THIRTY YEARS OF INVESTIGATING FISH AND WILDLIFE KILLS AND POLLUTION IN TEXAS

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June 2003

WRTS-2003-001

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ABSTRACT

From 1958 to 1997 Texas Parks and Wildlife investigated over 4500 incidents of pollution or kills involving fish and wildlife. The leading cause of fish and wildlife kills was low dissolved oxygen. The main human activity causing these type of kills is the stagnation of water due to construction of dead-end canals in industrial or residential developments along the coast. Other significant human-induced factors leading to low dissolved oxygen kills are the release of pollutants into the water and the reduction or stoppage of flow in a stream. Natural causes of low dissolved oxygen include storms and drought. After dissolved oxygen, the most common causes of fish and wildlife mortality included cold fronts or freezes and harmful algal blooms.

INTRODUCTION

Since the 1950s, Texas Parks and Wildlife Department (TPWD) has investigated mass mortalities of fish and wildlife, also known as fish kills or wildlife kills. In 1993 the agency staff with primary responsibility for conducting these investigations became known as the "Kills and Spills Team." When kills are caused by human activity, TPWD has a legislative mandate to document the magnitude of losses, identify the responsible party, and require restitution for the damage to fish and wildlife. Under this mandate, the Kills and Spills Team commissioned the development of a database to document kill and spill investigations. Historical investigation reports on paper and in a previous database format were keyed or migrated into the database by 1997.

Part of the value of documenting and storing information about kills and spills is that trends may be observed and generalizations made. Analyzing the causes and magnitudes of widespread die-offs is important for management of fish and wildlife populations. Understanding the major causes of kills and spills in Texas allows conservation efforts to be focused and limited state resources directed more effectively against threats to fish and wildlife.

METHODS

In 1997 the Kills and Spills Team worked to enter over 4500 historical kill and spill incident reports into a custom-designed Microsoft Access database application known as PRISM (pollution Response Incident and Species Mortality). The type of information stored in PRISM includes incident type (fish kill, wildlife kill, both F & W, pollution, other), start date, habitat type and size affected, notification record, county, TCEQ water quality segment number, location, source and cause, and information about species, sizes, and numbers killed in cases involving kills.

Using Microsoft Access' built-in query functions, the PRISM database was searched for the period of record (1958-1997) to categorize and summarize kill and spill reports.

RESULTS AND DISCUSSION

About half of the incidents examined were pollution incidents and half were fish kills, along with fewer incidents involving wildlife (Figure 1). Although some reports are available from the 1960s and 1970s, most of the reports are for incidents which occurred in the 1980s and 1990s (Figure 2).

Of the total numbers of fish and wildlife estimated killed, about 52% were due to human, activities, whether pollution, modification of wildlife habitat, or other activity (Figure 3). Natural causes such as severe weather accounted for 37% of the fish and wildlife killed, and a cause could not be determined for 11% of the number killed.

The confirmed or suspected cause of about 60% of all fish and wildlife mortality in water was low dissolved oxygen (Figure 4). Dissolved oxygen is critical for most aquatic organisms like fish since they extract the oxygen they need to live out of the water with their gills. Normally the amount of oxygen dissolved in surface waters, such as bays, lakes, and rivers, is fairly close to the requirements for gill-breathing aquatic life. Anything that reduces the dissolved oxygen content of the water significantly could result in a kill of the animals there, which get their oxygen from the water. About two-thirds of the mortalities from low dissolved oxygen were caused by human activities, and about one-third by natural or unknown causes.

The main human activity causing low oxygen kills is "dead end canals" (Figure 5). These are canals constructed for residential or industrial purposes, usually along the coast, especially around Houston, Corpus Christi, and South Padre Island. Large fish kills occur in these canals because of inadequate water circulation to keep oxygen levels normal. Physical and chemical factors such as hot weather and seepage from residential septic systems near the canals can combine at times to cause the dissolved oxygen level to plummet in canals, killing schools of fish which may not be able to move out of the area quickly enough. Most of the time, the fish killed are small menhaden, which can repopulate the area quickly after a kill. However, these kills would not have to happen if the canals were better designed to avoid the low oxygen conditions in the water. Other human activities can cause low dissolved oxygen when substances get into the water through dumping, spills, or runoff, which consume oxygen. Many common pollutants consume oxygen in the water, such as sewage and urban runoff which contains oil and other contaminants, Another human activity causing low dissolved oxygen kills is reducing or stopping the flow of a stream or the circulation of water. This

often occurs below dams when the flow through the dam is reduced or shut off entirely to conserve the water for some other use. In many cases there is a heavy concentration of fish right below a dam, since many species like to swim upstream against the current. When the flow drops, they are often trapped in ever-smaller pools and oxygen levels drop quickly due to all the fish breathing.

Many times kills from low dissolved oxygen are due to natural causes. For example, severe storms can blow leaves and other debris into streams, where the vegetation rots and consumes the oxygen. Hot weather, winds, and tides can sometimes create conditions similar to those in dead end canals where the circulation of water is reduced, and a large number of fish are trapped in the area as oxygen levels fall. During drought there are often fish kills in smaller streams whose flow drops to a trickle, or even stops, leaving all the fish crowded in shrinking pools.

Following low dissolved oxygen, a second major factor killing fish and wildlife is cold fronts or freezes (Figure 4). Three fast-moving severe freezes along the Texas coast in the 1980s killed an estimated 31 million fish and 1,168,000 invertebrates. Animals were unable to acclimate to the sudden drops in temperature, and there are limited openings between the barrier islands for marine life to escape from coastal bays to the warmer Gulf waters.

Another significant cause of fish and wildlife mortality is toxic algae blooms. These include incidents such as blooms of "red tide" along the coast, as well as “golden algae”, which has caused large fish kills in the Pecos River, Brazos Basin, and other freshwater bodies in the state.

As mentioned before, many times low dissolved oxygen due to the discharge or spill of a contaminant causes a kill. About 6% of the total numbers of fish and wildlife killed are due to direct toxicity of a contaminant. Contaminants reach the environment through dumping, accidental spills, legally permitted discharges, and rainfall runoff from facilities. Some of the more common contaminants causing kills include ammonia, gasoline, pesticides, and sewage (Figure 6). Many of the products we use everyday (such as gasoline) can be very toxic when they make their way into the aquatic environment.

When investigating kills and spills across the state, biologists reported the type and estimated size of habitat affected by incidents. Of the incidents in which habitat were measured in miles, most incidents took place in rivers (36%) or streams (29%) (Figure 7). About 18% of the incidents took place along the Gulf of Mexico, and 9% in estuaries. This reflects the generalization that the vast majority of pollution incidents inland tend to enter flowing surface waters, posing a threat to fish and wildlife and their habitat. Of incidents in which habitat was measured in acres, 56% of the habitat

affected was the Gulf of Mexico, 30% was in estuaries, and 13% in lakes (Figure 8). Another geographic trend is the data is that while fewer investigations were conducted on the coast as opposed to inland (23% of the total), coastal kills represent disproportionately more numbers killed (51% of the total) (Figure 9).

CONCLUSION

Dissolved oxygen is critical for aquatic life, and anything that decreases dissolved oxygen is a concern for the Kills and Spills Team. Human activities that inhibit normal circulation in a water body, such as construction of dead end canals, flow alterations, and reduced flow, have been responsible for a significant number of kills in Texas. Natural causes such as cold fronts and freezes can rival human activities as a significant source of kills. Conservation of the state's fish and wildlife must take into account common causes of kills and spills and focus efforts on preventing these incidents.

Figure 1. Types of Incidents (1958-1997).
(N = 4,637)

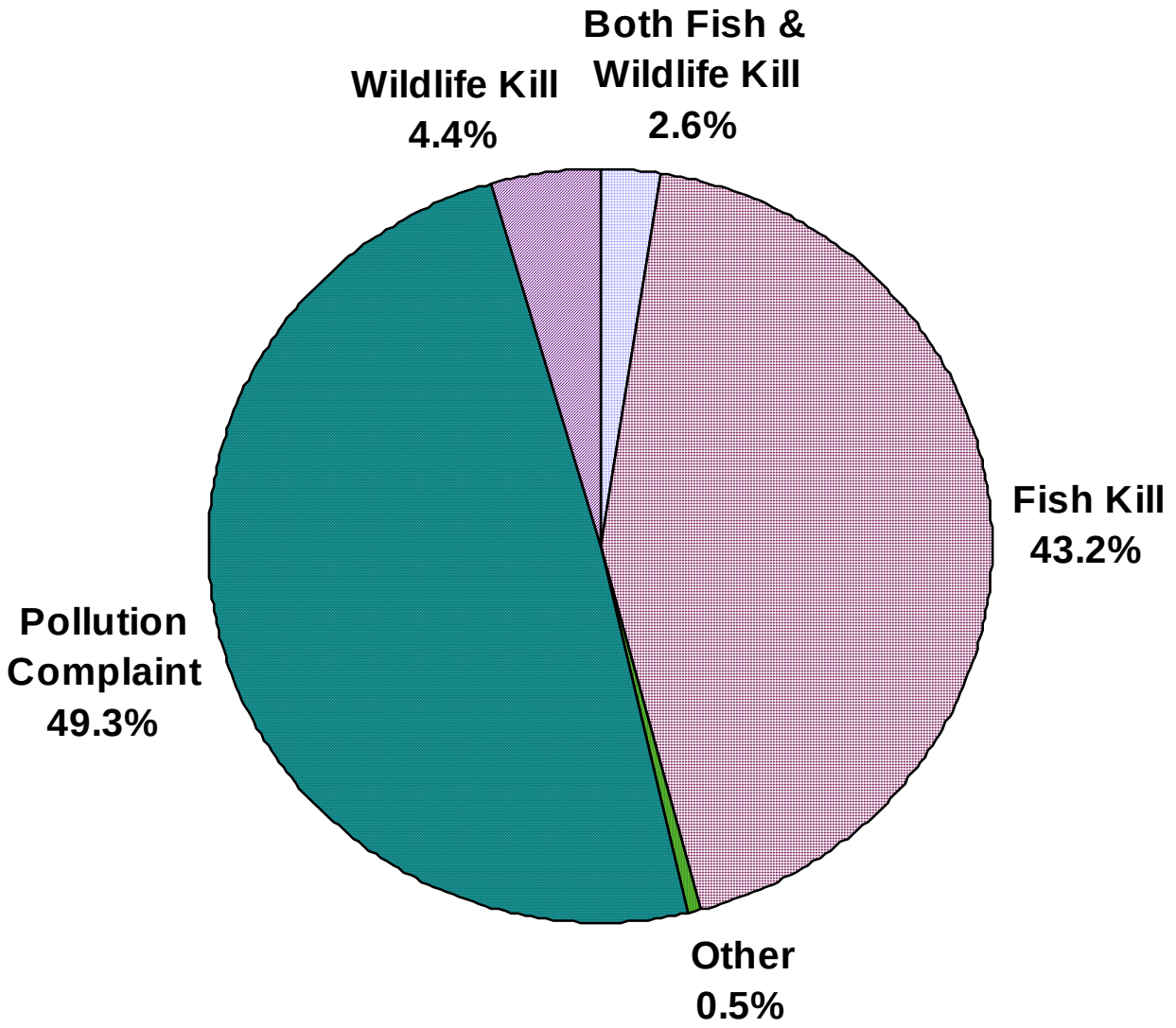

Figure 2. Number of Kill and Spill Reports By Year.
(N = 4,615)

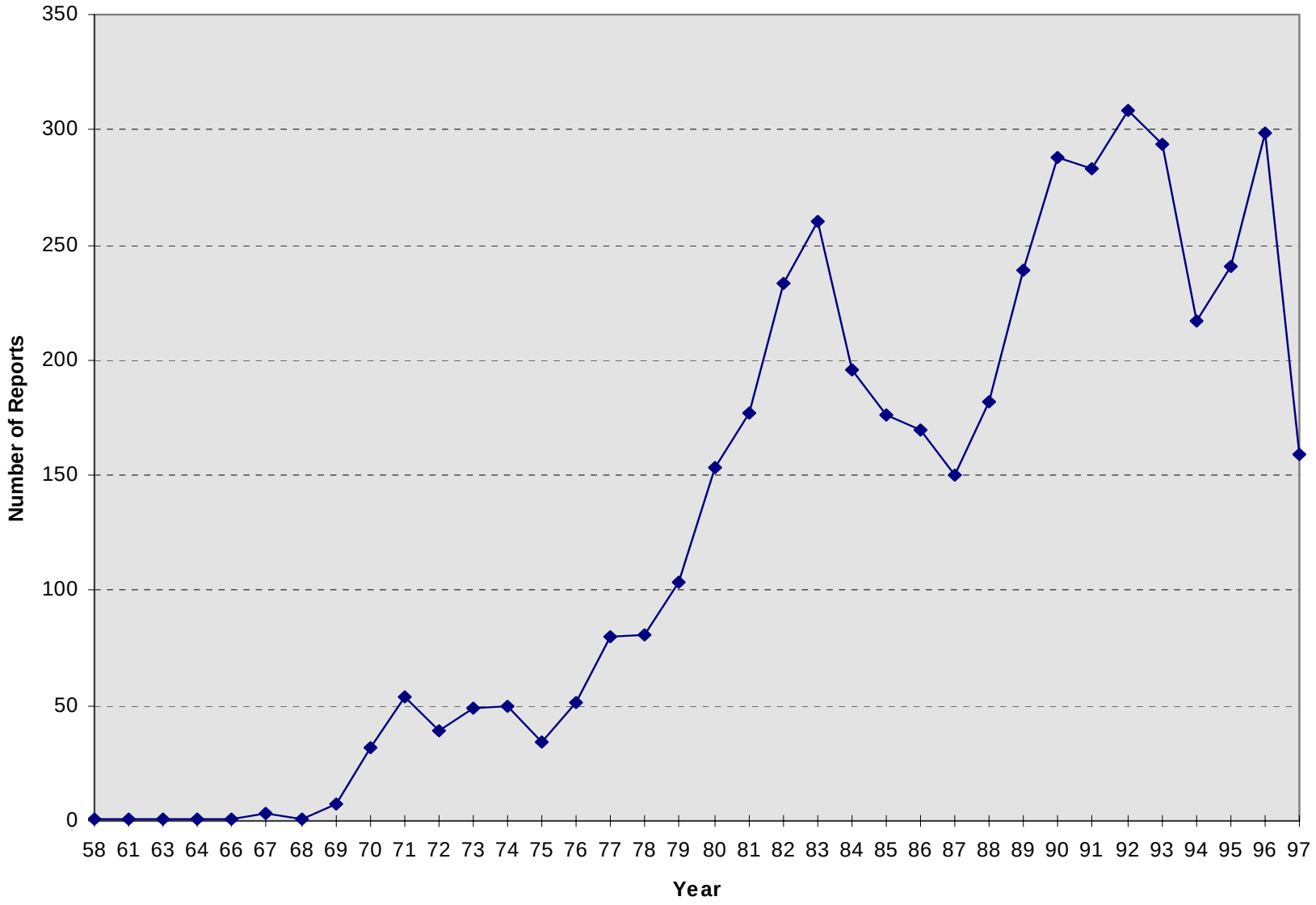

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Figure 3. Numbers of Fish and Wildlife Killed By Cause (designated "primary cause" whether "suspected" or "confirmed").

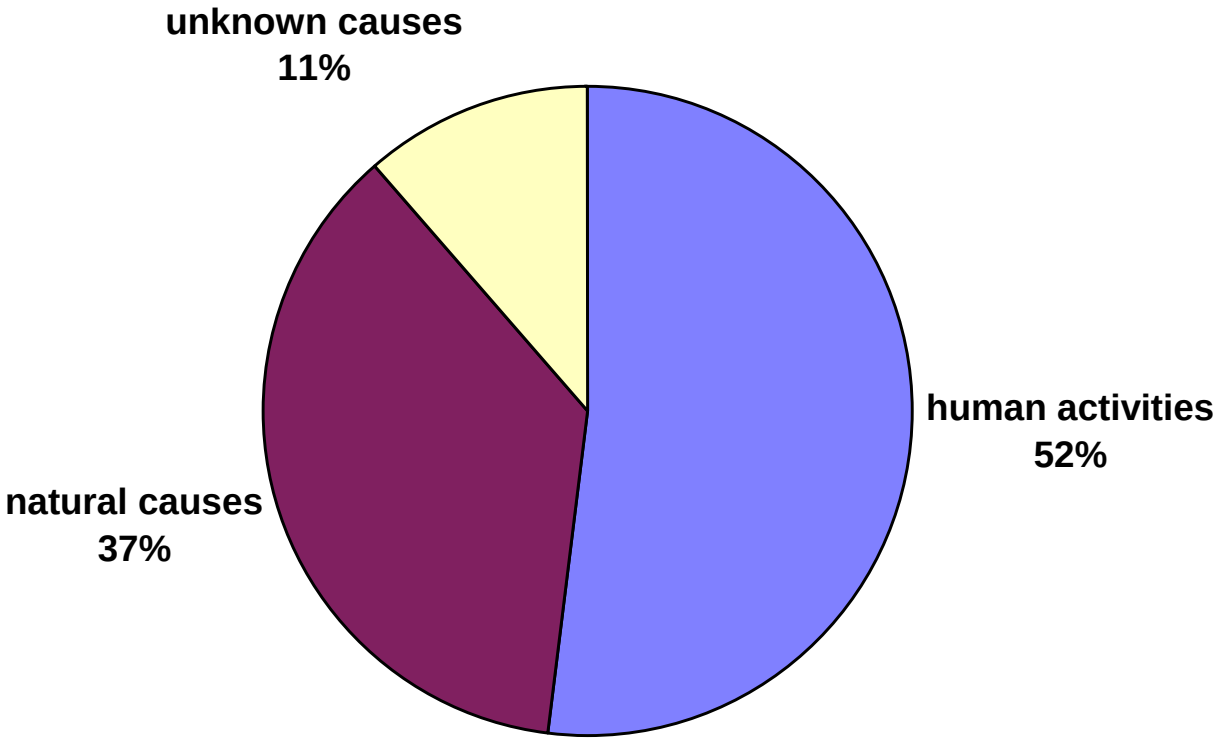

Figure 4. Number of Fish and Wildlife Killed by Cause ("primary cause"--"suspected" or "confirmed").

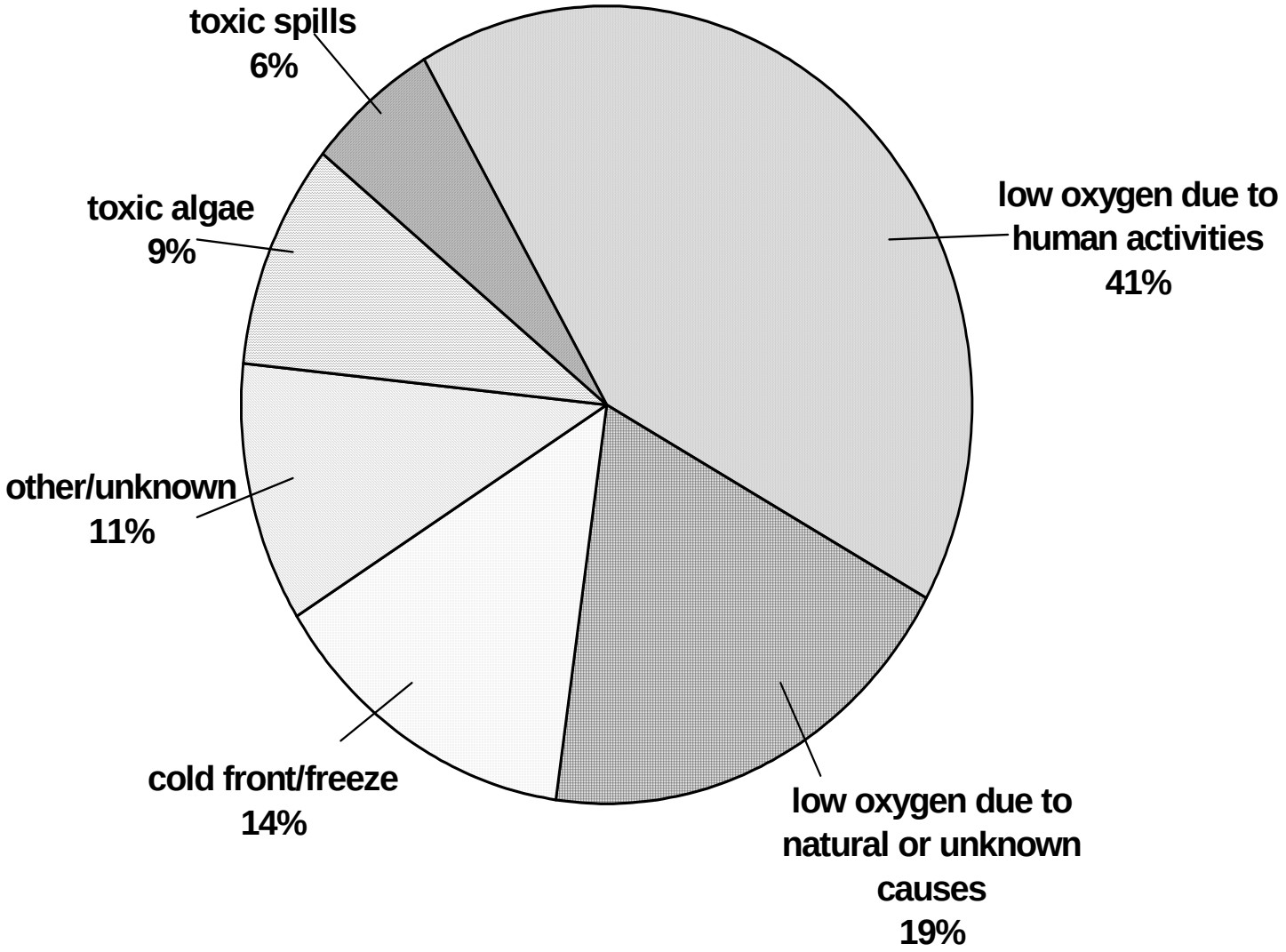

Figure 5. Number of fish and wildlife killed by primary cause (confirmed or suspected cause).

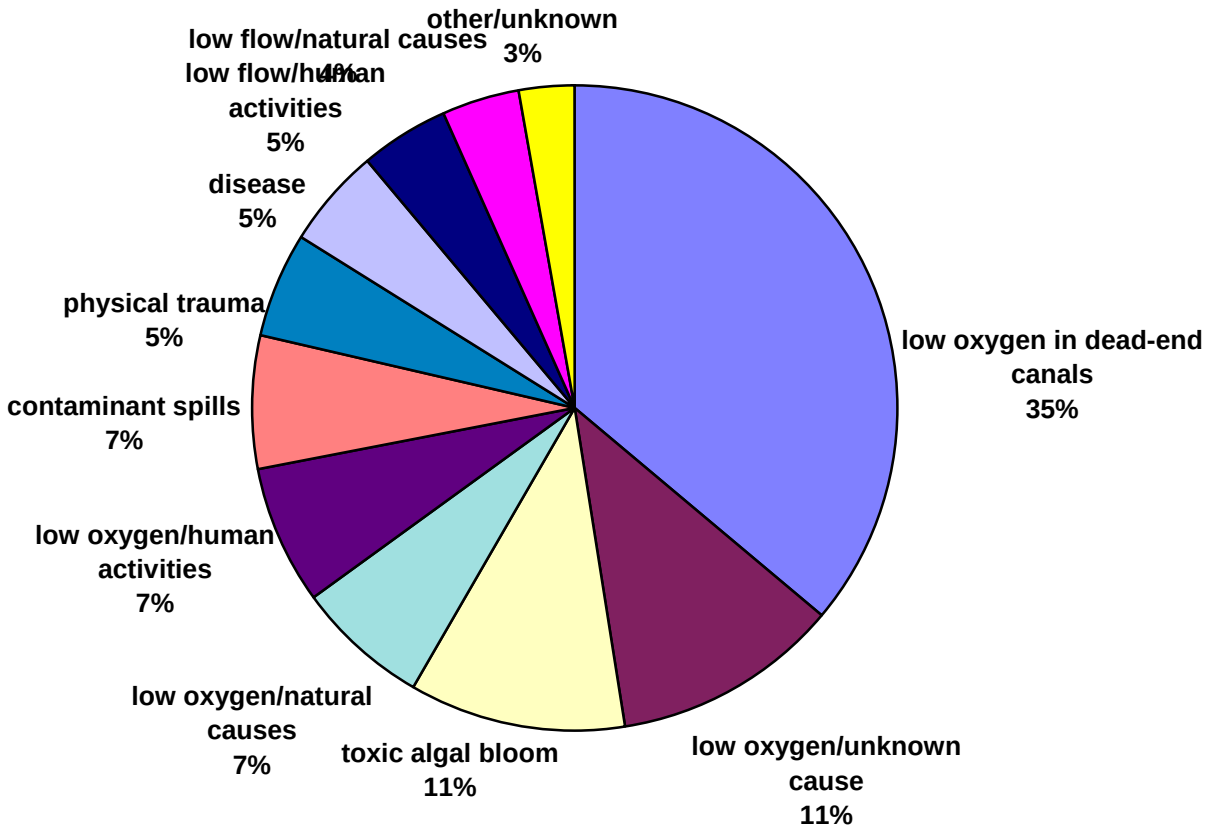

Figure 6. Numbers of fish and wildlife killed by type of pollution.

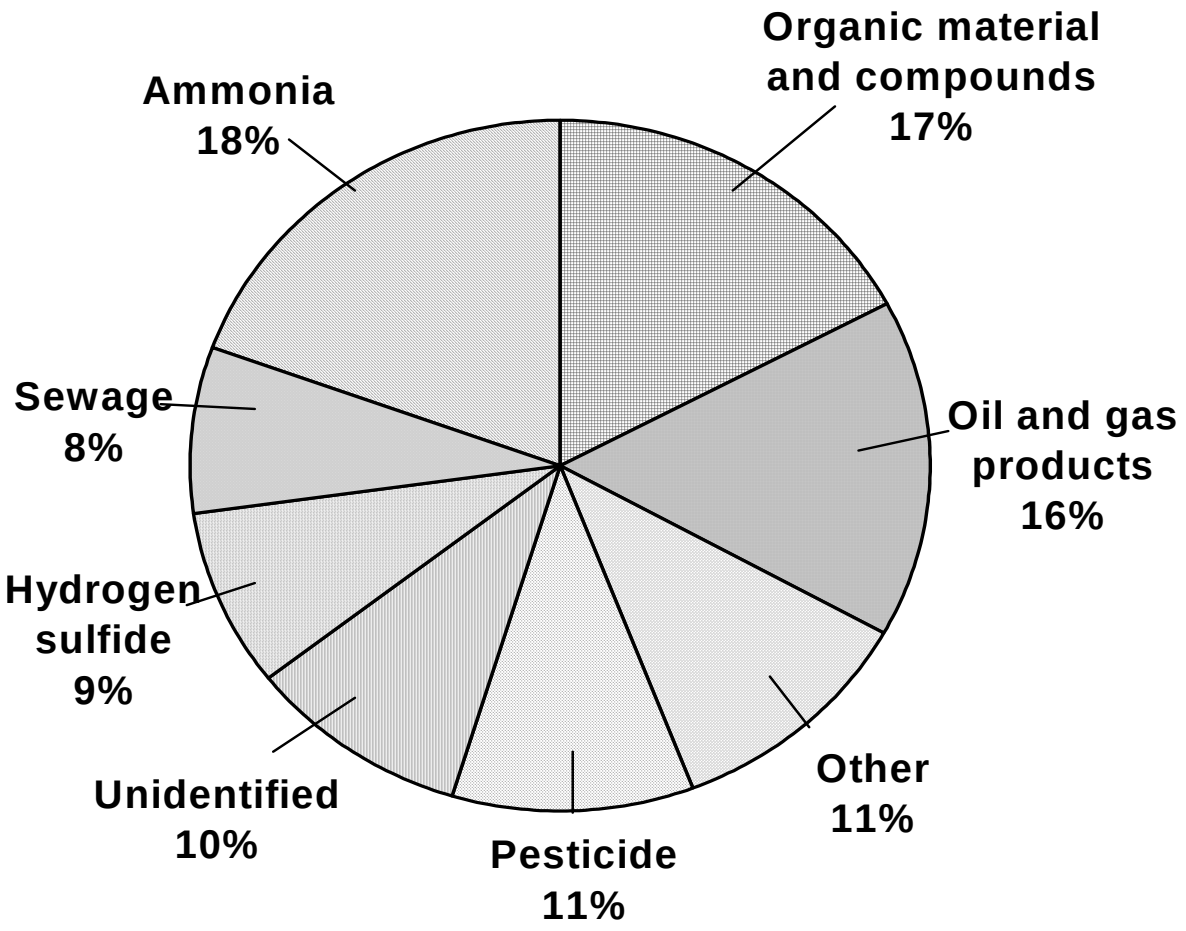

Figure 7. Habitats affected by kills and spills (measured in acres).

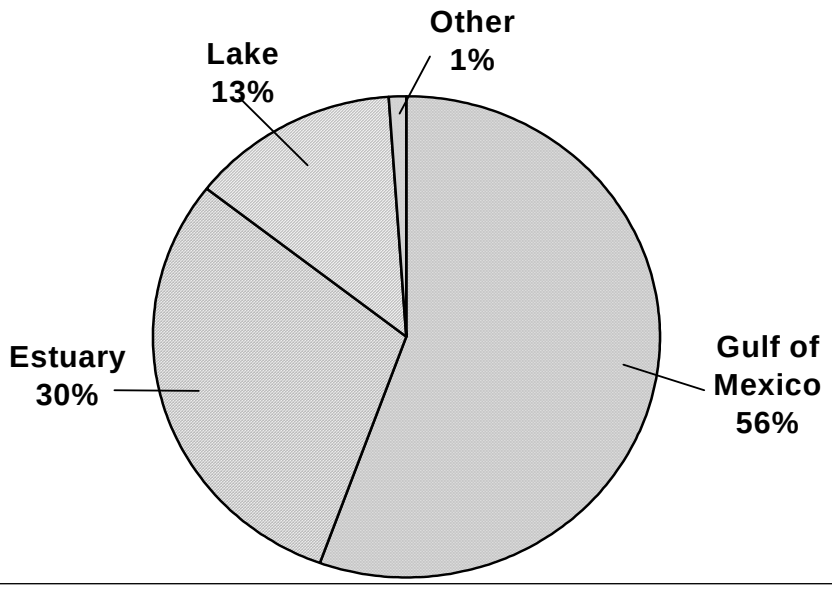

Figure 8. Habitats affected by kills and spills (measured in miles).

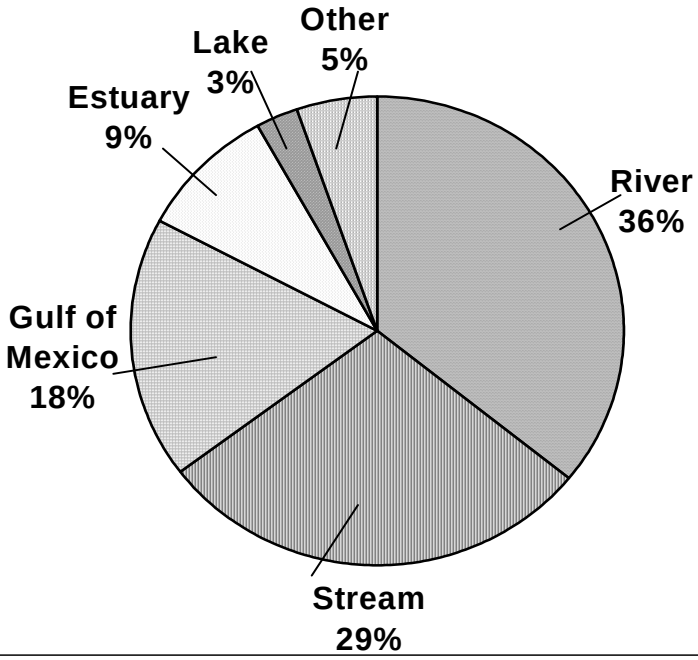

Figure 9. Number of Kills and Spills, Inland vs. Coastal.

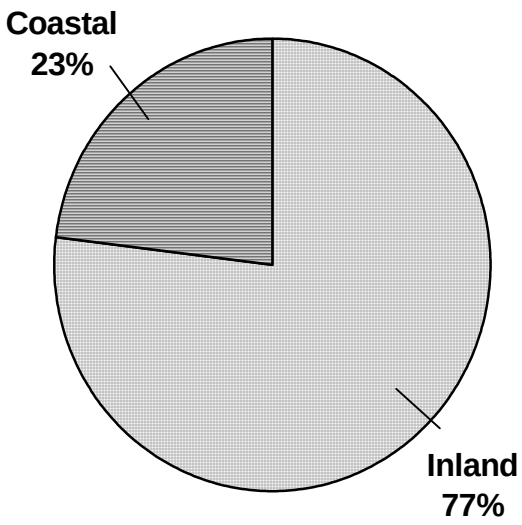

Figure 10. Estimated Numbers of Fish and Wildlife Killed, Inland vs. Coastal.