The Problem of Hypoxia in the Northern Gulf of Mexico
Nearly all marine animals depend on oxygen dissolved in the water. Where oxygen depletion is severe, the food web that supports bottom feeders, such as shrimp and drum, is disrupted, as well as the natural processing of organic matter, nutrients, and pollutants. Growth of marine organisms is inhibited when dissolved oxygen is less than about 5 mg/l. Mobile organisms leave as dissolved oxygen levels decrease below 2 mg/l, and trawlers in these areas produce little or no catch. Burrowing organisms first emerge from the sediment, and then die, if oxygen concentrations remain near 0.5 mg/l for prolonged periods. In areas where the oxygen concentrations are below 0.2 mg/l, the sediment is typically black, and sulfur-oxidizing bacteria form mats on the seafloor. Toxic hydrogen sulfide may be found where bottom waters are completely devoid of oxygen (anoxic).

Hypoxia is the condition in which dissolved oxygen is below the level necessary to sustain most animal life—generally defined by dissolved oxygen levels below 2 mg/l (or ppm). The largest hypoxic zone in U.S. coastal waters—and in the entire western Atlantic Ocean—is found in the northern Gulf of Mexico on the Louisiana/Texas continental shelf (Figure 1.1). The area affected, which is about the size of the state of New Jersey, has increased since regular measurements began in 1985 (Figure 1.2).

The fishery resources of the Gulf are among the most valuable in the United States, generating $2.8 billion annually. Although economic analyses have not shown a statistically significant correlation with the extent of hypoxia, catch per unit of effort for brown shrimp, one of the most commercially valuable species in the Gulf, has trended down since the late 1970s. If experiences in other coastal and marine systems are applicable to the Gulf of Mexico, then the potential impact of worsening hypoxic conditions could be the decline (perhaps precipitous) of ecologically and commercially important species.

In October 1998, Congress passed the Harmful Algal Bloom and Hypoxia Research and Control Act, which the President signed into law as P.L.105-383 on November 13, 1998. This law calls for an "integrated assessment of hypoxia in the northern Gulf of Mexico that examines: the distribution, dynamics and causes; ecological and economic consequences; sources and loads of nutri-
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The frequency of occurrence of hypoxia has been mapped from mid-summer “snapshots” obtained by sampling a 60- to 80-station grid in the Gulf annually from 1985 through 1999.

1 The six topic reports underwent a rigorous peer review with oversight by an independent editorial board. In addition, the six topic reports were available for a 90-day public comment period. The reports and the comments received on them are available at <http://www.nos.noaa.gov/products/pubs_hypox.html>. This assessment has been written with consideration of all that information. The assessment was available, in draft form, for a 60-day public comment period. Those comments are also posted on this web site and were carefully considered in producing the assessment in this final version.
Annual mid-summer cruises have been conducted systematically over the past 15 years (with the exception of 1989). Hypoxia in bottom waters covered an average of 8,000–9,000 km² in 1985–92 but increased to 16,000–20,000 km² in 1993–99.

of hypoxia in the northern Gulf of Mexico. It outlines a range of approaches for reducing those effects and examines the costs and benefits associated with those approaches. It also describes additional research and monitoring needed to reduce uncertainties, to track progress following any efforts developed in the Action Plan, and to identify potential future adjustments to any initial actions that may be taken to reduce hypoxia and improve water quality.