Gulf Hypoxia Communications Plan

An Output from the *Workshop to Coordinate Gulf of Mexico Hypoxic Zone Research*

Updated September 27, 2010

DRAFT

Introduction

The large hypoxic zone in the northern Gulf of Mexico has increased over time, associated with increases in nutrient loads from the Mississippi and Atchafalaya rivers. The watershed source of nutrients for the "Dead Zone" includes > 40% of the contiguous U.S., presenting an ecosystem management challenge requiring cooperation among numerous states and federal agencies. The interagency Mississippi River/Gulf of Mexico Watershed Nutrient Task Force was formed in 1997 to consider options for mitigating Gulf hypoxia. The Task Force directed production of the 2001 *Action Plan for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico*, followed by a four-year (2003-2007) science and management reassessment effort that led to the revised *2008 Gulf Hypoxia Action Plan*. The *2008 Action Plan* has 11 Actions that address critical needs to mitigate Gulf hypoxia. Action 10 is the management driver for this *Gulf Hypoxia Communications Plan*.

Action 10: "Promote effective communications to increase awareness of hypoxia and support the activities of the Task Force."

Progress toward advancing Action 10 was achieved at the *Summit on Long-Term Monitoring of the Gulf of Mexico: Developing the Implementation Plan for an Operational Observation System*, held on 30-31 January 2007 at Stennis Space Center, Mississippi. One of the outputs of the meeting was establishment of the Gulf Hypoxia Monitoring Stakeholder Committee (GHMSC) to provide a portal to stakeholder communities and ascertain their needs for monitoring, measurements, and products related to hypoxia. Another *Summit* output, the *Gulf of Mexico Hypoxia Monitoring Implementation Plan*, includes plans for an outreach program to promote effective communications to increase awareness of hypoxia, with dedicated personnel for communications (including maintaining the GHMSC and website formed from the *Summit*).

Among the seven highest priority ("Core") system requirements of the *Implementation Plan* is:

System Requirement 7: Dissemination of relevant data and findings to management community.

The FY10 needs under System Requirement 7 are to "review data needs of the research and management communities and the mechanisms to disseminate data; adjust the methods for data dissemination as identified in the review; and establish protocol for disseminating data."

The next phase in advancing Gulf hypoxia outreach was the *Workshop to Coordinate Gulf of Mexico Hypoxic Zone Research*, which convened hypoxia researchers and managers to exchange ideas and coordinate plans to further advance implementation of Action 10 from the *2008 Gulf Hypoxia Action Plan*. The *Gulf Hypoxia Communications Plan* is an output from the *Workshop* with the aim to develop a strategy for coordinating Gulf of Mexico hypoxia outreach and communication. The foundation for the *Communications Plan* came from discussions of *Workshop* attendees during the Outreach and Education Breakout Session. The goals and agenda for the Breakout Session were developed prior to the *Workshop* by a Communication Committee made up of representatives from communication groups that address Gulf hypoxia, including the GHMSC (Joe Stinus, NOAA NCDDC; Alan Lewitus, NOAA NCCOS), Hypoxia Task Force Communication Subcommittee (Aaron Kornbluth, EPA OWOW), Gulf of Mexico Alliance Environmental Education Network (Lee Yokel, Dauphin Island Sea Lab), LUMCON (Nancy Rabalais), GCOOS Educational and Outreach Council (Ann Jochens, Texas A&M University), Mississippi-Alabama Sea Grant Consortium's Engagement Pilot at GulfQuest (Stacy Ray), and NGI Education and Outreach (Jay Ritchie, Mississippi State University). The Communication Committee (Joe Stinus, Chair) had a teleconference on 2 Feb 2010 to discuss the current status and FY10 plans for hypoxia-related outreach, the attributes of a central hypoxia web site, and plans for the Breakout Session, as described below.

Results from *Workshop* Outreach and Education Breakout Session

Goal: To develop a strategy for improving and coordinating Gulf of Mexico hypoxia outreach and communication.

Web Resources: An inventory of web content related to Gulf of Mexico hypoxia was presented during the breakout session (see Appendix 1).

Target audiences: Participants from the communications breakout session identified two distinct groups as expected user communities and audiences for Gulf hypoxia-related information; those along the Gulf coast and those 'upstream' within the Mississippi River watershed. Within the Gulf coast region, there are a number of user communities that are interested in both hypoxia-related information and data. It was the consensus of session participants to prioritize Gulf coast resource managers (state and federal) as the primary target of hypoxia communications, based on the intention of System Requirement 7 of the *Implementation Plan* (see above). This information would be focused on increasing awareness of hypoxia and its impacts on living resources in order to improve management of resources. In addition, potential secondary audiences discussed included the general public and researchers. These groups would be the target of information to increase awareness, but researchers would also be the target of efforts to increase the dissemination and sharing of data.

Outreach and communication efforts in the watershed would also focus on raising awareness but would have an enhanced educational component. These messages would also highlight the benefits to communities of improved local water quality from reducing nutrient inputs in the watershed. As along the Gulf coast, managers would be the target audience, encompassing a broad community that includes state and local agriculture extension services, state conservationists, local and state water quality managers, state agriculture agencies, and waste

water treatment facility managers. This 'upstream' outreach strategy would also target farmers to highlight the benefits of implementing on-farm best management practices and communicate promising nutrient management strategies.

Strategy to Improve Coordination and Outreach

Objective 1: Improve engagement within the **upstream hypoxia community** (scientists, state natural resource managers in agriculture, water quality, fisheries, etc. in Arkansas, Kentucky, Illinois, Indiana, Iowa, Minnesota, Missouri, Ohio, Tennessee, and Wisconsin).

Tactics and Tools:

- Reach agriculture managers through guest articles in agricultural newsletters or other organizational publications.
    - local farm bureaus
    - local extension agencies
    - land grant universities

- Build and promote a constructive dialogue between natural resource managers and hypoxia researchers.
    - Share relevant anecdotal stories and management information at annual conferences/symposiums.

- Assess the information/research needs of managers by conducting a workshop/symposium at which state agencies have an opportunity to share local knowledge, information, and data and experience an open dialogue with scientists.

- Continue to provide exchange opportunities for Upper and Lower Mississippi River Watershed managers such as field tours and farmer-to-farmer exchanges. [already implemented through the Task Force]

Objective 2: Improve engagement within the **coastal hypoxia community** (hypoxia researchers, scientists, state natural resource managers in agriculture, water quality, fisheries, etc. in Texas, Louisiana and Mississippi).

Tactics and Tools:

- Create opportunities for information exchange throughout the hypoxia community by hosting annual symposia that bring together relevant researchers and managers to present/discuss recent results and coordinate upcoming efforts.
- Offer regional and local workshops that will provide educational opportunities, social networking opportunities, and leveraging opportunities to managers.
- Create an EPA-administered list serve to communicate ideas, schedule regular meetings of the Communications Committee, and share information.

- Administer live, online meetings and webcasts to set up live online presentations with the option for people to post questions and comments during the meeting.

Objective 3: Identify, support, and promote Gulf of Mexico hypoxia extension, outreach, and education efforts throughout the watershed.

Tactics and Tools:

- Support new and ongoing educational projects throughout the Mississippi River watershed by coordinating with partners (NERRs, NEPs, Sea Grant, TNC, CELCs, National Marine Sanctuaries, Universities, other non-profits) on hypoxia related projects.
    - assist with information dissemination
    - assist with development of materials/information [five bullets of hypoxia document (Appendix 2), YouTube videos, etc.]
    - assist with identifying funding opportunities
    - communicate Gulf Hypoxia extension, outreach, and education activities in newsletters [mentioned in objective 1]

- Build a virtual toolbox, hosted on the GOMA Environmental Education Network, which will provide a well organized set of Hypoxia related web links. [GOMA Nutrient PIT is already working on implementing this].

- Facebook
    - Focus on disseminating key messages

Timetable:

- Short-term actions (implemented in one year)- listserve, webcast, annual coordination workshop
- Long-term actions (implemented in two-five years)- enhanced farmer to farmer exchange, virtual toolbox

Evaluation:

- Quarterly conference call and subsequent report highlighting progress made and lessons learned
- Annual survey of target audiences

Considerations:

- Funding for proposed projects and activities
- Human resources and availability of individuals mentioned

Resource and Information Inventory by Audience

Resource Managers/Government

1. Gulf of Mexico Hypoxia Monitoring Stakeholders Committee http://www.ncddc.noaa.gov/activities/gulf-hypoxia-stakeholders/view
2. Gulf of Mexico Hypoxia: Hypoxia in the Northern Gulf of Mexico http://www.gulfhypoxia.net
3. Mississippi River Gulf of Mexico Watershed Nutrient Task Force http://www.epa.gov/msbasin/
4. The Gulf of Mexico Alliance Priority Issues: Nutrients and Nutrient Impacts http://gulfofmexicoalliance.org/issues/nutrients.html
5. Hypoxia in the Gulf of Mexico http://toxics.usgs.gov/hypoxia/
6. Hypoxia in the Gulf of Mexico and Nutrients in the Midwesthttp://www.isws.illinois.edu/docs/hypoxia/HYPOXIA.asp
7. Sea Grant links to GOMA Priority Actionshttp://masgc.org/goma/2008-2011%20Sea%20Grant%20Projects.htm
8. Hypoxia and Nutrient Pollution Overviewhttp://www.cop.noaa.gov/stressors/pollution/overview.html
9. Mississippi River Basin Gulf Hypoxiahttp://www.nrcs.usda.gov/programs/mrbi/mrbi_overview.html
10. Hypoxia Task Force Ohio River sub-basin committeehttp://www.orsanco.org
11. Innovative Producer Partnership Initiatives to Reduce Hypoxia in the Gulf of Mexico http://upstreamheroes.org/hypoxiczone.php
12. Gulf of Mexico Programhttp://www.epa.gov/gmpo/
13. Best Management Practices (BMP) and Treatment Technologies Clearinghouse http://www.epa.gov/waterscience/criteria/nutrient/clearinghouse/
14. National Management Measures to Control Nonpoint Source Pollution from Agriculture http://www.epa.gov/owow/nps/agmm/index.html
15. National Management Measures to Control Nonpoint Source Pollution from Forestry http://www.epa.gov/owow/nps/forestrymgmt/
16. National Management Measures to Control Nonpoint Source Pollution from Hydromodification http://www.epa.gov/owow/nps/hydromod/index.htm
17. National Management Measures to Control Nonpoint Source Pollution from Urban Areas http://www.epa.gov/owow/nps/urbanmm/index.html
18. Nutrient Management http://www.wsi.nrcs.usda.gov/products/W2Q/nutr/nutr_mgt.html
19. Conservation Reserve Enhancement Program (CREP)http://www.fsa.usda.gov/FSA/webapp?area=home&subject=prod&topic=cep
20. Conservation Reserve Program (CRP) http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp
21. Farmable Wetlands Program (FWP) http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=fwp
22. International Stormwater BMP Databasehttp://www.bmpdatabase.org/
23. Farm*A*Syst http://www.uwex.edu/farmasyst
24. Urban Small Sites Best Management Practice Manualhttp://www.metrocouncil.org/environment/Watershed/bmp/manual.htm
25. Resource Database for Gulf of Mexico Researchhttp://www.gulfbase.org/

Public

1. Mississippi River Gulf of Mexico Watershed Nutrient Task Force http://www.epa.gov/msbasin/
2. The Gulf of Mexico Alliance Priority Issues: Nutrients and Nutrient Impacts http://gulfofmexicoalliance.org/issues/nutrients.html
3. Hypoxia in the Gulf of Mexico and Nutrients in the Midwest http://www.isws.illinois.edu/docs/hypoxia/HYPOXIA.asp
4. Hypoxia and Nutrient Pollution Overview http://www.cop.noaa.gov/stressors/pollution/overview.html
5. Mississippi River Basin Gulf Hypoxia http://www.nrcs.usda.gov/programs/mrbi/mrbi_overview.html
6. Hypoxia Task Force Ohio River sub-basin committee http://www.orsanco.org
7. Where we work: The Dead Zone http://www.nature.org/wherewework/northamerica/states/indiana/misc/art25422.html
8. Ecosystem Management in the Gulf of Mexico http://www.nature.org/wherewework/northamerica/gulfofmexico/preserves/art16835.html
9. N.C. State University: Best Management Practices for Agricultural Nutrients http://www.soil.ncsu.edu/publications/Soilfacts/AG-439-20/
10. Purdue's Conservation Technology Information Center http://www.ctic.purdue.edu
11. The Gulf of Mexico Dead Zone http://www.smm.org/deadzone/
12. Surf Your Watershed http://cfpub.epa.gov/surf/locate/index.cfm
13. Gulf of Mexico Program http://www.epa.gov/gmpo/
14. National Menu of Stormwater Best Management Practices http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm
15. National Management Measures to Control Nonpoint Source Pollution from Hydromodification http://www.epa.gov/owow/nps/hydromod/index.htm
16. National Management Measures to Control Nonpoint Source Pollution from Urban Areas http://www.epa.gov/owow/nps/urbanmm/index.html
17. Resource Database for Gulf of Mexico Research http://www.gulfbase.org/
18. Gulf of Mexico Hypoxia: Hypoxia in the Northern Gulf of Mexico http://www.gulfhypoxia.net

Industry

1. Gulf of Mexico Hypoxia Watch http://ecowatch.ncddc.noaa.gov/hypoxia
2. 2009 Gulf Hypoxia http://sites.google.com/site/2009gulfhypoxia/
3. Mississippi River Gulf of Mexico Watershed Nutrient Task Force http://www.epa.gov/msbasin/
4. The Gulf of Mexico Alliance Priority Issues: Nutrients and Nutrient Impacts http://gulfofmexicoalliance.org/issues/nutrients.html
5. Hypoxia in the Gulf of Mexico and Nutrients in the Midwest http://www.isws.illinois.edu/docs/hypoxia/HYPOXIA.asp

6. Mississippi River Basin Gulf Hypoxia http://www.nrcs.usda.gov/programs/mrbi/mrbi_overview.html
7. Hypoxia Task Force Ohio River sub-basin committee http://www.orsanco.org
8. Innovative Producer Partnership Initiatives to Reduce Hypoxia in the Gulf of Mexico http://upstreamheroes.org/hypoxiczone.php
9. N.C. State University: Best Management Practices for Agricultural Nutrients http://www.soil.ncsu.edu/publications/Soilfacts/AG-439-20/
10. Ohio State University Extension: Agricultural Best Management Practices http://ohioline.osu.edu/aex-fact/0464.html
11. Agricultural Management Practices for Water Quality Protection http://www.epa.gov/watertrain/agmodule/
12. Best Management Practices (BMP) and Treatment Technologies Clearinghouse http://www.epa.gov/waterscience/criteria/nutrient/clearinghouse/
13. National Management Measures to Control Nonpoint Source Pollution from Forestry http://www.epa.gov/owow/nps/forestrymgmt/
14. Conservation Reserve Enhancement Program (CREP) http://www.fsa.usda.gov/FSA/webapp?area=home&subject=prod&topic=cep
15. Conservation Reserve Program (CRP) http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp
16. Farmable Wetlands Program (FWP) http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=fwp
17. Farm*A*Syst http://www.uwex.edu/farmasyst

Researchers/Scientists

1. Gulf of Mexico Hypoxia Watch http://ecowatch.ncddc.noaa.gov/hypoxia
2. Gulf of Mexico Hypoxia Monitoring Stakeholders Committee http://www.ncddc.noaa.gov/activities/gulf-hypoxia-stakeholders/view
3. Gulf of Mexico Hypoxia: Hypoxia in the Northern Gulf of Mexico http://www.gulfhypoxia.net
4. 2009 Gulf Hypoxia http://sites.google.com/site/2009gulfhypoxia/
5. Mississippi River Gulf of Mexico Watershed Nutrient Task Force http://www.epa.gov/msbasin/
6. The Gulf of Mexico Alliance Priority Issues: Nutrient Impacts http://gulfofmexicoalliance.org/issues/nutrients.html
7. Hypoxia in the Gulf of Mexico http://toxics.usgs.gov/hypoxia/
8. Hypoxia in the Gulf of Mexico and Nutrients in the Midwest http://www.isws.illinois.edu/docs/hypoxia/HYPOXIA.asp
9. Sea Grant links to GOMA Priority Actions http://masgc.org/goma/2008-2011%20Sea%20Grant%20Projects.htm
10. Hypoxia Task Force Ohio River sub-basin committee http://www.orsanco.org
11. Mechanisms Controlling Hypoxia Project http://hypoxia.tamu.edu/
12. Nutrient Steps (NSTEPS) http://n-steps.tetratech-ffx.com/
13. Causal Analysis/Diagnosis Decision Information System http://cfpub.epa.gov/caddis/index.cfm

14. Water Environment Resource Foundation (WERF) Stormwater BMP Database Searchhttp://www.werf.org/AM/Template.cfm?Section=Home
15. International Stormwater BMP Database http://www.bmpdatabase.org/
16. Resource Database for Gulf of Mexico Research http://www.gulfbase.org/

Organizations

1. Where we work: The Dead Zone http://www.nature.org/wherewework/northamerica/states/indiana/misc/art25422.html
2. Ecosystem Management in the Gulf of Mexico http://www.nature.org/wherewework/northamerica/gulfofmexico/preserves/art16835.html
3. Surf Your Watershed http://cfpub.epa.gov/surf/locate/index.cfm
4. Gulf of Mexico Program http://www.epa.gov/gmpo/
5. National Management Measures to Protect and Restore Wetlands and Riparian Areas for the Abatement of Nonpoint Source Pollution http://www.epa.gov/owow/nps/wetmeasures/
6. Conservation Reserve Enhancement Program (CREP) http://www.fsa.usda.gov/FSA/webapp?area=home&subject=prod&topic=cep
7. Conservation Reserve Program (CRP) http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp

Educators

1. Gulf of Mexico Hypoxia Monitoring Stakeholders Committee http://www.ncddc.noaa.gov/activities/gulf-hypoxia-stakeholders/view
2. Gulf of Mexico Hypoxia: Hypoxia in the Northern Gulf of Mexico http://www.gulfhypoxia.net
3. The Gulf of Mexico Alliance Priority Issues: Nutrients and Nutrient Impacts http://gulfofmexicoalliance.org/issues/nutrients.html
4. Hypoxia Task Force Ohio River sub-basin committee http://www.orsanco.org
5. Innovative Producer Partnership Initiatives to Reduce Hypoxia in the Gulf of Mexico http://upstreamheroes.org/hypoxiczone.php
6. Nonpoint Source Outreach Toolbox http://www.epa.gov/owow/nps/toolbox/

Professionals/Consultants

1. Sea Grant links to GOMA Priority Actions http://masgc.org/goma/2008-2011%20Sea%20Grant%20Projects.htm
2. Urban BMP Performance Tool http://cfpub.epa.gov/npdes/stormwater/urbanbmp/bmpeffectiveness.cfm
3. National Menu of Stormwater Best Management Practices http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm
4. National Management Measures to Protect and Restore Wetlands and Riparian Areas for the Abatement of Nonpoint Source Pollution http://www.epa.gov/owow/nps/wetmeasures/

5. Farmable Wetlands Program (FWP)
   http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=fwp

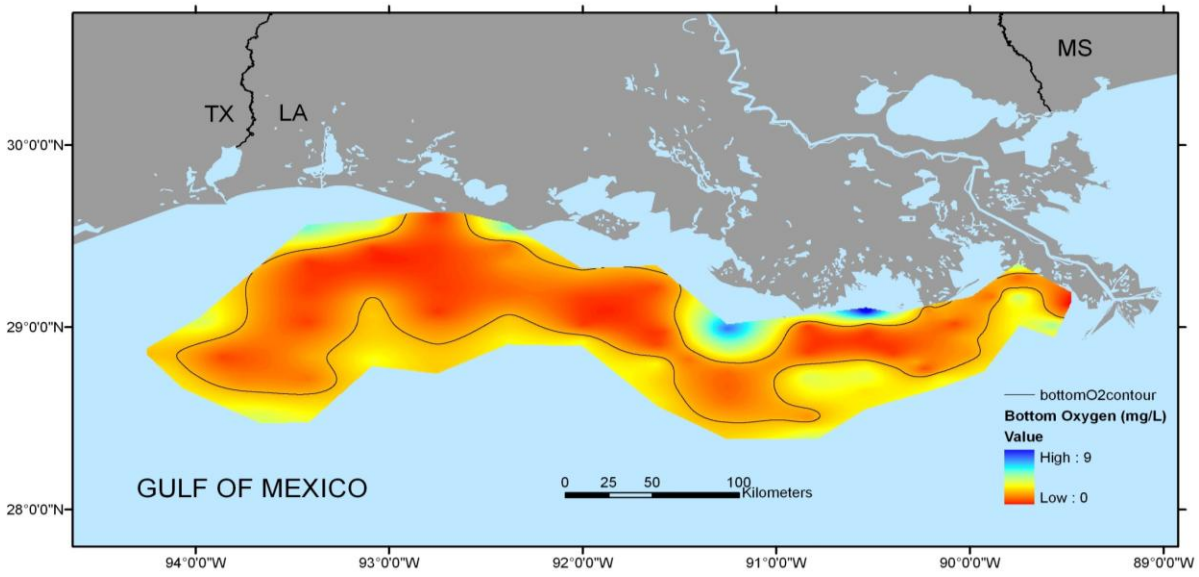
Students

1. Mechanisms Controlling Hypoxia Project http://hypoxia.tamu.edu/
2. International Stormwater BMP Database http://www.bmpdatabase.org/

Five Bullets about Gulf Hypoxia

- **What is hypoxia and what causes it?**

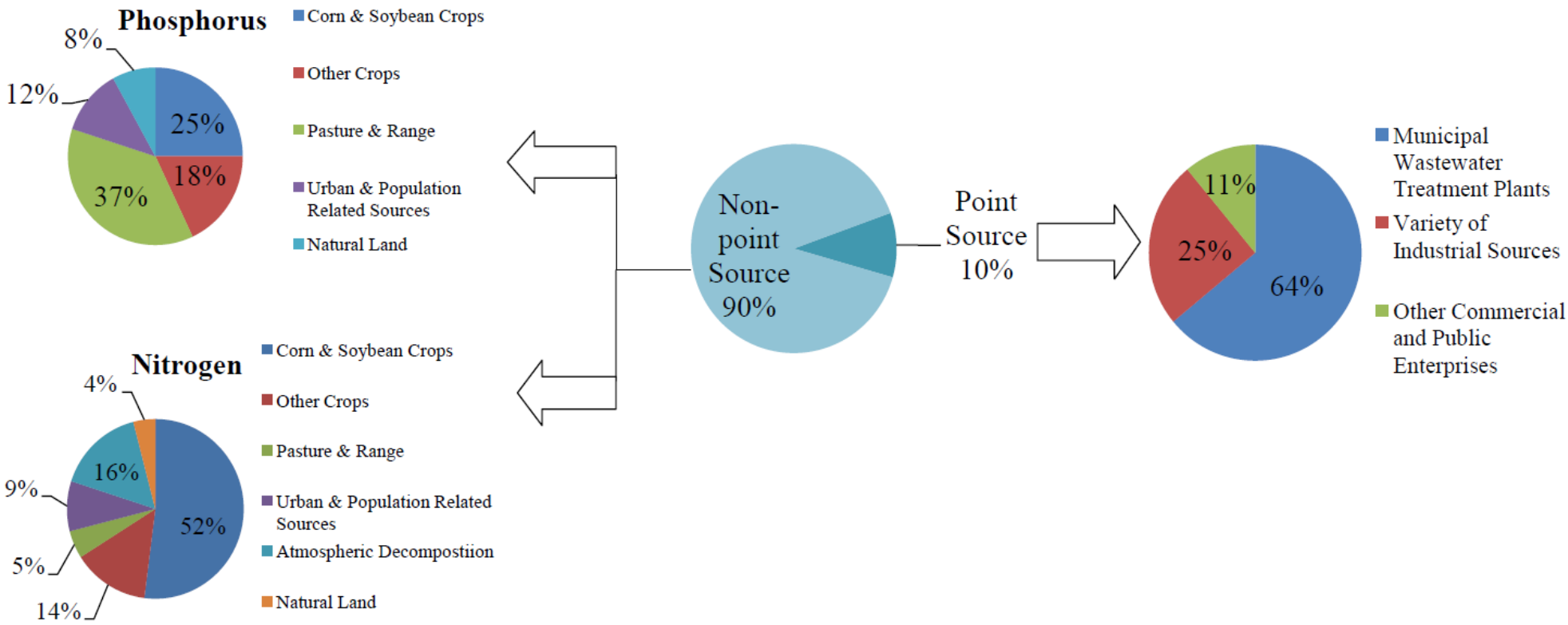
  Hypoxia means "low oxygen." Hypoxic water bodies are depleted in dissolved oxygen content to a level that no longer supports most living aquatic organisms (GulfHypoxia Website). Hypoxia is caused by several environmental factors acting in tandem. In the northern Gulf of Mexico, large amounts of nutrients are discharged into the Gulf by rivers, such as the Mississippi-Atchafalaya Rivers. The nutrients provide food for microscopic phytoplankton, and so their discharge can increase the growth of algae in the water. The algae are either passed up through multiple levels of the food web, or their remains sink as dying cells or in zooplankton fecal pellets. The remains of the algae that settle in the lower water and on the seabed are decomposed by bacteria. This decomposition uses the dissolved oxygen contained in the water. If the oxygen is not replenished, such as when the water column is stratified so that oxygen from the atmosphere cannot reach the bottom, then most of the oxygen in the water is used up, leaving little or no oxygen for the aquatic animals to use (U.S. DOI Website). With little or no oxygen left in the water, fish leave the area while less mobile animals die due to lack of adequate oxygen (Ferber 2001). The stratification, or layering of water masses, is controlled primarily by the freshwater discharge of the Mississippi and Atchafalaya rivers, along with summer warming of the surface waters. Stratification is maintained in calm summer weather but is broken down by fall and winter storms.



Hypoxic Zone in the Gulf of Mexico measuring 20,500 km^2 7900 mi^2, July 2007.
Data source: N.N. Rabalais, Louisiana Universities Marine Consortium, R.E. Turner, Louisiana State University
Funded by: NOAA, Center for Sponsored Coastal Ocean Research

- **What are the sources of the nutrients?**

  Nutrients can come from two sources: point source and nonpoint source. A point source is water discharge that enters water bodies from easily identifiable places (Alabama Smart Yards 2010). Common point sources include discharges from factories and sewage treatment plants. A nonpoint source is water discharge that cannot be traced back to any one source (Alabama Smart Yards 2010). Examples include agricultural fertilizers, fertilizers applied to golf courses and suburban lawns, atmospheric deposition of nitrogen, and erosion of soil containing nutrients (DOI Website).


Phosphorus
8%
12%
25%
18%
37%
Corn & Soybean Crops
Other Crops
Pasture & Range
Urban & Population Related Sources
Natural Land
Nitrogen
4%
16%
9%
52%
5%
14%
Corn & Soybean Crops
Other Crops
Pasture & Range
Urban & Population Related Sources
Atmospheric Decompostiion
Natural Land
Non-point Source 90%
Point Source 10%
11%
25%
64%
Municipal Wastewater Treatment Plants
Variety of Industrial Sources
Other Commercial and Public Enterprises

- **Facts about hypoxia in the northern Gulf of Mexico**

  - ***Much of the U.S. drains into the Gulf of Mexico***
    The Mississippi and Atchafalaya rivers drain 41% of the lower 48 United States, which accounts for 90% of the freshwater that enters the northern Gulf of Mexico. This freshwater releases about 1.6 million metric tons of nitrogen and 0.1 million metric tons of phosphorus into the Gulf each year (Goolsby et al. 1999).
  - ***Size of the Gulf of Mexico Hypoxic Zone***
    The northern Gulf of Mexico hypoxic zone is the largest hypoxic zone in the United States, and is the second largest human-caused area of coastal water hypoxia on earth. In recent years, the hypoxic zone in the Gulf of Mexico averaged 17,000 km^2, about 7,700 square miles (Petrolia and Gowda 2006). In 2002, it reached 22,000 km^2, an area about the size of Massachusetts (Rabalais, Turner and Scavia 2002; Rabalais et al., 2007a).
  - ***Historical change in the hypoxic zone***
    The northern Gulf of Mexico hypoxic zone was first recorded on the continental shelf in the early 1970s. This zone of hypoxia has been persistent ever since consistent data collection on its distribution and dynamics was begun in 1985 (Rabalais, Turner and Scavia 2002; Nutrient Control Actions for Improving Water Quality in the Mississippi River Basin and Northern Gulf of Mexico 2009). Retrospective analyses of sedimentary records and model hindcasts suggest that hypoxia in this region has intensified since the 1950s, and that large-scale hypoxia began in the 1970s (reviewed in Justić et al. 2007, Rabalais et al. 2007b). The areal extent of the hypoxic zone, monitored in mid-summer since 1985, has increased from an average of 6,900 km^2 from 1985-1992 to 15,733 km^2 from 1993-2009, (Rabalais et al. 2007a). These observations indicate the spatial extent of hypoxia is enlarging.
  - ***Average duration of the zone each year***
    Gulf hypoxia can begin in late February and last through mid November. It is most severe from June through August (Rabalais et al. 2007a). The Gulf hypoxic zone occurs at a crucial time of year for commercial and recreational fisheries and could threaten the economy of the Gulf (National Centers for Coastal Ocean Science: Gulf of Mexico Hypoxia Assessment 2000; EPA SAB 2007).
  - ***What disrupts hypoxia (hurricanes, winds, less fresh water, etc.)?***
    Hypoxia in the Gulf of Mexico is a seasonal phenomenon dependent in part on the cycle of the winds for establishing the conditions of strong stratification that prevent oxygen replenishment in the bottom waters. During the hypoxia season, tropical storms and hurricanes may temporarily reduce hypoxia due to the mixing of stratified waters that occurs during these events (Rabalais et al. 2007a; Ariyama and Secor 2010). Although nutrient loads and freshwater discharge were sufficient to develop hypoxia in June 1998, the historical low discharge of the Mississippi River that summer resulted in no stratification and therefore a small area of hypoxia (Rabalais, Turner and Scavia 2002).

- **What efforts are underway to reduce the hypoxic zone?**
  The interagency (5 Federal, 10 State agencies) Mississippi River/Gulf of Mexico Hypoxia Task Force (http://www.epa.gov/msbasin/taskforce.htm) was established in the fall of 1997 as part of a process of considering options for responding to the northern

Gulf of Mexico Dead Zone. In 2001, the Task Force issued an Action Plan that set a goal to reduce the size of the hypoxic zone to 5,000 km^2 by 2015 (based on an average of 5 years). The Action Plan, which included 11 specific implementation actions, suggested that a 30% reduction in nitrogen load was needed to reach the goal. A U.S. EPA, Science Advisory Board, Science Reassessment updated the science in support of a revised Action Plan in an adaptive management framework. This information has been incorporated into a 2008 Gulf Hypoxia Action Plan (http://www.epa.gov/msbasin/actionplan.htm), which retains the Coastal Goal of reducing the hypoxic zone areal extent to 5000 km^2 by 2015, but calls for nutrient loading reduction targets of 45% for both nitrogen and phosphorus, based on revised model predictions.

- **How can you help?**

  As citizens, we each can contribute to reducing the extent of the hypoxic zone through our individual actions. Here are a few suggestions:

  - Fertilizer run-off from our yards, fields, and lands contribute to the nutrient loading. You can help reduce this by becoming educated on proper fertilization practices, or by minimizing your use of fertilizers overall.
  - Preserve land adjoining rivers and streams. This land helps prevent nutrient runoff (Bledzki 2009).
  - Support the use of and build artificial wetlands that can help reduce nutrients before they enter streams.
  - Support best waste-water management and treatment practices in your community.

References

Alabama Smart Yards: Introducing Environmental Consciousness and Practical Management Options to Our Yards and Neighborhoods. 2010. Alabama A & M and Auburn Universities. ANR-1359. http://www.aces.edu/pubs/docs/A/ANR-1359/ANR-1359.pdf

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Gulf Hypoxia Website: Louisiana Universities Marine Consortium. http://www.gulfhypoxia.net

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