Dead zone pdf

This article is about the oceanic phenomenon. For more uses, see Dead zone. For the natural anoxic basins, see Anoxic Waters. Oxygen-poor areas in oceans and large lakes due to nutrient and fertilizer pollution Red circles show the location and size of many dead zones. Black dots show dead zones of unknown size. The size and number of dead sea zones – areas where deep water contains so little oxygen that marine animals cannot survive – have grown explosively over the past half-century. – NASA Earth Observatory (2008)[1] Dead zones are hypoxic (oxygen-poor) areas in the world's oceans and large lakes, which means that these waters do not support marine life living there. [2] Historically, many of these sites were naturally present. In the 1970s, however, oceanographers noticed increased cases and extents of dead zones. These occur near inhabited coasts, where water life is most concentrated. Dead zones are waters that do not have enough oxygen (3) to support most marine life. Dead zones are caused by oxygen-degrading factors, which include human pollution but are not limited (4). This is a process called eutrophication, in which the oxygen content decreases as elements such as nitrogen and phosphorus increase. A healthy flow will have increased oxygen levels for consumption by organisms (1). As nitrogen increases, algae (5) produce large amounts of oxygen, but die from increased nitrogen. Decomposers then use all the remaining oxygen that decomposes the algae, resulting in no oxygen remaining and no oxygen being produced. (2) In March 2004, when the recently established United Nations Environment Programme published its first Global Environment Outlook Year Book (GEO Year Book 2003), it reported 146 dead zones in the world's oceans where marine life could not be supported due to depleted oxygen levels. Some of them were as small as one square kilometer (0.4 mi2), but the largest dead zone was 70,000 square kilometers (27,000 mi2). A 2008 study counted 405 dead zones worldwide. [3] [4] Causes of dead zones are often caused by the decay of algae during algal blooms, such as these off the coast of La Jolla, San Diego, California. The climate has a significant impact on the growth and decline of ecological dead zones. During the spring months, as rainfall increases, more nutritious water flows down the mouth of the Mississippi River. [5] At the same time as sunlight increases in spring, algae growth in the dead zones increases To. In the autumn months, tropical storms begin to invade the Gulf of Mexico and break up the dead zones, and the cycle repeats in the spring. Aquatic and marine dead zones can be caused by an increase in nutrients (especially nitrogen and phosphorus) in water, known as eutrophication. These chemicals are the basic building blocks plant-like organisms that live in the water column and whose growth is limited in part by the availability of these materials. Eutrophication can lead to a rapid increase in the density of certain types of these phytoplankton, a phenomenon known as algal bloom. [Quote Required] The limnologist Dr. David Schindler, whose research in the area of experimental lakes led to the prohibition of harmful phosphates in detergents, warned against algal blooms and dead zones: the fish-killing flowers that devastated the Great Lakes in the 1960s and 1970s have not disappeared; they have moved west to a dry world in which people, industry and agriculture are increasingly taxing the quality of the little fresh water that exists here.... This is not just a prairie problem. The global expansion of dead zones caused by algal blooms is increasing rapidly. [6] The main groups of algae are cyanobacteria, green algae, dinoflagellates, coccolithophores and diatom algae. An increase in the use of nitrogen and phosphorus usually causes cyanobacteria to bloom. Other algae are consumed and therefore do not accumulate to the same extent as cyanobacteria. [Quote Required] Cyanobacteria are not a good food for zooplankton and fish and therefore accumulate in the water, die and then decompose. The bacterial degradation of their biomass consumes the oxygen in the water and thus produces the state of hypoxia. Dead zones can be caused by natural and anthropogenic factors. Natural causes are coastal rise and changes in wind and water circulation patterns. The use of chemical fertilizers is considered the leading cause of dead zones worldwide. Waste water, urban land use and fertilisers can also contribute to eutrophication. [7] Notable dead zones in the United States are the northern Gulf region of Mexico[5], which surrounds the fall of the Mississippi River, the coastal regions of the Pacific Northwest, and the Elizabeth River in Virginia Beach, which have proved to be recurring events in recent years. In addition, natural oceanographic phenomena can lead to desoxygenation of parts of the water column. For example, closed waters such as fjords or the Black Sea have shallow sills at their entrances, causing the water there to stagnate for a long time. [Quote Required] The eastern tropical Pacific Ocean and the northern Indian Ocean have lowered oxygen concentrations, which are thought to be in regions where there is minimal circulation to replace the oxygen consumed. [8] These areas are also known as oxygen minimum zones (OMZ). In many cases, OMZs are permanent or semi-permanent areas. [Quote Remains of organisms found in sediment layers near the mouth of the Mississippi River indicate four hypoxic events before the advent of synthetic fertilizer. In these sediment layers, anoxia-tolerant species are the most common Found. The periods specified by the sediment record correspond to historical records of a high river flow recorded by instruments in Vicksburg, Mississippi. [Quote Required] Changes in ocean circulation caused by ongoing climate change could also add or increase other causes of oxygen reduction in the ocean. [9] In August 2017, according to a report, the U.S. meat industry and the agro-economic system were largely blamed for the largest death zone to date in the Gulf of Mexico. [10] Soil draining and depleted nitrate, exacerbated by agricultural and tillage, dengenatics and synthetic fertilizers, contaminated water from the heartland to the Gulf of Mexico. A large proportion of the crops grown in the region are used as the main feed component in the production of meat animals for agricultural companies such as Tyson and Smithfield Foods. [11] Types Dead zones can be classified by type and are identified by the length of their occurrence:[12] Permanent dead zones are deepwater deposits that rarely exceed 2 milligrams per liter. Temporary dead zones are short-lived dead zones that last hours or days. Seasonal dead zones occur annually, typically in warm months of summer and autumn. Diel-bicycle hypoxia is a specific seasonal dead zone that only during the night effects underwater video frames of the seabed in the western Baltic Sea covered with dead or dying crabs, fish and mussels killed by lack of oxygen Due to the hypoxic conditions in dead zones, marine life in these areas tends to be scarce. Most fish and motile organisms tend to migrate to the zone when oxygen concentrations drop, and benthic populations can suffer severe losses if oxygen concentrations are below 0.5 mg l-1 O2. [13] Under severe anoxic conditions, microbial life can also experience dramatic changes in community identity, leading to an increased abundance of anaeric organisms, as aerobic microbes decrease in number and change energy sources for oxidation such as nitrate, sulfate or iron reduction. Sulphur reduction is a particular problem, as hydrogen sulphide is toxic and further pollutes most organisms within the zone, exacerbating the risk of mortality. [14] Low oxygen levels can have serious effects on the survival of organisms within the area, while they are above deadly anoxic conditions. Studies conducted along the Gulf Coast of North America have shown that hypoxic conditions lead to a reduction in reproductive rates and growth rates in North America. variety of organisms, including fish and benthic invertebrates. Organisms that are able to leave the area usually do so when oxygen concentrations drop to less than 2 mg l'1. [13] At these oxygen concentrations and below, organisms that survive in the oxygen-deficient environment and are unable to escape the area will often exhibit increasingly deteriorating stress and die. Die. Organisms that are tolerant to hypoxic conditions often exhibit physiological adjustments suitable for survival in hypoxic environments. Examples of such adjustments include increased efficiency of oxygen uptake and use, reduction of the required amount of oxygen uptake through reduced growth rates or resting state, and increased use of anaerobic metabolic pathways. [13] The composition of the community in benthic communities is dramatically disrupted by periodic oxygen degradation events, such as those of seasonal dead zones that occur as a result of diel cycles. The long-term effects of such hypoxic diseases lead to a shift in communities, which most often manifest themselves as a decline in biodiversity due to mass mortality events. The restoration of benthic communities depends on the composition of neighbouring communities for larval recruitment. [13] This leads to a shift towards faster establishment of colonizers with shorter and more opportunistic life strategies that may interfere with historical benthic compositions. The impact of dead zones on fisheries and other maritime trade activities varies depending on frequency and location. Dead zones are often linked to a decline in biodiversity and a collapse of benthic populations, which reduces yield diversity in commercial fishing activities, but in cases of eutrophication-related death zone formations, increasing nutrient availability can lead to temporary increases in selected yields among pelagic populations such as anchovies. [13] Studies, however, assume that increased production in the surrounding areas does not compensate for the net productivity decline resulting from the death zone. For example, dead zones in the Gulf of Mexico have lost an estimated 17,000 MT of carbon in the form of prey for fishing. [4] In addition, many stressors in fishing are exacerbated by hypoxic conditions. Indirect factors such as the increasing success of invasive species and the increased pandemic intensity in stressed species such as oysters lead to both loss of revenue and environmental stability in the affected regions. [15] Although most other life forms are killed by oxygen deficiency, jellyfish can thrive and are sometimes present in many dead zones. Jellyfish flowers produce large amounts of mucus, which leads to major changes in food webs in the ocean, as few organisms feed on them. The organic carbon in the mucus is metabolized by bacteria that enter the atmosphere in the form of carbon dioxide in a so-called jelly carbon shunt [16] The possible deterioration of jellyfish blooms as a result of human activity has driven new research into the influence of dead zones on jelly populations. The main concern is the potential for dead areas to serve as breeding grounds for jelly populations, as the hypoxic conditions increase competition for resources and common Jellyfish. [17] The increased population of jellyfish could have high trade costs with the loss of fishing, destruction and contamination of trawls and fishing vessels, and reduce tourism revenues in coastal systems. [17] Tote Zone sites in the Gulf of Mexico In the 1970s, in populated areas where intensive economic exploitation stimulated scientific research, sites in the Chesapeake Bay of the US East Coast, in the Sea-Scandinavian Strait of Kattegat, the mouth of the Baltic Sea, and in other important Baltic Sea fishing areas in the Black Sea were first detected. , and in the northern Adriatic. [18] Other dead sea zones have appeared in the coastal waters of South America, China, Japan and New Zealand. A 2008 study counted 405 dead zones worldwide. [3] [4] Baltic Sea main article: Baltic Hypoxia Researchers from the Baltic Nest Institute published in one of the PNAS editions that the dead zones in the Baltic Sea have grown from about 5,000 km2 to more than 60,000 km2 in recent years. Some of the reasons for the increased increase in dead zones are due to the use of fertilizers, large animal farms, the burning of fossil fuels and waste water from municipal wastewater treatment plants. [19] This section needs to be expanded. You can help by adding it. (August 2013) Chesapeake Bay, as Reported by National Geographic, the Chesapeake Bay on the east coast of the United States became one of the first dead zones ever identified in the 1970s. The high nitrogen levels of the Chesapeake are caused by two factors: urbanization and agriculture. The western part of the bay is full of factories and urban centers that emit nitrogen into the air. Atmospheric nitrogen accounts for about one third of the nitrogen entering the bay. The eastern part of the bay is a centre of poultry farming that produces large amounts of manure. [20] The National Geographic went on to explain that since 1967, the

Chesapeake Bay Foundation has led a number of programs aimed at improving the bay's water quality and curbing pollution. The Chesapeake still has a dead zone, the size of which varies depending on the season and weather. [20] Elizabeth River, Virginia The mouth of the Elizabeth River is important for Norfolk, Virginia, Chesapeake, Virginia, Virginia Beach, Virginia, and Portsmouth, Virginia, Virginia. It was polluted by nitrogen and phosphorus, but also by toxic deposits from the shipbuilding industry, the military, the world's largest coal export facility, refineries, loading stations, container repair facilities, and others, so that fish had been absent since the 1920s. In 1993, a group formed to clean him up, took Mummichog as a mascot and has removed thousands of tons of contaminated sediment. In 2006, a 35-hectare biological dead zone called Money Point was dredged, and this allowed fish to return, and the wetland recovered. [21] Lake Erie A dead zone exists in Central part of Lake Erie from Point Pelee to Long Point and extends to the coast in Canada and the United States. [22] The zone has been noted since the 1950s to the 1960s, but since the 1970s, Canada and the United States have made efforts to reduce the deforestation of the lake to reverse the growth of the dead zone. Overall, the oxygen content of the lake is poor with only a small area east of Long Point, which has a better level. The biggest impacts of poor oxygen levels are the lacustrine life and fishing industry. Lower St. Lawrence Estuary A dead zone exists in the Lower St. Lawrence River area from the east of the Saguenay River east of Baie Comeau, the largest at depths of over 275 meters and has been noticed since the 1930s. [23] The main concern for Canadian scientists is the impact of fish found in the area. Oregon Off the coast of Cape Perpetua, Oregon, there is also a dead zone with a reported size of 780 km2 in 2006. [Quote Required] This Dead Zone exists only in summer, perhaps due to wind patterns. On the Oregon coast, hypoxic water has also moved from the continental shelf to the coastal bays. This appears to cause intensity in several areas of Oregon's climate, such as.B heated water with oxygen concentration and heated winds. [24] [25] Gulf of Mexico 'dead zone' The area of temporary hypoxic groundwater that occurs most summers off the coast of Louisiana in the Gulf of Mexico[26] is the largest recurrent hypoxic zone in the United States. [27] The Mississippi River, the area that covers 41% of the continental United States, sinks nutrient-rich drains such as nitrogen and phosphorus into the Gulf of Mexico. According to a 2009 factsheet prepared by NOAA, seventy percent of the nutrient loads that cause hypoxia are the result of this vast catchment. [28] including the heart of the U.S. agricultural industry, the Midwest. The discharge of treated wastewater from urban areas (pop.c 12 million in 2009) combined with agricultural runoff delivers approximately 1.7 million tons of phosphorus and nitrogen annually to the Gulf of Mexico. [28] Although Iowa occupies less than 5% of the Mississippi River basin, the average annual nitrate runoff from surface water in Iowa is about 204,000 to 222,000 tons, or 25% of the total nitrate that the Mississippi River supplies to the Gulf of Mexico. [29] Exports from the Raccoon River Basin are among the highest in the United States, with an annual result of 26.1 kg/ha/year, which is considered to be the highest nitrate loss of 42 Mississippi underwater basins hypoxia report in the Gulf of Mexico. [30] [31] In 2012, Iowa introduced the Iowa Nutrient Reduction Strategy, which is a science-technology-based framework for assessing and reducing nutrients in Iowa waters and the Gulf of Mexico. It is designed to support efforts to reduce nutrients in Water from point and non-point sources in a scientific, reasonable and cost-effective way. [32] The strategy continues to evolve and uses voluntary methods to reduce Iowa's negative contributions through public relations, research, and implementation of nutrient husbandry practices. To reduce agricultural runoff into the Mississippi Basin, Minnesota passed MN Statute 103F.48, also known as Buffer Law, in 2015, which was designed to introduce mandatory shore buffers between farmland and public waterways throughout the state of Minnesota. The Minnesota Board of Water and Soil Resources (BWSR) released a report in January 2019 that said compliance with the Buffer Act had reached 99%. Size The area of hypoxic groundwater that occurs every summer for several weeks in the Gulf of Mexico was mapped for most years from 1985 to 2017. The size varies annually from a record high in 2017, when it covered more than 22,730 square kilometers, to a record low of 39 square kilometers in 1988. [33] [26] [34] The 2015 dead zone measures 16,760 square kilometers. [35] Nancy Rabalais of the Louisiana Universities Marine Consortium in Cocodrie, Louisiana, predicted that the dead zone or hypoxic zone in 2012 would cover an area of 17,353 square kilometers larger than Connecticut; However, when the measurements were completed, the area of hypoxic groundwater in 2012 was only 7,480 square kilometers. The models that use the nitrogen flow from the Mississippi River to predict the dead zone areas have been criticized for being systematically high from 2006 to 2014, after predicting record-breaking areas that were never realized in 2007, 2008, 2009, 2011, and 2013. [36] In the late summer of 1988, the dead zone disappeared as the great drought brought the Mississippi River to its lowest level since 1933. In times of severe flooding in the Mississippi River Basin, such as in 1993, the dead zone has increased dramatically, about 5,000 km larger than the previous year. [37] Economic impactSome claim that the dead zone threatens the lucrative commercial and recreational fishing in the Gulf of Mexico. In 2009, the value of commercial fishing in the Gulf was USD 629 million. Nearly three million recreational fishermen contributed another about 10 billion dollars to the Gulf economy and made 22 million fishing trips. [38] Scientists do not agree that nutrient pollution has a negative impact on fisheries. Grimes argues that nutrient pollution improves fishing in the Gulf of Mexico. [39] Courtney et al. suspect that the nutrient load is due to the increase in the red snapper in the north and west may have contributed from Mexico. [40] History shrimp trawlers first reported a dead zone in the Gulf of Mexico in 1950, but not until 1970-1970 the hypoxic zone had increased that scientists began to investigate. [41] After 1950, the transformation of forests and wetlands for agricultural and urban development accelerated. The Missouri River Basin has replaced hundreds of thousands of acres of forest and wetlands (66,000,000 hectares) with agricultural activities [. . .] In the Lower Mississippi, a third of the valley's forests were converted into agriculture between 1950 and 1976. [41] In July 2007, a dead zone was discovered off the coast of Texas, where the Brazos River flows into the Gulf. [42] Energy Independence and Security Act of 2007 The Energy Independence and Security Act of 2007 requires the production of 36 billion U.S. gallons (140,000,000 m3) of renewable fuels by 2022, including 15 billion U.S. gallons (57,000,000 m3) of corn-based ethanol, a tripling of current production that would require a similar increase in corn production. [43] Unfortunately, the plan raises a new problem; the increasing demand for maize production leads to a proportional increase in nitrogen flow. Although nitrogen, which accounts for 78% of the Earth's atmosphere, is an inert gas, it has more reactive forms, two of which (nitrate and ammonia) are used to produce fertilizers. [44] According to Fred Below, professor of plant physiology at the University of Illinois at Urbana-Champaign, corn needs more nitrogen fertilizer because it produces a higher grain per unit area than other crops and, unlike other crops, is entirely dependent on available nitrogen in the soil. The results, reported in Proceedings of the National Academy of Sciences on March 18, 2008, showed that an increase in corn production to reach the 15 billion U.S. gallon target (57,000,000 m3) would increase nitrogen pollution in the Dead Zone by 10-18%. This would increase nitrogen levels to double the level recommended by the Mississippi Basin/Gulf of Mexico Water Nutrient Task Force,' a coalition of federal, state, and tribal agencies that have been monitoring the dead zone since 1997. The task force says a 30% reduction in nitrogen flow is needed if the dead zone is to shrink. [43] Repentance The recovery of Benthic communities depends primarily on the length and severity of hypoxic diseases within the hypoxic zone. Less severe conditions and temporary oxygen depletion allow a rapid recovery of the benthic communities in the region due to the restoration by benthic larvae from adjacent areas, with longer hypoxia conditions and a more severe oxygen deficiency, which leads to longer recovery times. [4] Recovery also depends on stratification levels within the area, so that highly layered areas in warmer waters are less likely to recover from anoxic or hypoxic conditions and are more susceptible to eutrophic-driven hypoxia. [4] The difference in recovery capability and vulnerability Hypoxia in stratified marine environmentes is expected to complicate recovery efforts in dead zones in the future if ocean warming continues. Small hypoxic systems with rich surrounding communities are most likely to recover from nutrient inflows that lead to a eutrophication stop. However, depending on the extent of the damage and characteristics of the zone, a large-scale hypoxic condition could also recover after a period of ten years. For example, the Black Sea dead zone, once the largest in the world, largely disappeared between 1991 and 2001, after fertilizers became too expensive to use after the collapse of the Soviet Union and the decline of centrally planned economies in Eastern and Central Europe. Fishing has once again become an important economic activity in the region. [45] While the clean-up of the Black Sea was largely unintentional and led to a decline in the use of fertilizers that is difficult to control, the United Nations has advocated other cleanups by reducing large industrial emissions. [45] Between 1985 and 2000, the nitrogen zone in the North Sea decreased by 37% as the political efforts of the countries on the Rhine reduced the waste water and industrial emissions of nitrogen into the water. Further clean-up work took place along the Hudson River[46] and San Francisco Bay. [3] Other methods of reversal can be found here. See also Algal Bloom Anoxic Event Anoxic Waters Cultural Eutrophication Eutrophication Fish Kill Hypoxia Marine Pollution Ocean Desoxygenation Oxygen Minimum Zone Shutdown of Thermohaline Circulation Notes

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