

increased growth can cause numerous adverse ecological effects and economic impacts, including nuisance algal blooms, dieback of underwater plants due to reduced light penetration, and toxic plankton blooms. Algal and plankton blooms can also reduce the level of dissolved oxygen, which can also adversely affect fish and shellfish populations.

In 1999, NOAA published the results of a five year national assessment of the severity and extent of estuarine eutrophication. An estuary is defined as the inland arm of the sea that meets the mouth of a river. The 138 estuaries characterized in the study represent more than 90 percent of total estuarine water surface area and the total number of U.S. estuaries. The study found that estuaries with moderate to high eutrophication conditions represented 65 percent of the estuarine surface area. Eutrophication is of particular concern in coastal areas with poor or stratified circulation patterns, such as the Chesapeake Bay, Long Island Sound, or the Gulf of Mexico. In such areas, the "overproduced" algae tends to sink to the bottom and decay, using all or most of the available oxygen and thereby reducing or eliminating populations of bottom-feeder fish and shellfish, distorting the normal population balance between different aquatic organisms, and in extreme cases causing dramatic fish kills.

Severe and persistent eutrophication often directly impacts human activities. For example, losses in the nation's fishery resources may be directly caused by fish kills associated with low dissolved oxygen and toxic blooms. Declines in tourism occur when low dissolved oxygen causes noxious smells and floating mats of algal blooms create unfavorable aesthetic conditions. Risks to human health increase when the toxins from algal blooms accumulate in edible fish and shellfish, and when toxins become airborne, causing respiratory problems due to inhalation. According to the NOAA report, more than half of the nation's estuaries have moderate to high expressions of at least one of these symptoms—an indication that eutrophication is well developed in more than half of U.S. estuaries.

In recent decades, human activities have greatly accelerated nutrient inputs, such as nitrogen and phosphorous, causing excessive growth of algae and leading to degraded water quality and associated impairments of freshwater and estuarine resources for human uses.⁶² Since 1970, eutrophic conditions

worsened in 48 estuaries and improved in 14. In 26 systems, there was no trend in overall eutrophication conditions since 1970.⁶³ On the New England coast, for example, the number of red and brown tides and shellfish problems from nuisance and toxic plankton blooms have increased over the past two decades, a development thought to be linked to increased nitrogen loadings in coastal waters. Long-term monitoring in the U.S., Europe, and other developed regions of the world shows a substantial rise of nitrogen levels in surface waters, which are highly correlated with human-generated inputs of nitrogen to their watersheds.

Between 1992 and 1997, experts surveyed by National Oceanic and Atmospheric Administration (NOAA) most frequently recommended that control strategies be developed for agriculture, wastewater treatment, urban runoff, and atmospheric deposition.⁶⁴ In its Third Report to Congress on the Great Waters, EPA reported that atmospheric deposition contributes from 2 to 38 percent of the nitrogen load to certain coastal waters.⁶⁵ A review of peer reviewed literature in 1995 on the subject of air deposition suggests a typical contribution of 20 percent or higher.⁶⁶ Human-caused nitrogen loading to the Long Island Sound from the atmosphere was estimated at 14 percent by a collaboration of Federal and State air and water agencies in 1997.⁶⁷ The National Exposure Research Laboratory, U.S. EPA, estimated based on prior studies that 20 to 35 percent of the nitrogen loading to the Chesapeake Bay is attributable to atmospheric

deposition.⁶⁸ The mobile source portion of atmospheric NO_x contribution to the Chesapeake Bay was modeled at about 30 percent of total air deposition.⁶⁹

Deposition of nitrogen from aircraft engines contributes to elevated nitrogen levels in waterbodies. The NO_x reductions from the proposed standards would help reduce the airborne nitrogen deposition that contributes to eutrophication of watersheds, particularly in aquatic systems where atmospheric deposition of nitrogen represents a significant portion of total nitrogen loadings.

3. Plant Damage From Ozone

Ground-level ozone can also cause adverse welfare effects. Specifically, ozone enters the leaves of plants where it interferes with cellular metabolic processes. This interference can be manifest either as visible foliar injury from cell injury or death, and/or as decreased plant growth and yield due to a reduced ability to produce food. With fewer resources, the plant reallocates existing resources away from root storage, growth and reproduction toward leaf repair and maintenance. Plants that are stressed in these ways become more susceptible to disease, insect attack, harsh weather and other environmental stresses. Because not all plants are equally sensitive to ozone, ozone pollution can also exert a selective pressure that leads to changes in plant community composition.

Since plants are at the center of the food web in many ecosystems, changes to the plant community can affect associated organisms and ecosystems (including the suitability of habitats that support threatened or endangered species and below ground organisms living in the root zone). Given the range of plant sensitivities and the fact that numerous other environmental factors modify plant uptake and response to ozone, it is not possible to identify threshold values above which ozone is toxic and below which it is safe for all plants. However, in general, the science suggests that ozone concentrations of 0.10 ppm or greater can be phytotoxic to a large number of plant species, and can produce acute foliar injury responses, crop yield loss and reduced biomass production. Ozone concentrations below 0.10 ppm (0.05 to 0.09 ppm) can produce these effects in more sensitive plant species, and have the potential over a longer duration of

copy of this document is available in Docket No. OAR 2002-0030.

⁶³ *Deposition of Air Pollutants to the Great Waters, Third Report to Congress*, June, 2000. Great Waters are defined as the Great Lakes, the Chesapeake Bay, Lake Champlain, and coastal waters. The first report to Congress was delivered in May, 1994; the second report to Congress in June, 1997. A copy of this document is available in Docket No. OAR 2002-0030.

⁶⁴ Bricker, Suzanne B., et al., *National Estuarine Eutrophication Assessment, Effects of Nutrient Enrichment in the Nation's Estuaries*, National Ocean Service, National Oceanic and Atmospheric Administration, September, 1999. A copy of this document is available in Docket No. OAR 2002-0030.

⁶⁵ *Deposition of Air Pollutants to the Great Waters, Third Report to Congress*, June, 2000. A copy of this document is available in Docket No. OAR 2002-0030.

⁶⁶ Valigura, Richard, et al., *Airsheds and Watersheds II: A Shared Resources Workshop*, Air Subcommittee of the Chesapeake Bay Program, March, 1997. Available in Docket A-99-06, Document No. IV-G-144.

⁶⁷ *The Impact of Atmospheric Nitrogen Deposition on Long Island Sound*, The Long Island Sound Study, September, 1997. A copy of this document is available in Docket No. OAR-2002-0030.

⁶⁸ Dennis, Robin L., *Using the Regional Acid Deposition Model to Determine the Nitrogen Deposition Airshed of the Chesapeake Bay Watershed*, SETAC Technical Publications Series, 1997.

⁶⁹ *Ibid.*

⁶² *Deposition of Air Pollutants to the Great Waters, Third Report to Congress*, June, 2000. A