2019 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.

2019 After Hours fish kill duty roster: Nick Kaltenbach, Chris Luckett, and Charles Poukish.

Others who participated in 2019 investigations:
Kathleen Basset (MDE-FSP), Jeff Carter (MDE-WSA-FSP), Rusty Mckay (MDE-FSP), Joe Miller (MDE-WSA-CP), Eric Naibert (MO-DEP), Waldo Nelson (MDE-FSP), Adam Wose (MDE-FSP)

Cooperating agencies in 2019:

- 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 2019. 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 36 investigations, and all investigations were coordinated through this office. Other MDE groups participated in eight: one by the Water and Science Administration (Inspection and Compliance) and seven by the Field Services Program-Shellfish Compliance Division. The Montgomery County Department of Environmental Protection participated in one.

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 80 fish kills were reported in 2019, and 43 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 75.4% of the historic average of 106.1 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-four percent of reported kills occurred during the five-month period between April 1 and August 31 (Figure 1). Sixty-nine percent occurred during the four-month period of May 1 through August 31.

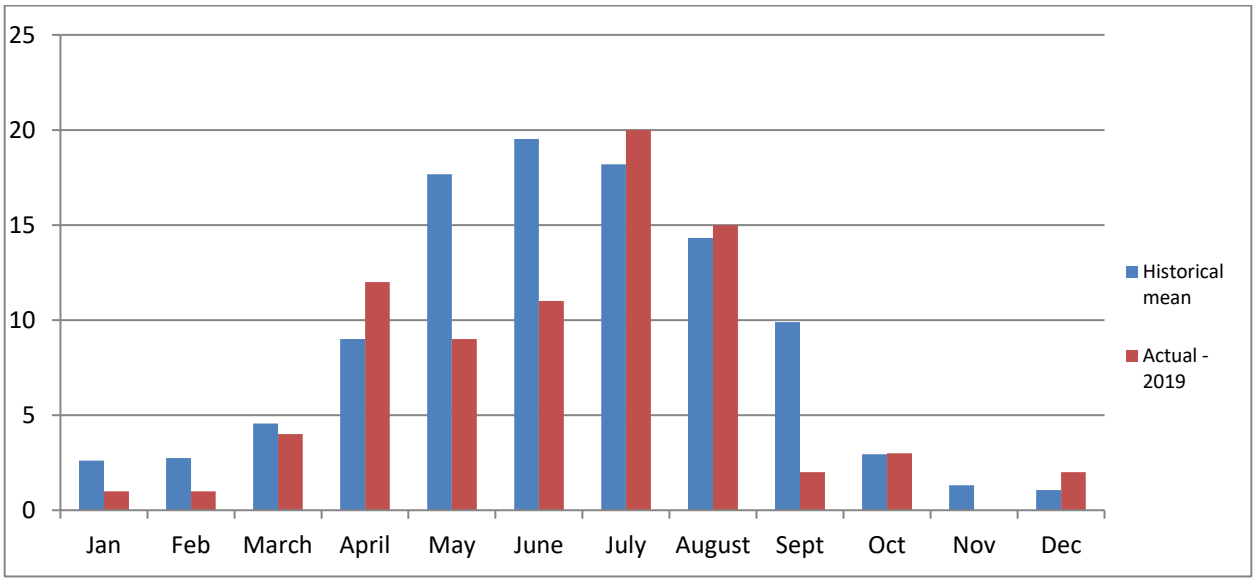


Figure 1. Fish kill reports received by month.

In 2018 the region experienced record rainfall from May to the year's end. In 2019, the Chesapeake Bay and many of its tributaries were largely tidal fresh for much of the year. Rainfall in 2019 was about normal, without prolonged dry periods, and salinities

gradually rose to about normal by year's end. By mid-summer, the annual dead zone had formed and was reportedly above average in size and volume. However, hypoxia was not common in the tributaries as is often the case when high temperature and low rainfall occur.

The first scenario of 2019 that adversely affected aquatic life was the result of low salinity and osmotic stress. In areas where salinities are normally 5-10 ppt during late 2019, bivalves were subjected to salinities between 0-5 ppt for months. Two related mortality events were reported in January. Hundreds of razor clams (*Ensis directus*) were reported washing ashore along Calvert county beaches during winter storm events. At the same time, approximately one million of dead bent mussel (*Ishadium recurvum*) were also reported to be washing ashore in the Potomac River from Maryland Point to the Route 301 Bridge. It is presumed that these organisms died in late 2018 and wind driven waves eventually pushed the shells ashore. Freshet-driven mortality events in estuarine bivalves are not uncommon in this region. MDE's biological monitoring project at Hart-Miller Island has documented several of these die offs in the Balthic Macoma clam (Macoma balthica) over the last 35 years. A major die off of M. balthica was again documented by that project in fall of 2018 (Carter et. al., 2020).

Another water quality related issue contributed to a significant fish kill scenario in the Chesapeake Bay in 2019. Beginning in late June, and lasting until late August, striped bass and the recreational fishing fleet were concentrated in the bay in the vicinity of the Bay Bridge on Kent Island (mouth of Chester River) to Tolchester Beach (Kent County). There was immense fishing pressure in the area. During this period, there were numerous reports of moribund and dead striped bass associated with recreational and

commercial fishing activities. Dead striped bass were observed floating in this region of the bay and being deposited on various shorelines. On an average day, there were 100 or more legal size striped bass (> 19 inches) observed. This sustained striped bass fish kill was very similar to events observed in 2018. Although local pound nets in the vicinity of Swan Point likely contributed to these mortalities, the vast majority of dead fish were undoubtedly caused by hook-and-line stress. During the month of July, hundreds of recreational boats were observed near the mouth of the Chester River during day light hours and night fishing close to the Bay Bridges.

This mortality event is attributable to a combination of hooking stress and “low dissolved oxygen/temperature squeeze”. This scenario occurred because striped bass were forced to concentrate in warm (>85 F°) shallow surface water because more tolerable temperatures near the bottom were critically low in dissolved oxygen. This event was essentially caused by a one-two punch consisting of stressful water quality, concentrated fish, and intense recreational angling. Approximately 5,000 striped bass mortalities were estimated to have occurred in this region in both 2018 and 2019.

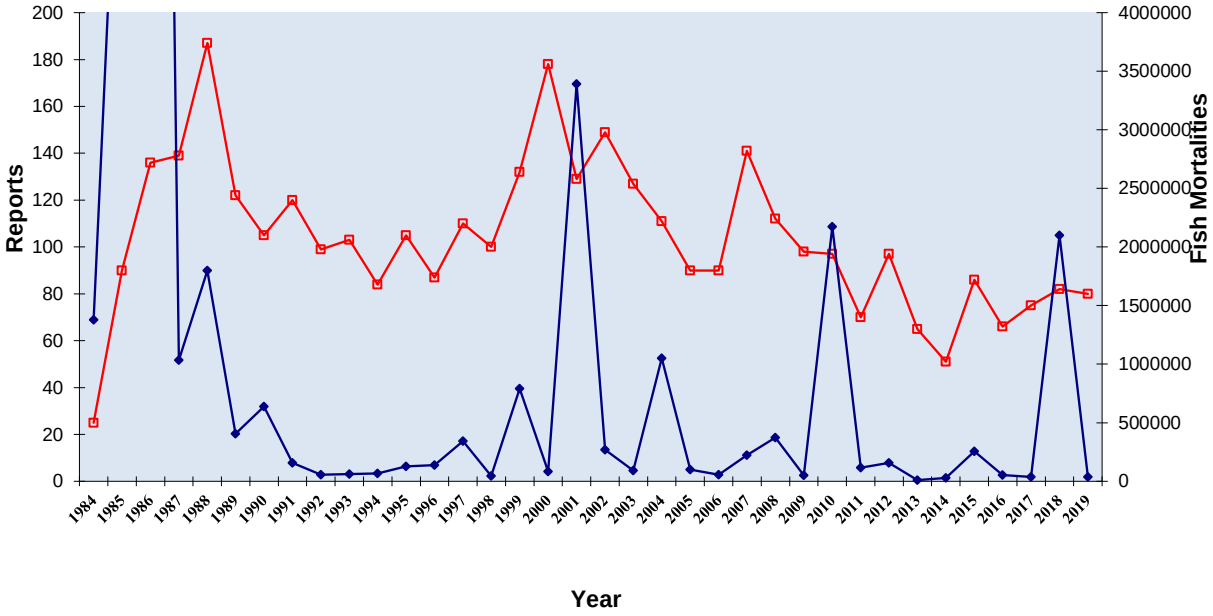
Magnitude of Events

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 have become 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 that dominated the yearly totals for this period.

The total fish mortalities in Maryland for 2019 (36,009) is 2.96 percent of the 35-year average of 1,218,504 (the median is 158,680). It was the third lowest annual total recorded since 1984.

Figure 2. Reports and Fish Mortalities



Distribution of Fish Kills

Table 1: Fish Kill Reports by County.

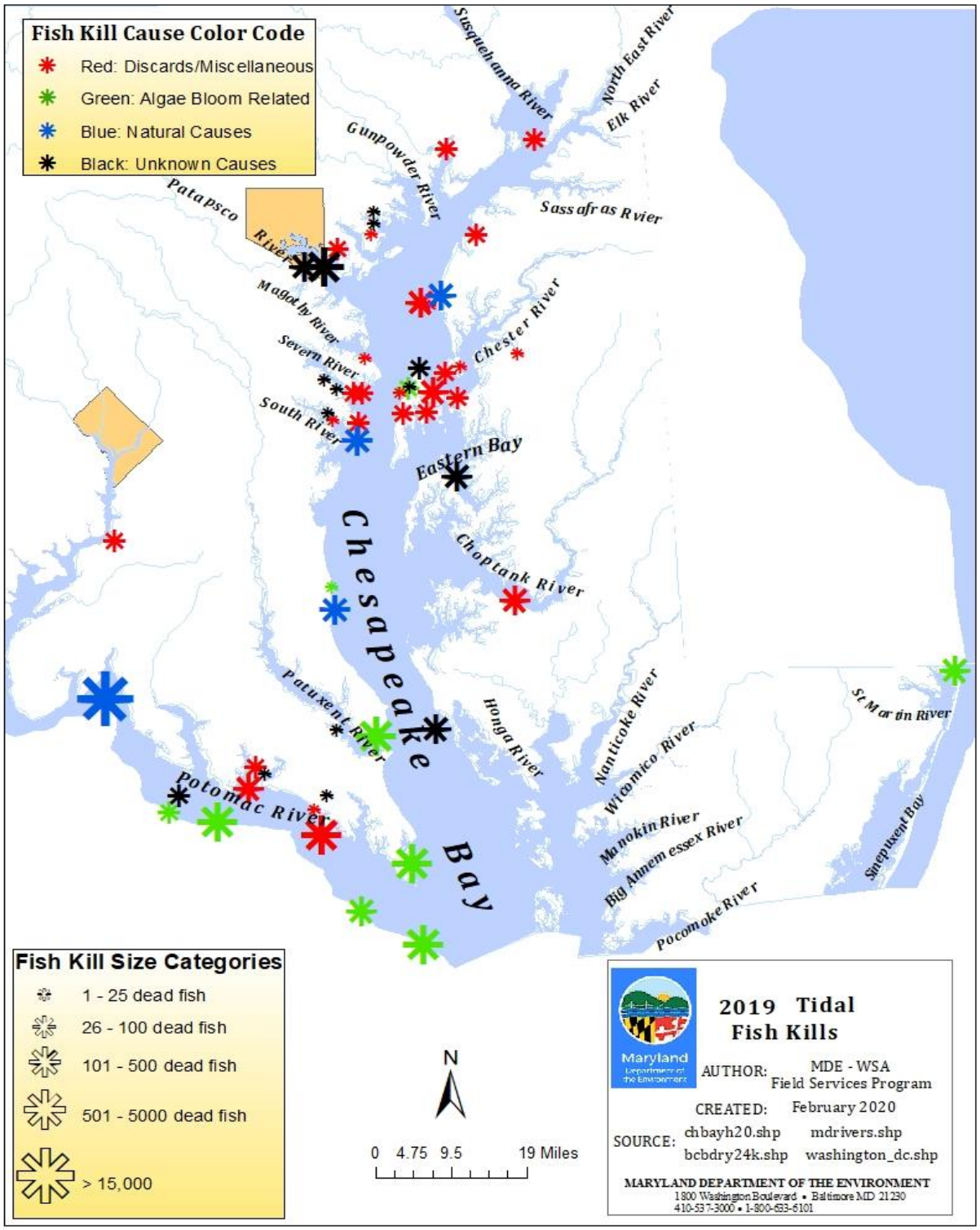
County	# Reports (2019)	# Reports (1984-2019)
Allegany	0	35
Anne Arundel	11	684
Baltimore	5	384
Baltimore City	2	112
Calvert	4	187
Caroline	3	72
Carroll	0	101
Cecil	3	214
Charles	2	135
Dorchester	2	72
Frederick	1	114
Garrett	0	45
Harford	2	180
Howard	0	81
Kent	7	127
Montgomery	4	160
Prince Georges	4	165
Queen Anne's	9	167
Somerset	0	65
St. Mary's	15	207
Talbot	2	98
Washington	0	62
Wicomico	1	105
Worcester	3	110
TOTAL*	80*	3682

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

Every county except Allegheny, Carroll, Garrett, Howard, Somerset, and Washington was affected by fish kills in 2019 (Table 1). The highest number (15) occurred in Saint Mary's County. Anne Arundel County had the second highest occurrence with 11. Queen Anne's County had the third highest occurrence with 9. Kent had the fourth highest with 7. Baltimore County had the fifth highest with 5. Montgomery, Prince George's and Calvert were sixth highest with 4. Of these eight jurisdictions, all but Kent rank in the top eight for historical reports. Anne Arundel County has had the most reported kills (684) since 1984. Baltimore County ranks second highest with 384. 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 2019.

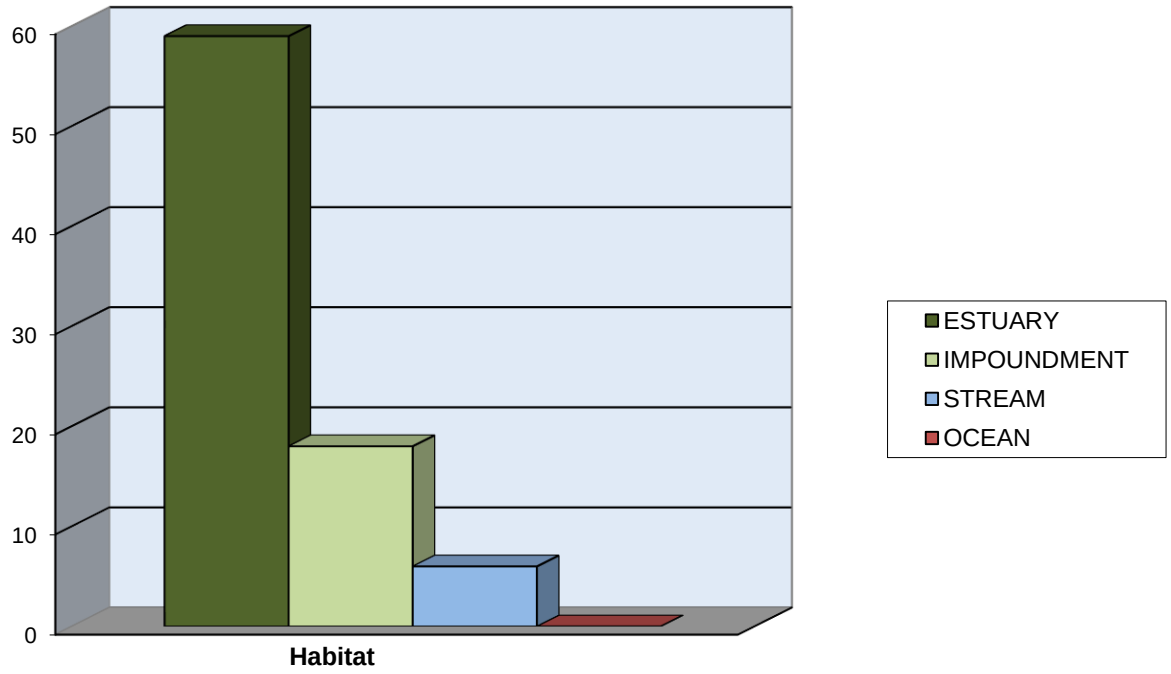
Figure 3 shows the geographical distribution, and magnitude of tidal fish kills, including the causes attributed to them in 2019.

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



Reported fish kills occurred in various aquatic habitats. There were seventeen reported from impoundments, five from free-flowing streams, and fifty-eight from estuarine waters (Figure 4). The number of reports from estuarine waters was one below the historic average. The number of reports from streams and impoundments were about ten each, below average. The percentage of fish kill reports from estuarine waters (72.5%) was above historical average (57.4%).

Figure 4. 2019 Fish Kills by Environment



Causes of Fish Kills

Of the 80 events reported, 77 were classified as fish kills. Three were determined to be a non-kill or insignificant events where no dead fish were found.

Probable cause was determined in 59 of the 77 fish kills (Table 2). Natural causes were implicated in 29 events, including 23 cases of oxygen depletion, and 2 cases each of

winter/seasonal/spawning stress, stranding, and of osmotic stress. The remaining events included 24 caused by fishing discards, 3 cases of entrapment in man-made structures, 1 case of pond management/draining, and 2 pollution cases. There were 18 cases where the cause was undetermined.

Table 2: Probable causes of fish kill reports, 2019.

Probable cause	**2019 Only**	***Percent of Annual Total***	**# of Reports 1984-2019**	***Percent of Historic Total***
Natural	29	36.25%	1506	40.29%
Disease	0		237	
Low dissolved O_2	23		874	
Seasonal / Spawning stress	2		232	
Stranding	2		71	
Salinity/Osmotic shock	2		6	
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	2	2.50%	297	7.95%
Agriculture	0		33	
Municipal sewage	0		46	
Industrial discharge	0		56	
Swimming pool discharge	0		19	
Fuel/Oil spills	0		31	
Unidentified source	0		57	
Construction	0		13	
Municipal discharge	2		27	
Pond Management chemicals	0		15	
Miscellaneous	28	35.00%	809	21.64%
Discards	24		580	
Entrapment	3		155	
Stocking stress, pond Mgmt.	1		66	
Scientific discards, exotic species control	0		8	
Unknown	18	22.50%	852	22.79%
Non-kill	3	3.75%	274	7.33%
TOTAL	**80**		**3738**	

In 2019, 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 36,009 fish mortalities were confirmed in 2019. An additional 1,003,505 invertebrates and other aquatic animals also died totaling 1,039,514 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 2019.

The largest kill (#219038) occurred June 28th in Deep Creek/Long Neck Creek in Rodo Beach (Saint Mary's County). Approximately 21,475 fish (five species) and 800 blue crabs died as a result of low dissolved oxygen caused by a mixed species bloom of bluegreen algae. This water body is approximately 100 acres in size and no longer has a sustained tidal connection to Chesapeake Bay. It is subject to frequent fish kills due to poor tidal flushing. This was the eighth fish kill documented there since 1989.

Pollution Caused Events

Intense local pollution or other direct anthropogenic causes were implicated in two Maryland events that totaled approximately 1,976 fish. A third pollution case that involved the intentional discarding of dead fish into waters of the state is included. Approximately eight pollution caused fish kills occur each year. All three pollution related events were referred to the appropriate enforcement agencies for follow-up procedures.

- (#219075) occurred September 7th in Dead Run, a tributary of the Gwynn's Falls (Baltimore City). Approximately 1,926 fish (7 species) and 20 crayfish 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 1.67 miles to the confluence with Gwynn's falls.
- (#219079) occurred February 5th in an unnamed tributary of Tinkers Creek, which is a tributary of Piscataway Creek in Fort Washington (Prince George's County). Approximately 50 fish died as a result of a water main break and chlorine discharge.
- (#219022) occurred May 17th in Tracy's Creek in Deale (Anne Arundel Creek). Approximately 1,000 dead eels were discovered in the creek

adjacent to a small dirt road along the creek. Investigation revealed that the fish had been dumped there by an aquaculture facility that had attempted to keep them alive in *Tilapia* culture tanks. When the eels died in the tank, the operator of the plant illegally deposited the carcasses in the tidal headwaters of this small creek.

Species Involved

Fish kills in 2019 affected at least 27 species of fish, representing 13 families and 9 orders (Table 3). Non-piscine species affected were: Razor clams (500) and Bent mussels (1,000,000), blue crab (2,985), unidentified crayfish (20). Approximately 5,867 fish were unidentified.

Table 3: Species and Numbers of Individuals Affected by Fish Kills in 2019.

Arthropoda	
Decapoda	
Portunidae	
***Callinectes sapidus*-blue crab**	**2,985**
Cambaridae (unidentified crayfish)	**20**
Mollusca	
Bivalvia-	
Mytilidae	
***Ischadium recurvum*-hooked or bent mussel**	**1,000,000**
Solecurtidae	
***Tagelus plebeius*-stout razor clam**	**500**
Osteichthyes	
Unidentified bony fish	**534**
Anguillaformes	
Anguillidae	
***Anguilla rostrata*-American eel**	**1,181**
Batrachoidiformes	
Batrachoididae	
***Opsanus tau*-oyster toadfish**	**25**
Atheriniformes	
Atherinopsidae	
***Menidia menidia*- atlantic silverdides**	**200**
Myliobatiformes	
Rhinopteridae	
***Rhinoptera bonasus*-cownose ray**	**5**
Clupeiformes	
Clupeidae	
Alosa mediocris-hickory shad	**200**
***Brevoortia tyrannus*-Atlantic menhaden**	**20,611**
***Dorosoma cepedianum*-gizzard shad**	**3,820**

Siluriformes	
Ictaluridae	
Unidentified catfish	**230**
***Ictalurus punctatus*-channel catfish**	**68**
***Noturus insignis*-margined madtom**	**1**
Cypriniformes	
Cyprinidae	
Unidentified minnow	**17**
***Campostoma anomalum*-central stoneroller**	**428**
***Cyprinus carpio*-common carp/koi**	**25**
***Rhinichthys atratulus*-blacknose dace**	**58**
***Rhinichthys cataractae*-longnose dace**	**1,011**
***Semotilus atromaculatus*–creek chub**	**20**
***Semotilus corporalis*-fallfish**	**1**
Catostomidae	
***Catostomus commersoni*-white sucker**	**320**
Plueronectiformes	
Paralichthyidae	
***Paralichthys dentatus*-summer flounder**	**1**
Perciformes	
Centrarchidae	
***Lepomis cyanellus*-green sunfish**	**150**
***Lepomis gibbosus*-pumpkinseed**	**3**
***Lepomis macrochirus*-bluegill**	**3,034**
***Lepomis sp*.-unidentified sunfish**	**1,250**
***Micropterus salmoides*-largemouth bass**	**333**
***Pomoxis sp.*-unidentified crappie**	**100**
***Pomoxis nigromaculatus*-black crappie**	**5**
Moronidae	
***Morone americana*-white perch**	**1,311**
***Morone saxatilis*-striped bass**	**897**
Percidae	
***Perca flavescens*-yellow perch**	**5**
Sciaenidae	
***Leiostomus xanthurus*-norfolk spot**	**165**

References

Carter et al., 2018. Appendix II: Benthic Community Studies (Project III) (September 2017 – August 2018) Technical Report. *Prepared by* Maryland Department of the Environment Water and Science Administration Bio-regulatory Monitoring and Response Division *for* Maryland Port Administration.