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*The Impact of Hurricane Katrina on Biological Resources*

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February 22, 2006

**Abstract.** Winds, storm surge, and associated flooding from Hurricane Katrina had substantial impacts on the biological resources of the affected region. Some impacts caused by this hurricane included wetland and timber loss, and declines in fisheries and wildlife populations. This report discusses the reported and potential impacts of Hurricane Katrina on the biological resources in the affected region. Most of the impacts reported are anecdotal and estimated; some biological surveys have been completed and little quantitative information on the status of most biological resources is available. Several state and federal science agencies were initially involved in humanitarian efforts before investigating damage to biological resources. Currently, studies are underway to provide information on the short and long-term impacts of Katrina on biological resources. This report will summarize the known and estimated impacts of Hurricane Katrina on coastal ecosystems, forests, freshwater and marine bodies, fisheries, and wildlife. Questions for specifying the impacts on biological resources are listed and possible restoration activities are discussed.

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# CRS Report for Congress

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## **The Impact of Hurricane Katrina on Biological Resources**

**Updated February 22, 2006**

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# The Impact of Hurricane Katrina on Biological Resources

## Summary

Winds, storm surge, and associated flooding from Hurricane Katrina had substantial impacts on the biological resources of the affected region. Some impacts caused by this hurricane included wetland and timber loss, and declines in fisheries and wildlife populations. This report discusses the reported and potential impacts of Hurricane Katrina on the biological resources in the affected region. Most of the impacts reported are anecdotal and estimated; some biological surveys have been completed and little quantitative information on the status of most biological resources is available. Several state and federal science agencies were initially involved in humanitarian efforts before investigating damage to biological resources. Currently, studies are underway to provide information on the short and long-term impacts of Katrina on biological resources. This report will summarize the known and estimated impacts of Hurricane Katrina on coastal ecosystems, forests, freshwater and marine bodies, fisheries, and wildlife. Questions for specifying the impacts on biological resources are listed and possible restoration activities are discussed. This report will be updated as events warrant.

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# The Impact of Hurricane Katrina on Biological Resources

## Introduction

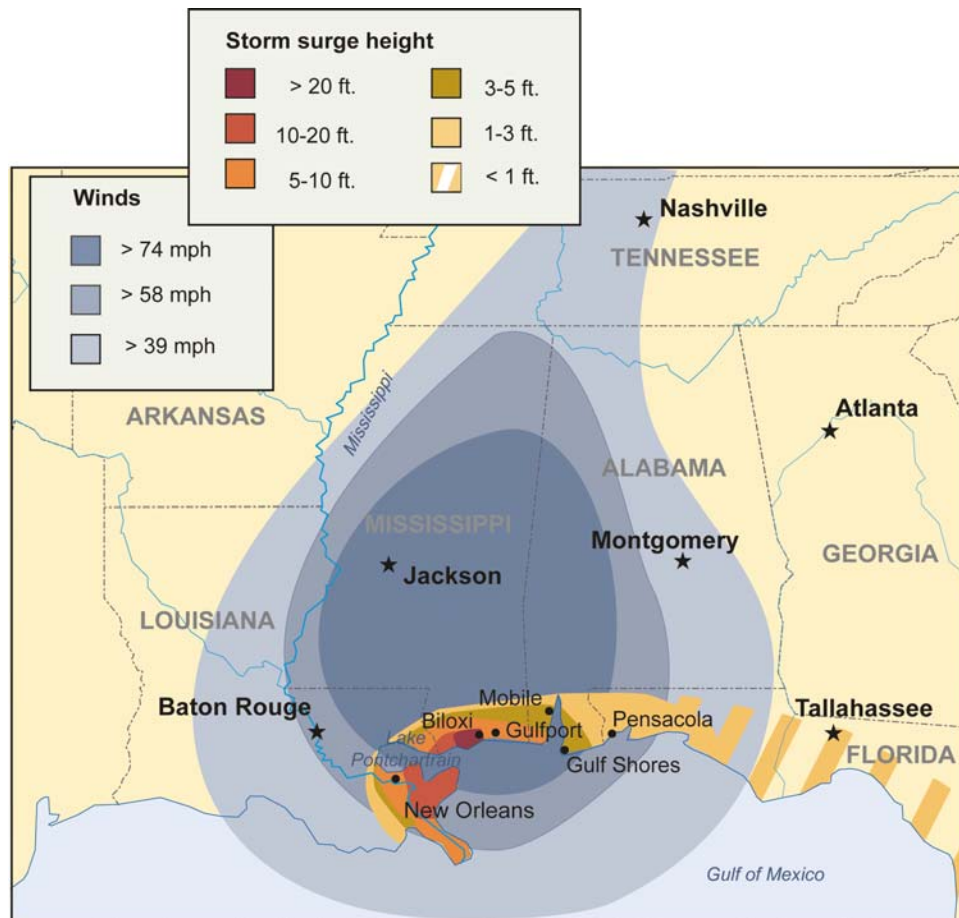
Hurricanes generate four forces which can cause damage to the biological resources of a region: strong winds, tornadoes, storm surges, and rain. Hurricane Katrina hit the Gulf Coast region with all of these forces on August 29, 2005 and has caused considerable alterations to Gulf Coast ecosystems, and their biological resources. (See **Figure 1** for the area of reported forces.) Katrina went through several areas of shallow-shelf estuarine waters including extensive oyster reefs, large marine and estuarine submerged aquatic vegetation beds, and wetlands. Katrina also affected inland forests and wildlife refuges by downing trees and scattering debris. Further, storm surges from Katrina led to the breaching of levees in New Orleans and flooding throughout the city. The return flow of contaminated floodwaters back into Lake Pontchartrain has the potential to affect the lake and associated ecosystems. Surveys of the damage to biological resources have started according to several sources, and quantitative evaluations of the losses to biological resources caused by Katrina is just starting to be reported. There are regional estimates of wetland loss, and estimates of impacts on fisheries, forests, and aquatic areas.

Congressional interest in the biological resources of the region affected by Hurricane Katrina is widespread. Impacts to fisheries, timberland, agricultural, and recreational sites contain not only environmental costs, but a significant economic cost as well. Further, alterations to wildlife refuges and forest lands can stress populations of endangered and threatened species, as well as reduce recreational activities such as hunting.<sup>1</sup> This report will discuss the reported and potential effects of Hurricane Katrina on the biological resources in terrestrial and aquatic ecosystems in the region, as well as present questions to consider for further assessment.

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<sup>1</sup> There are several examples of hunting seasons being called off or changed on state lands due to the impacts of Katrina.

**Figure 1. Storm Surge and Winds Generated by Hurricane Katrina**



Source: Information provided by the 2005 Houston Chronicle Special Report on Hurricane Katrina and the U.S. Fish and Wildlife Services. Map Resources. Adapted by CRS. (K. Yancey 9/20/05).

## Consequences for Terrestrial Ecosystems

**Coastal Wetlands.** The storm surge and strong winds from Hurricane Katrina altered several barrier islands off the coast of Louisiana. These islands serve as buffers against hurricanes and storm surges, and are important wildlife habitat. Post-hurricane flights by the U.S. Geological Survey (USGS) and comparative analyses of island areas before and after the hurricane revealed significant land losses and damaged seagrass beds.<sup>2</sup> The loss of seagrass beds on barrier islands can affect aquatic life, which use these habitats for spawning, nesting, and feeding. Species that depend on seagrass beds include marine mammals, turtles, and fish, as well as migratory species such as redhead ducks. According to the USGS, the Chandeleur Islands and Breton Sound were significantly altered by the hurricane and permanent habitat loss may have occurred. Satellite imagery analyzed by the USGS has shown that the effects of Katrina and Hurricane Rita converted more than 118 square miles

<sup>2</sup> U.S. Department of the Interior, Geological Survey, *Hurricane Katrina Impact Studies*, accessed on Oct. 7, 2005 at [<http://coastal.er.usgs.gov/hurricanes/katrina/>].

of land into new water areas within a 9,742 square mile area in affected region.<sup>3</sup> In barrier islands of Mississippi and Alabama, storm surges reportedly eroded large areas of sand and submerged wildlife habitat.

Storm surges associated with hurricanes shift sediments, moving them from wetlands, beaches, and coastal barrier islands to other land areas. For this reason, some scientists contend that some wetland areas lost to the storm may be temporary and other areas previously inundated may have emerged due to sediment deposition. Sediment deposition along large areas of the Gulf coastline was recorded after the landfall of Hurricane Andrew in 1992. Sediment deposition caused by Katrina has not been quantified. Further, the permanency of land converting to water is uncertain and may not be known until after several growing seasons. Some shallow inundated areas may be re-vegetated with grasses and other vegetation; whereas others may remain as open ponds. Aerial surveys of the region as well as satellite imagery are continuously be used to analyze the land loss caused by Katrina.<sup>4</sup>

About 15,000 acres of coastal wetlands were being converted to open water each year in Louisiana before Katrina. The land loss due to Hurricane Katrina and Rita in all of Coastal Louisiana east of the Mississippi River from 2004 to 2005 was 72.9 square miles, 12.9 square miles above the projected 60 square mile loss projected to occur between 2000 and 2050. Many believe that the restoration and reclamation of these wetlands will provide a buffer against the impacts of future hurricanes and will prevent further loss of land. Activities aimed at restoring coastal wetlands in Louisiana have been ongoing for several years. The 109<sup>th</sup> Congress is considering proposals that would authorize the U.S. Army Corps of Engineers to implement a set of restoration projects that would slow the rate of coastal wetland loss in Louisiana over the next decade. According to some, the proposed projects may not be sufficient to completely restore wetlands to a state where they would be an effective buffer against storm surges created from future hurricanes. For more information on the issues associated with coastal restoration and Hurricane Katrina, see CRS Report RS22276, *Hurricanes Katrina and Rita and Coastal Louisiana Ecosystem Restoration*, by Jeffrey Zinn.

**Wildlife Refuges.** Hurricane Katrina damaged 16 federal wildlife refuges and altered habitat for at least three endangered or threatened species, including the endangered Alabama beach mouse, Kemp's ridley sea turtle, and some species of wading birds.<sup>5</sup> All 16 refuges in the area, totaling approximately 365,000 acres, were closed; and currently 7 refuges are still closed. Significant damage was reported in Louisiana's Breton National Wildlife Refuge, where some estimates claim that nearly

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<sup>3</sup> U.S. Geological Survey, *USGS Reports Latest Land-Water Changes for Southeastern Louisiana*, Fact Sheet (Reston VA: Feb. 2006).

<sup>4</sup> Landsat 5 Thematic Mapper imagery is being used by the USGS to determine landscape changes over time.

<sup>5</sup> U.S. Department of the Interior, Fish and Wildlife Service, *U.S. Fish and Wildlife Service Conducting Initial Damage Assessments to Wildlife and National Wildlife Refuges*, accessed Sept. 17, 2005 at [<http://www.fws.gov/southeast/news/2005/r05-088.html>]. Hereafter cited as *FWS Hurricane Impact*.

half of the refuge's approximately 18,000 acres was inundated.<sup>6</sup> Other refuges were flooded, including Bayou Sauvage, which is near the city of New Orleans. Several closed refuges as well as barrier islands serve as stopover points for migratory birds who fly along the Mississippi flyway to wintering spots in Central and South America. Some believe that the habitat alterations in the refuges will cause waterfowl and other avian species to search for other nesting sites. According to preliminary findings by the Fish and Wildlife Service (FWS), damage to habitat within refuges is widespread, including the loss of wetlands, large areas of tree blowdowns and defoliation, and saltwater intrusion, among other things.<sup>7</sup> Secondary effects of habitat loss are being noted by some scientists. High concentrations of wildlife are occupying remaining habitat in some areas, which according to some scientists, will lead to increased competition for food and resources and stress on species populations.

The habitats of several endangered species were altered by Katrina. The endangered Alabama beach mouse has lost several acres of primary and secondary dunes that serve as habitat, and has lost scrub forest habitat, where it finds prey, to saline ocean waters. Along the Alabama coast, some nesting sites for the endangered Kemp's ridley sea turtle have been destroyed, and forested areas have been blown down in the Noxubee National Wildlife Refuge in Mississippi, where the listed red-cockaded woodpecker has habitat.<sup>8</sup> The entry of toxic waters and excess nutrients into Lake Pontchartrain may also affect endangered populations of manatees, which were recently observed in the lake and its waterways. According to the FWS, all hurricane related federal activities in presidentially-declared disaster areas will invoke the emergency consultation provisions of the Endangered Species Act (ESA; 16 U.S.C. §§1531-1544). Specifically, the FWS states that the restoration of "any infrastructure damaged or lost due to the hurricane back into the original footprint" does not require ESA consultation with the Service."<sup>10</sup>

**Forested Lands.** The Gulf Coast states are significantly forested and are major producers of lumber and plywood. The USDA Forest Service estimated 19 billion board feet of timber damaged on over 5 million acres in Mississippi, Alabama, and Louisiana.<sup>11</sup> This would translate into an estimated \$5 billion loss in

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<sup>6</sup> Twenty-three species of seabirds and shorebirds frequently use the refuge. The most abundant nesters are brown pelicans, laughing gulls, and royal, caspian, and sandwich terns. Endangered and threatened species, common to the refuge include the least tern, brown pelican, and piping plover.

<sup>7</sup> *FWS Hurricane Impact.*

<sup>8</sup> *Ibid.*

<sup>9</sup> A footprint is generally considered to be the range of physical features involved in a structure. The term was not defined in the statement nor is it defined in the law.

<sup>10</sup> Letter from Jackie Parrish, Acting Regional Director, Southeast Region, U.S. Fish and Wildlife Service, Sept. 13, 2005.

<sup>11</sup> U.S. Department of Agriculture, *USDA Forest Service Reports Significant Damage by Hurricane Katrina to Public and Private Timberland*, USDA News Release No. 0376.05, available on Sept. 16, 2005, at [http://www.usda.gov/wps/portal/!ut/p/\\_s.7\\_0\\_A/7\\_0\\_1RD?](http://www.usda.gov/wps/portal/!ut/p/_s.7_0_A/7_0_1RD?)

(continued...)



potential timber revenues according to the Forest Service. The forested area damaged represents 30% of the total timberland in the affected region, 90% of which occurred on non-federal lands.<sup>12</sup> Eighty percent of the damage occurred in Mississippi. The Mississippi Forestry Commission issued a news release estimating that 1.3 million acres of forested land in the state had been damaged, with commercial timber valued at about \$1.3 billion; urban tree damage in Mississippi was estimated at \$1.1 billion.<sup>13</sup>

In addition to the damages to wildlife habitat and other environmental services from the loss of forest cover, the dead and damaged trees can become hazardous fuels for wildfires as well as a haven for forest insects and diseases. In southern Mississippi, for example, the amount of tree debris available for fueling a wildfire is an estimated 20-30 times the normal levels.<sup>14</sup> Efforts to remove fallen timber and salvage usable timber are underway, although some contend that the period for salvaging timber is declining due to warm and moist conditions that promote wood decomposition.<sup>15</sup> Fallen timber can promote insect infestations as well as provide favorable conditions for the establishment of invasive species. Some damaging insect species such as the southern pine beetle and black turpentine beetle can thrive on fallen trees and then harm living trees. Forested land exposed to increased levels of sunlight caused by fallen trees is susceptible to invasive non-native species such as Chinese tallow tree (*Triadica sebifera*) and cogongrass (*Imperata brasiliensis*), which are prevalent in the areas damaged.

## Consequences for Aquatic Ecosystems

**Lake Pontchartrain.** Lake Pontchartrain is a relatively closed, 630 square-mile waterbody that is connected to the Gulf of Mexico through Lake Borgne.<sup>16</sup> Before Hurricane Katrina, waters entering Lake Pontchartrain were impaired by several sources of pollution, including fertilizers and animal wastes from agricultural operations, stormwater runoff, oil and gas spills, and discharges from wastewater treatment plants. Natural occurrences — such as previous hurricanes, subsidence, and erosion — have compounded the pollution problems. Restoration activities in

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<sup>11</sup> (...continued)

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<sup>12</sup> Testimony of Dale Bosworth, Chief, U.S. Forest Service, U.S. Dept. Of Agriculture, U.S. House Resources Subcommittee on Forests and Forest Health, *Restoration after Recent Hurricanes and Other Natural Disasters: Federal Role in Catastrophic Events Affecting Forested Lands*, oversight hearing, Oct. 7, 2005.

<sup>13</sup> Available at [<http://www.mfc.state.ms.us/pdf/katrina/timberdamage.pdf>], visited on Sept. 15, 2005.

<sup>14</sup> Testimony of Everard Baker, Acting State Forester, Mississippi Forestry Commission, U.S. House Resources Subcommittee on Forests and Forest Health, *Restoration after Recent Hurricanes and Other Natural Disasters: Federal Role in Catastrophic Events Affecting Forested Lands*, oversight hearing, Oct. 7, 2005.

<sup>15</sup> *Ibid.*

<sup>16</sup> Lake Pontchartrain and its surrounding Basin constitute an estuarine ecosystem of national significance according to the National Estuary Program.

the lake were started before Katrina and the federal role was defined through the Lake Pontchartrain Basin Restoration Act of 2000 (P.L. 106-457). This act authorized the Administrator of the U.S. Environmental Protection Agency to establish and administer a grant program for restoration projects.<sup>17</sup>

Flood waters being pumped into Lake Pontchartrain after Katrina contain a mix of raw sewage, bacteria, heavy metals, pesticides and toxic chemicals, among other things, according to several sources. Specifically, estimates reported that releases from Hurricane Katrina included 6.5 million gallons of oil released from seven major incidences,<sup>18</sup> releases from major sewage treatment centers and many smaller ones, as well as runoff from fuel storage tanks, and household and industrial chemical stores. The lake was also affected by the storm surge, which brought saltwater into the lake ecosystem.<sup>19</sup>

The impacts of this water on the lake ecosystem and its aquatic species have yet to be determined by scientists. Some have predicted that toxic waters will lead to large fish kills and severe impacts on riparian and aquatic habitat. Further, they contend that some toxins will settle into lake sediments and be prevalent for years to come. Others contend that water flows out of Lake Pontchartrain should carry most toxic substances into the Gulf of Mexico; thus flushing out the lake. Because of the lake's geography and location, this scenario may allow toxic substances to reach coastal islands and wetlands. Scientists reported in a recently published study that the toxicity of floodwaters in New Orleans immediately after Katrina was typical of stormwater runoff in the region, and floodwaters caused by Katrina were distinguished by their large volume and increased human exposure to pollutants.<sup>20</sup> Further, the Corps has reported that there have been no reports of oily sheens on Lake Pontchartrain waters and no reports of fish kills in the Lake.<sup>21</sup> For more information on environmental considerations of cleanup after Katrina, see CRS Report RL33115, *Cleanup After Hurricane Katrina: Environmental Considerations*, by Robert Esworthy, Linda Jo Schierow, Claudia Copeland, and Linda Luther.

Based on previous experiences, the effect of toxic chemicals and wastes entering coastal waters and lakes can be high. When Hurricane Andrew hit Florida in 1992, concentrations of ammonia, dissolved phosphate, and dissolved organic carbon increased. Phytoplankton blooms resulted and dissolved oxygen decreased. This, along with contaminants from runoff and hydrocarbon spills, resulted in large fish

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<sup>17</sup> Authorized appropriations included \$20 million annually from FY2001-FY2005.

<sup>18</sup> U.S. Coast Guard, *Oil Pollution, Containment, and Recovery Continue*, accessed at [<http://www.uscgstormwatch.com/external/?cid=1008&fuseaction=external.viewDocument&documentID=83501>], Sept. 15, 2005.

<sup>19</sup> For more information about water quality and environmental contaminants, see CRS Report RL33115, *Cleanup After Hurricane Katrina: Environmental Considerations*, by Robert Esworthy, Linda Jo Schierow, Claudia Copeland, and Linda Luther.

<sup>20</sup> J.H. Pardue, et al. Chemical and Microbiological Parameters in New Orleans Floodwater Following Hurricane Katrina, *Environmental Science and Technology* (Oct. 2005).

<sup>21</sup> U.S. Army Corps of Engineers, *Quick, Coordinated Efforts to Reduce Environmental Impact on Lake Pontchartrain*, accessed at [<http://www.usace.army.mil/>] on Nov. 4, 2005.

kills off the southeastern coast of Florida.<sup>22</sup> Some scientists report that saltwater intrusion could kill lakeside habitat consisting of cypress and tupelo swamps. The long-term ecosystem effects of saltwater intrusion and pumping toxic water into Lake Pontchartrain may not be fully known for years.

**Gulf of Mexico.** Some scientists believe that the risk of long-term damage of toxic floodwaters entering the Gulf of Mexico is not high. They contend that tidal flows and flushing of Gulf waters will dilute substances to non-harmful levels. Specifically, scientists contend that bacterial contaminants will die off quickly, and that other organic material will degrade with natural processes. Other scientists offer a different perspective on the impacts of toxic waters in the Gulf of Mexico. They contend that toxic chemicals and excess nutrients will severely deplete fisheries by killing fish and will contaminate sediments. A recent toxicology survey of the Gulf of Mexico states that elevated bacterial toxins due to hurricanes do not exist in sampled water, marine species, and sediments.<sup>23</sup>

The impact of Katrina on the annual *dead zone* in the Gulf of Mexico is uncertain.<sup>24</sup> Some scientists contend that excess nutrients sent into Gulf waters from Katrina will not increase the intensity of the dead zone because of the timing of the influx.<sup>25</sup> When Katrina reached the Gulf of Mexico, the dead zone had started to break down and the conditions became unfavorable for the dead zone to regenerate. Other scientists, however, contend that deposition of toxic substances and excess nutrients in sediments may contribute to the intensity of the dead zone next season and in years to come.

**Fisheries.** The Gulf Coast where Hurricane Katrina struck is an especially important center of commercial and recreational fishing, producing 10% of the shrimp and 40% of the oysters consumed in the United States. Further, commercial shrimpers fishing out of or delivering to Alabama, Mississippi, and Louisiana ports account for almost half of all U.S. shrimp production. Katrina has destroyed or severely damaged fishing boats and processing and storage facilities throughout this area.<sup>26</sup>

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<sup>22</sup> G. Guntenspurgen, U.S. Geological Survey, *The Impact of Hurricane Andrew on Louisiana's Coastal Landscape*, accessed Sept. 19, 2005 at [<http://biology.usgs.gov/s+t/SNT/noframe/np104.htm>].

<sup>23</sup> The National Oceanic and Atmospheric Association, *News Release*, [[http://www.st.nmfs.noaa.gov/hurricane\\_katrina/press\\_releases/Latest\\_Katrina\\_Results\\_CLEAREDv2\\_011906.pdf](http://www.st.nmfs.noaa.gov/hurricane_katrina/press_releases/Latest_Katrina_Results_CLEAREDv2_011906.pdf)], accessed Feb. 1, 2006. Hereafter referred to as *NOAA Survey*.

<sup>24</sup> For more information, see CRS Report 98-869, *Marine Dead Zones: Understanding the Problem*, by John R. Dandelski and Eugene H. Buck.

<sup>25</sup> National Environmental Trust, *Toxic Stew, Hazardous Chemicals in Hurricane Katrina's Floodwaters*, accessed at [[http://www.net.org/health/katrina\\_toxics.vtml](http://www.net.org/health/katrina_toxics.vtml)], Sept. 23, 2005.

<sup>26</sup> For more information on the impacts of Katrina on fisheries and fisheries infrastructure, see CRS Report RS22241, *Hurricane Katrina: Fishing and Aquaculture Industries — Damage and Recovery*, by Gene Buck.

The impact of Katrina on fish populations, habitat, and their viability for consumption may not be as significant as originally thought. For oysters, the Louisiana Department of Fish and Wildlife used studies of resource mortality caused by hurricanes Ivan and Andrew to estimate mortality of existing resources caused by Katrina. The initial estimate was a 99% loss of oyster resources in Louisiana waters. Filter feeding organisms such as oysters readily uptake toxins and excess nutrients making them very susceptible to contamination. Further, habitat can be destroyed by sediment deposition and toxins. Many areas have been administratively closed to fishing because of pollution-related contamination concerns. For example, the presence of *E.coli* bacteria in water surrounding oyster beds automatically triggers their administrative closure to harvesting. Recent surveys, however, indicate that the Hurricane Katrina did not cause a reduction in fish and shrimp populations or decline in fish quality as was expected.<sup>27</sup>

The long-term effects of Katrina on fisheries is uncertain. Quantification of habitat loss is underway and estimates from satellite imagery and aerial reconnaissance reveal large losses of wetland ecosystems which support spawning areas and prey populations. NOAA is undertaking a sampling study to determine levels of toxicity and contamination in fish and marine waters. There is concern over the long-term contamination of fisheries through the food chain. Toxins released to the environment through flooding may accumulate through the food chain into the tissues of fish. Bioaccumulative toxins such as lead and mercury have been detected in floodwaters that are now being pumped in Lake Pontchartrain. The timeline for bioaccumulation is uncertain, and depends on the amount of toxins released, where they were released, and whether the release was in specific areas or diffuse.

## Questions for Consideration

Several questions regarding the impact of Hurricane Katrina on regional biological resources remain. Some questions being raised about the impact of Katrina on regional ecosystems include:

- What is the extent of coastal wetland loss in the region, is this loss permanent or temporary, and how will this loss alter the buffering capacity of coastal wetlands against future hurricanes?
- Can coastal wetlands be restored, and if so, can restoration be done through the proposed U.S. Army Corps of Engineers project, *The Louisiana Coastal Area Ecosystem Restoration Study*?
- What has been the impact of Katrina on endangered and threatened species populations and their habitat?
- What are the long-term ecological and economic consequences for coastal fisheries and can the fisheries be restored?
- How much is wildfire risk increased by the dead and damaged trees?
- How much time can elapse before this risk and the threat of insect or disease infestation become severe?
- Will coastal and inland ecosystems be more susceptible to invasive species?

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<sup>27</sup> NOAA Survey.

- Will toxic substances released through flooding leach into the groundwater? Where and how much leaching may occur, and how long will it take to remediate water supplies?
- Will there be bioaccumulation of toxic substances through the food chain? How long will it take for substances to accumulate in aquatic and terrestrial wildlife?

## Conclusion

The impacts of Hurricane Katrina may not be readily absorbed by the coastal ecosystem; several short-term and long-term ecosystem impacts are anticipated. Short-term impacts may include the effect of toxic waters on wildlife and aquatic organisms; the fate of inundated vegetation; and the habitat and economic loss of forest blow-downs, among others. Long-term impacts may include the settling of contaminated sediments, infiltration of toxic substances into groundwater, wetland loss, and decline of populations of threatened and endangered organisms.

When considering what ecosystem restoration objectives to pursue after Katrina, Congress may be faced with several choices and may have to prioritize resources. Some stakeholders contend that the primary restoration objective should be restoring and increasing the area of coastal wetlands because of their role in providing a buffer against future hurricanes and storm surges. Others suggest that monitoring the cleanup and deposition of waste and debris away from sensitive environmental areas should be a priority. Restorative actions that have been suggested include increasing oyster habitat and supplementing oyster populations; clearing forest debris and salvaging fallen timber to lower the chance of forest fires; rehabilitating wildlife refuges and reserves to increase wildlife populations and recreational options; and creating new sanctuaries for migrating birds and turtles to replace lost areas