**
Chordata-Aves	
Phalacorcoraciae	
***Phalacrocorax auratus* – double crested cormorant**	**12**
Chordata- Mammalia	
Delphinidae	
***Tursiops truncates* – common bottlenose dolphin**	**1**
Chordata-Osteichthyes	
Unidentified bony fish	**2,401**
Petromyzontiformes	
Petromyzontidae	
***Lampetra aepyptera* – least brook lamprey**	**17**

Myliobatiformes	
Rhinopteridae	
Rhinoptera bonasus – cownose ray	**1**
Anguillaformes	
Anguillidae	
***Anguilla rostrata* - American eel**	**88**
Cyprinodontiformes	
Fundulidae	
***Fundulus diaphanus* – banded killifish**	**35**
***Fundulus* sp. – unidentified killifish**	**200**
Esociformes	
Esocidae	
***Esox niger* - chain pickerel**	**1**
Salmoniformes	
Salmonidae	
***Oncorynchus mykiss* – rainbow trout**	**1**
***Salmo trutta* – brown trout**	**240**
Clupeiformes	
Clupeidae	
Alosa aestivalis - blueback herring	**1**
***Brevoortia tyrannus* - Atlantic menhaden**	**109,628**
***Dorosoma cepedianum* - gizzard shad**	**1,593**
Siluriformes	
Ictaluridae	
***Amieurus natalis* – yellow bullhead**	**16**
***Amieurus nebulosus* – brown bullhead**	**116**
***Amieurus* sp. – unidentified bullhead**	**98**
***Ictalurus punctatus* - channel catfish**	**95**
***Noturus insignis* - margined madtom**	**102**
***Pylodictis olivaris* – flathead catfish**	**1**
Cypriniformes	
Cyprinidae	
Unidentified minnow	**1900**
***Campostoma anomalum* - central stoneroller**	**779**
***Cyprinella analostana* – satinfin shiner**	**282**
***Cyprinus carpio* - common carp/koi**	**171**
***Exoglossum maxillingua* – cutlips minnow**	**88**
***Nocomis micropogon* – river chub**	**56**
***Notemigonus chrysoleucas* – golden shiner**	**10**
***Notropis hudsonius* – spottail shiner**	**98**
***Notropis procne* – swallowtail shiner**	**493**
***Pimephales notatus* – bluntnose minnow**	**60**
***Rhinichthys atratulus* - blacknose dace**	**3,959**
***Rhinichthys cataractae* - longnose dace**	**850**
***Semotilus atromaculatus* – creek chub**	**473**
***Semotilus corporalis* - fallfish**	**116**
Catostomidae	
***Catostomus commersoni* - white sucker**	**393**
***Hypentelium nigricans* – northern hogsucker**	**40**
***Moxostoma erythrurum* – golden redhorse**	**2217**

Scorpaeniformes	
Cottidae	
***Cottus caeruleomentum* – blue ridge sculpin**	**480**
Plueronectiformes	
Achiridae	
***Trinectes maculatus* – hogchoker**	**52**
Gobiiformes	
Gobiidae	
***Gobiosoma bosc* – naked goby**	**1**
Perciformes	
Centrarchidae	
***Lepomis auritus* – redbreast sunfish**	**190**
***Lepomis cyanellus* - green sunfish**	**127**
***Lepomis gibbosus* - pumpkinseed**	**3,973**
***Lepomis macrochirus* - bluegill**	**1,037**
***Lepomis sp.*- unidentified sunfish**	**2,055**
***Micropterus dolomieu* – smallmouth bass**	**514**
***Micropterus salmoides* - largemouth bass**	**238**
***Pomoxis sp.* - unidentified crappie**	**12**
***Pomoxis nigromaculatus* - black crappie**	**95**
Moronidae	
***Morone americana* - white perch**	**85**
***Morone saxatilis* - striped bass**	**308**
***Morone chrysops x saxatilis* – hybrid striped bass**	**100**
Percidae	
Percidae sp. Unidentified darters	**118**
***Etheostoma olmstedi* – tessellated darter**	**302**
***Sander vitreus* - walleye**	**1**
Pomatomidae	
***Pomatomus salatrix* - bluefish**	**1**
Sciaenidae	
***Leiostomus xanthurus* - norfolk spot**	**3,913**
***Micropogonias undulatus* – Atlantic croaker**	**500**

References

MD DNR, Eyes on the Bay web site, 2020