FISH KILL RESPONSE PLAN
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INTRODUCTION

The August 2020 fish kill revealed the need for a coordinated response plan to address future major Biscayne Bay crises. It is possible, if not likely, that subsequent fish kills or other water quality crises will occur. Here, we outline guiding principles for emergency response planning based on lessons learned from the 2020 fish kill. Of course, each crisis will be of a different nature; therefore, circumstances and adaptability within these principles will be key. This plan proposes responses for: (1) government entities; (2) the scientific community; and (3) the public.

This plan was developed by Miami Waterkeeper with input from the Biscayne Bay Science Coordination (BBSC) group, which was formed to share data during and after the August 2020 Fish Kill. The BBSC is a collaborative group of government, university, and Non Governmental Organization (NGO) partners, which continues to meet regularly to discuss Biscayne Bay-related scientific efforts. This response plan is intended to be routinely updated with input from the local science community and agency partners.

The following individuals provided input and feedback on this plan:

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For more detailed information and available data about the fish kill, see Miami Waterkeeper’s Fish Kill Report.
In August 2020, a fish kill unprecedented in scale and severity occurred in northern Biscayne Bay. The acute event lasted for five days and affected at least 27,000 fish and other wildlife. The most likely cause of the 2020 fish kill is low DO resulting from chronic nutrient pollution inputs, combined with warm waters, low winds, and possibly increased freshwater flow from nearby canals. Years of acute seagrass declines and increases of chlorophyll-a due to nutrient pollution preceded this event. Observations of thick algae mats and foam immediately followed reports of the fish kill.

During the fish kill event, the public submitted hundreds of photographs and videos of unusual fish behavior, dead fish, algae blooms, and foam. These valuable observations aided researchers in tracking the progression of the fish kill. Large amounts of deceased fish also accumulated at the shorelines and began to decay, which contributed further to declining water quality. Emergency aeration efforts were undertaken by the Phillip and Patricia Frost Museum of Science, Miami-Dade County fireboats, and City of Miami stormwater pumps. Taken together, data suggest that these interventions likely had a localized benefit on DO levels and water quality.

Response and coordination amongst research groups and agencies began with the earliest reports of the fish kill. The scientific community and agencies shared valuable data and observations about unusual events. These calls have continued as monthly BBSC calls. As a part of this coordination group, Miami Waterkeeper gathered the following "lessons learned" from the community about the fish kill response. Those lessons, as well as research from other communities, comprise the below recommendations.

The identification and delegation of resources, contacts, and roles should be assigned and accepted before an incident occurs. Multiple governmental agencies, universities, and NGOs have interests in the health of Biscayne Bay. Government oversight includes federal agencies, such as the NPS, EPA, the US Coast Guard, and NOAA; Florida state agencies such as the FDEP, the BBAP, and FWC; Miami-Dade County, including DERM, PortMiami, and marine patrol; and 34 local municipalities, including 17 with bayfront jurisdictions.

An incident coordinator/point of contact from each agency/organization should be assigned to be the point of contact for the issue. Full cooperation, open communication, and resource sharing will be critical to the success of a fish kill response or other environmental crisis.

Some of the pre-incident preparation items include:

### Public Coordination

- Establish which reporting hotline or email address should be utilized for the public. The capability to easily send videos and photos is helpful, as is the ability to receive reports posted on social media.
- Establish a system for tracking and cataloging a high volume of public reports, photos, videos, reports, and locations before the crisis occurs.
- Pay special attention to any geographic referencing data to pinpoint possible ‘hotspots’
- Determine public talking points about fish kills: what causes them and how to prevent them, what to look for, what to do if you see dead fish, along with public health and safety information. These should be updated daily as circumstances require.
- Develop an outreach strategy that can be customized if a fish kill event occurs.

### Response and Scientific Coordination

- Establish a lead coordinator/point of contact from each agency.
- Establish relationships with local labs and scientists to coordinate before, during, and after data collection (parameters listed below).
- Partners should identify and train internal response staff.
- Partners should participate in the BBSC calls.
- Identify available boat support within the County and local municipalities that may be willing to respond and develop MOUs or contracts as needed.
- The following organizations were identified as having boats able to respond during a crisis:
  - Bonefish and Tarpon Trust (2 boats)
  - DEP BBAP
  - Dockmasters
  - FIU Institute of Environment
  - Miami-Dade County
  - Seakeepers Society
  - City of Miami Scavenger Vessels
  - Towboat operators contacts
  - Various law enforcement
  - Other private groups
Prepared for Possible Interventions

As low DO conditions may be present, including reports of fish “gasing” for air or congregating at the surface, it may be warranted to provide additional aeration to key areas. To prepare for this, pre-incident, response agencies should:

• Prepare an MOU with cities in northern Biscayne Bay that allows shared use of a boat, clean-up, and aeration capabilities.
• Identify available stormwater pumps that can be used for aeration; contractors may also have large stormwater pumps.
• Identify available aeration devices that could be deployed (e.g., for wastewater treatment, construction sites.)

Baseline Data Collection

During the 2020 fish kill, a lack of comprehensive baseline data prevented robust data analysis about the conditions that preceded the event. While ongoing monitoring is being conducted in some areas of northern Biscayne Bay, such as the long-term DERM and BBAP datasets, few continuous monitoring instruments were in place in Northern Biscayne Bay. Only BBAP had continuous monitoring devices in place before and during the fish kill event. FIU moved YSI sondes to northern Biscayne Bay to provide continuous real-time monitoring during the event. One YSI sonde remains. (See Fish Kill Report for details.)

The BBSC group has identified increased monitoring in northern Biscayne Bay as their top scientific priority. The group identified continuous monitoring (especially overnight) and real-time data transmissions as the most valuable data. Whole water column samples, which cover from surface to bottom, also provided important information for understanding factors leading to the fish kill. In addition to ongoing water quality monitoring, it is also valuable to understand the fish population levels in Biscayne Bay in order to understand the general impact of the fish kill on the overall population of fish. The last northern Bay fish population surveys were conducted in 1997 by Serafy et al.

Prof. Henry Briceño is working to complete a 2-D circulation model of northern Biscayne Bay. Miami Waterkeeper is conducting an EPA-funded monitoring program of 10 sites in Northern Biscayne to investigate linkages between FIB and nutrients along with partners at FIU, Beta Analytic, and UM. Prof. Chris Langdon (UM) is also surveying oxygen profiles of northern Biscayne Bay.

Pre-Incident Data collection needs:

• Understand baseline conditions (e.g., BBAP, DERM)
• Gather fish population data
• Ongoing in situ monitoring, preferably real-time
• Full water-column sampling
• Canal monitoring
## Immediate Response to a Fish Kill

### Verifying a Fish Kill

If a fish kill is confirmed, samples of dead fish can be collected and inspected for brown gills. This could be an indication of hydrogen sulfide poisoning (Meyer and Barclay 1990).

### Determining a Cause

Responders should assess whether a fish kill could be related to acute point-source pollution (e.g., spills/leaks), a disease outbreak occurs, or natural causes such as "cold kills." Some causes may have public safety implications. Longer-term monitoring, investigation, and research will elucidate ecosystem-level causes.

### Communicating With the Public

As much information as is known should be communicated with the public directly, including location, likely causes, further investigation steps, and possible interventions. The public should also be instructed on safety considerations and what kind of information is helpful to document and/or report. The public should also be given ways to assist in the crisis, such as what kind of information to report.
In the case of a fish kill, large numbers of fish and wildlife may be washing ashore. If left in place, these carcasses may decompose and exacerbate poor water quality conditions, including nutrient releases and bacteria. It may therefore be necessary to initiate a clean-up of the shoreline or waterways.

Pre-incident, we recommend that local governments:
• Establish a relationship with a cleaning crew to remove dead fish and wildlife.
• Establish a relationship with a scavenger vessel (such as the City of Miami and Coral Gables.)
• Establish a relationship with a composting service to dispose of fish safely and sustainably (e.g., Fertile Earth Worm Farm)
• Provide receptacles with clearly marked instructions for the public to safely dispose of fish.
• Establish a relationship with canal cleaning/algae removal service.
• Establish relationships with volunteer organizations/community groups for residents who want to help in a crisis.

Addressing Clean-Up

As with information on locations of dead fish or fish in distress, the public will likely report algal bloom sightings as well. On-the-water resources should be ready to respond to verify and sample at possible bloom locations.

It will be essential to have a team ready to collect samples and send them to the correct agency for analysis. The contacts are FWC (Catalina Brown) and FIU’s Dr. Thomas Frankovich and Dr. Ligia Collado-Vides (especially macroalgae). Depending on the algae bloom species, there may be public health implications.

Pre-incident, we recommend:
• Determine public talking points about algal blooms: what causes them, what to look for, what to do if you see a bloom, public health, and safety information.
• Develop an outreach strategy that can be customized.
• Establish relationships with local labs and scientists to coordinate before, during, and after data collection.

During and post-incident, clean-up of algae may be necessary, especially if harmful varieties are present. The decay of blooms can also lead to deterioration of water quality and might trigger further low DO conditions and fish kill events. Therefore, we do recommend mechanically removing algae from the waterways. FDEP has a list of contractors that can provide canal or bay cleaning services. The City of Miami and the City of Coral Gables also have scavenger vessels that could address concentrated blooms.

• Pre-incident, we recommend that the County and local governments establish contracts with cleaning companies and/or the scavenger vessels of local municipalities.

Considering Interventions

Measurements (e.g., FIU, UM, Miami Waterkeeper, DERM, DEP) found low DO (0-2 mg/l), specifically near Pelican Harbor/79th Street Causeway and the Little River/Belle Meade area during the August 2020 fish kill event. Marine life was reported to be congregating at the surface, exhibiting abnormal behavior, and struggling to breathe at Pelican Harbor, Morningside Park, Albert Pallot Park, and Margaret Pace Park. The fish were congregating at the shoreline, and their behaviors were described as “gaping.”
In response, the Phillip and Patricia Frost Museum of Science sent aeration devices to Pelican Harbor and PortMiami sent fireboats to oxygen-starved areas of the Bay near North Bay Village. The City of Miami deployed stormwater pumps as aerators at Morningside, Albert Palotto, and Margaret Pace parks. While none of these locations had carefully controlled studies of efficacy, taken together, data from DEP, FIU, UM, and Miami Waterkeeper suggest that these interventions did seem to alleviate the anoxia and wildlife distress and may have decreased bacteria levels. After interventions were deployed by PortMiami and the City of Miami, additional dead fish were not reported in those areas. DEP did observe possible increased turbidity in areas with aeration. More information can be found in the Fish Kill Report.

T aken together, we do recommend that aeration efforts should be deployed where fish or wildlife are observed to be congregating at the surface or gasping for oxygenated water. Aerated areas, while small, may provide refuge for wildlife to survive until conditions change. Therefore, we recommend that pre-incident, local governments:

- Understand the availability of stormwater pumps within the County or municipal government that can be used as aerators (flood control, construction sites, wastewater treatment.)
- Contract with companies to provide aeration services on an emergency basis.

It is crucial to emphasize that aeration is not the desired solution to preventing or addressing fish kill events, as it is treating the "symptom" of low DO rather than the disease, nutrient pollution. Instead, the majority of resources should be put towards addressing the root causes of the fish kill to prevent future low DO conditions. Aeration is only a temporary alleviation of low DO conditions in a highly localized area.

### Communicating With the Public and Public Response

Timely, clear, and accurate communication to the public is crucial to emergency response. Regular communication with the media and the public will minimize any confusion and unsubstantiated claims. This is also an opportunity to present the proper response to the incident. Uniformity of information is vital in limiting conflicting reports among various agencies involved.

Each partner should designate a Communications Lead to maintain a flow of information to partners and agencies throughout the entirety of the event. Staff members that address the incident in the field will be provided with procedures to follow when approached by community members. It is vital to avoid spreading opinions or speculations about the cause or severity of the incident unless it is scientifically supported. The Communications Lead will need to coordinate to request assistance from the public or media to protect the community from public health risks, gain access to locations, obtain background information of the situation, and ensure the integrity of the data.

Depending on the severity of the incident and the flow of new information, the public should be given updates once to twice a day via social media or on a central website for fish kill information. Coordinated talking points amongst community groups are very helpful to maintain accurate information and coordinated response efforts.

- Information about what is known, or unknown, about the ongoing crisis should be shared.
- Ensuring the accuracy and consistency of information is vital. Always be clear with the public if the information is not yet known or not well-understood.
- Information about the underlying causes of the crisis, if known, should be shared.
- Include actions to move forward with to avoid future fish kills in public communications.
- Information about ways to help during the crisis and after the crisis should be shared.

During the 2020 fish kill, the public sent over 400 photographs of the crisis and other reports or videos of fish behavior. These became vital for understanding the scale and location of the ongoing crisis. However, it is difficult to organize and manage the flow of information at this volume. We suggest:

- Create a specific email address or form for public photos and reports or develop a process for handling a high volume of reports.
- Enter information in such a way that the date, location, and observer name is clearly identified in the file label.
- Make clear to all observers that photos and videos submitted and their names may be made public.
- Enter reports into Google Maps with representative photos at each site.

Many members of the public are interested in finding ways to help during a crisis. In 2020, dozens of people volunteered to clean up fish carcasses from shorelines.

- Safety information, such as wearing gloves, trespassing rules, and proper fish waste disposal information should be shared.
- Locations, where fish clean-up is needed, should be disseminated.
- Areas where fish waste can be safely disposed of or composted, should be provided and clearly advertised and marked.
- If fish can be composted, care should be taken to avoid mixing plastic or trash.

It may be necessary to generate a consensus statement if enough information is available about the cause and effect of the crisis. This was effective in 2020, although many agencies could not sign on quickly enough to join the statement, due to the many levels of review required.

If another incident such as the fish kill in 2020 were to occur, Miami Waterkeeper can take an active role in external communications and public response. During the 2020 event, for example, Miami Waterkeeper collated the public’s reports with sightings of the fish kills and algae blooms with an interactive map. We have analyzed the photos for species and the number of fish impacted. Click HERE to view; the draft summary data can be found here.

Several members from the BBSC group have volunteered to aid in external communications with the public as well, including Ana Zangroniz (Florida Sea Grant), Todd Crowl (FIU), Piero Gardinali (FIU), Henry Briceño (FIU), and Bonefish and Tarpon Trust.
The post-incident period is one of analysis, assessment, and reporting. This process should focus on:

**Debriefing**

- Debriefing on all aspects of response to the crisis
  - Discussing what worked well and what did not, from pre-incident preparation to the strategies employed during the incident, is vital to improving response.
  - Examining lessons learned for preparation for future events
  - Assessing readiness for community, government, and scientific response

**Data Analysis and Report Compilation**

- Compiling pre-incident baseline data
- Analyzing data collected during the crisis
- Compiling a comprehensive report about the crisis and data gathered.
- Identifying the root causes of the crisis
- Identification of remaining questions, data gaps, and future work

**Preventing Future Fish Kills**

It is crucial to address the root causes of the fish kill and work together to prevent future fish kills. Based on the data collected, the August 2020 fish kill was caused by low DO conditions that resulted from excess nutrient and bacteria pollution. These underlying conditions caused the Bay to become vulnerable to low DO stress, particularly when combined with the additional stressors of seagrass loss, high temperatures, and high canal flows (see the Fish Kill Report for more details.) Actions that would limit the amount of nitrogen and phosphorus entering Biscayne Bay will improve the resilience of the Biscayne Bay ecosystem and avoid future fish kills.

These actions include:

- Regulating and removing septic tanks
- Repairing and improving sewage infrastructure
- Reducing and mitigating pollution in stormwater runoff
- Reducing fertilizer overuse and educating the public about the new fertilizer ordinances
- Removing algae, leaf litter, grass clippings, and sargassum from the system

Additionally, fish kill response would be improved by:

- Expanded monitoring in northern Biscayne Bay, particularly with an in situ, real-time sonde network and whole water-column sampling
- Improved baseline data collection of fish population levels
- Funded research and preparation for fish kills or other crises in the Biscayne Bay watershed