INDICATOR: Release of pollutants harmful to Biodiversity

Startegic Direction: Enhanced Resilience

Target: N/A

Theme: State of Ecosystems and Species

Background Information

The release of pollutants into the air and water and onto the land can have significant effects on biodiversity. Pollutants can kill organisms outright, change the conditions and processes occurring within an ecosystem, and result in broad changes that degrade habitats and ecosystem services. Biodiversity associated with areas used intensively by humans (e.g., urban areas, agriculture, forestry, mining, and other industries) may be most at risk from pollution; however, non-point-based effects of pollution on biodiversity (e.g., downstream water pollution and downwind air pollution) can also be significant. Currently, a wide range of pollutants interact with natural and other human created factors to alter ecosystems and impact Ontario's biodiversity. Three pollutants in particular - nitrogen oxides (NOx), sulphur oxides (SOx) and mercury - have all been shown to impact biodiversity in Ontario and were used in this indicator as an index to examine trends in the release of pollutants harmful to biodiversity.

Nitrogen and sulphur oxides are two of the most common air pollutants produced as a result of human activities. They are primarily released as a result of the combustion process. In Ontario, the biggest contributor to NOx emissions is the transportation sector, while the major sources of SOx emissions are from smelters, industrial processes and electric utilities. When emitted into the atmosphere these gases can be transformed into acidic particles or, when they react with water, into acid rain (Driscoll et al., 2001). The effects of nitrogen and sulphur oxides on the environment are generally not caused by direct exposure to the gases themselves but are related to chronic accumulation in plants and soils and long-term changes in soil and water chemistry (Lovett et al. 2009). Nitrogen and sulphur oxides in the air can damage the leaves of plants, decrease their ability to produce food (photosynthesis) and decrease their growth. In addition, when deposited on land and in estuaries, lakes and streams, nitrogen and sulphur oxides can acidify and over-fertilize sensitive ecosystems resulting in a range of harmful deposition-related effects on plants, soils, water quality and fish and wildlife (e.g., loss of habitat, reduced tree growth, loss of fish species, and harmful algal blooms) (Lee 1998; Bobbink and Lamers 2020). This can result in an overall loss of biodiversity and subsequent reduction in ecosystem services (e.g., water and soil quality) (Aherne and Posch 2013). These impacts are likely to occur where the accumulation of nitrogen and sulphur crosses a threshold known as the critical load. For more than a decade, Canada has worked to reduce nitrogen and sulphur oxides by implementing the Canada-wide Acid Rain Strategy for Post-2000.

Mercury is a highly toxic element released primarily from coal combustion, waste incineration and industrial processes (Lovett et al. 2009). Mercury, primarily methylmercury, is quickly accumulated by aquatic species and causes adverse effects. Biomagnification of mercury up the food chain has been shown, especially in aquatic systems where predators at the top of the food

chain accumulate the highest concentrations of mercury (Lovett et al. 2009). There has been increasing recognition that mercury affects fish and wildlife health in ecosystems both severely and moderately polluted with mercury. In particular, studies have documented diminished reproductive success, behavioural changes and reduced survival of fish, fish-eating birds and mammals due to mercury contamination in aquatic ecosystems (Scheuhammer et al. 2007). There has been effort to reduce the amount of mercury released into the environment. Most recently, in 2017, Canada ratified and brought into force the Minamata Convention on Mercury, a global treaty to protect both human health and the environment from the adverse effects of mercury.

This indicator assesses trends in the release of nitrogen oxides, sulphur oxides and mercury in Ontario as an index of trends in the release of pollutants harmful to biodiversity in Ontario.

Data Analysis

Provincial data for emissions of nitrogen oxides, sulphur oxides (reported as sulphur dioxide—the primary constituent of sulfur oxide emissions) over the period of 2002-2019 and mercury (elemental, inorganic) over the period 2000-2019 were obtained from Canada's Air Pollutant Emissions Inventory (APEI). The APEI includes data from the National Pollutant Release Inventory (NPRI) -- Canada's legislated, publicly accessible inventory of pollutant releases to air, water and land by reporting industries across Canada—as well as air pollutant emission estimates for facilities not required to report and non-industrial sources such as motor vehicles, residential heating, forest fires and agriculture pollution. The APEI is published by Environment and Climate Change Canada and can be accessed at: https://www.canada.ca/en/environment-climate-change/services/pollutants/air-emissions-inventory-overview.html.

Results

Trend: Improvement **Data Confidence:** High **Geographic Extent:** Provincial

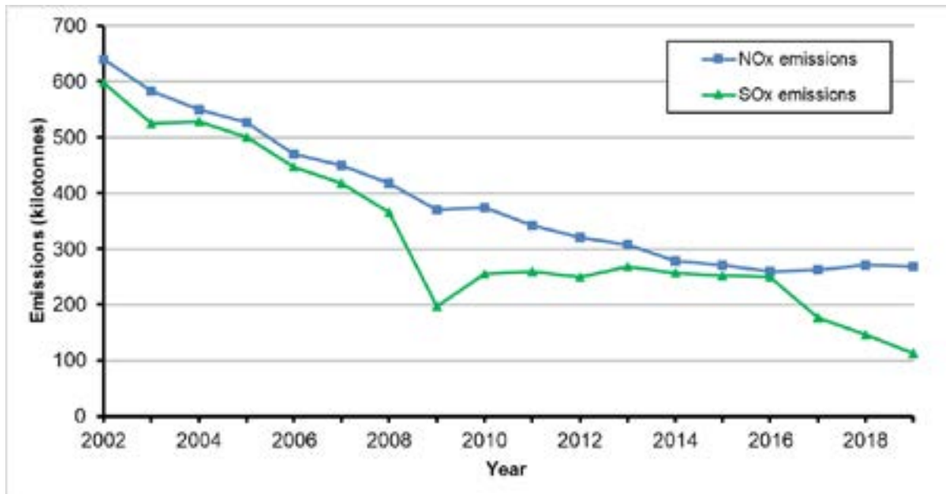

Figure 1. Nitrogen oxide (NOx) and sulphur oxide (SOx) emissions in Ontario 2002-2019. Note: Emissions from natural sources and open sources are not included (Source APEI).

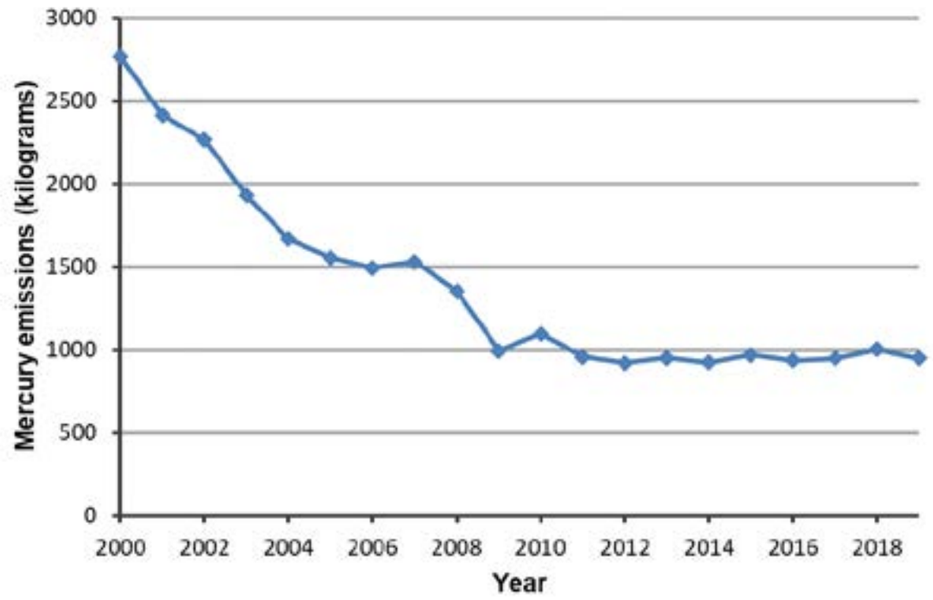

Figure 2. Mercury (elemental, inorganic) emissions in Ontario 2000-2019 (Source APEI).

Status

- Between 2002 and 2019 nitrogen oxide (NOx) emissions in Ontario decreased by 58%, dropping to 2014 and remaining relatively stable from 2014-2019. The decline can be attributed to emissions regulations for industry as well as the phase-in of new vehicles having more stringent emission standards.
- Between 2002 and 2019 sulphur oxide (SOx) emissions in Ontario decreased by 81%. These reductions were largely due to reductions in emissions from fossil-fuel (e.g. coal) fired power-generating utilities, plant closures, as well as a reduction in emissions from the petroleum refining sector. The recent decline in SOx emissions between 2016 and 2019 reflects major renovation work as part of SO2 emission reduction projects at two of the largest smelters in the province.
- Between 2000 and 2019 mercury emissions in Ontario decreased by 66%, mainly due to the closing of coal fired power plants and a reduction of emissions from waste disposal and industrial sources. Most of the decline occurred between 2000-2010 and has remained relatively stable from 2010-2019.

Links

Related Targets: N/A

Related Themes: N/A

Web Links

- Air Pollutant Emissions Inventory (APEI) https://www.canada.ca/en/environment-climate-change/services/pollutants/air-emissions-inventory-overview.html
- National Pollutant Release Inventory (NPRI) https://www.canada.ca/en/services/environment/pollution-waste-management/national-pollutant-release-inventory.html

References

- Aherne, J., and M. Posch. 2013. Impacts of nitrogen and sulphur deposition on forest ecosystem services in Canada. Current Opinion in Environmental Sustainability 5:108-115.
- Bobbink, R., and L.P.M. Lamers. 2002. Effects of increased nitrogen deposition. In: Bell, J.N.D., and M. Treshow (eds). Air pollution and plant life, 2nd edition. John Wiley and Sons Ltd, Chichester, U.K.
- Driscoll, C.T., G.B. Lawrence, A.J. Bulger, T.J. Butler, C.S. Cronan, C. Eagar, K.F. Lambert, G.E. Likens, J.L. Stoddard, and K.C. Weathers. 2001. Acidic deposition in the northeastern United States: sources and inputs, ecosystem effects, and management strategies. BioScience 51:180-198.
- Environment and Climate Change Canada. 2018. Canadian Environmental Sustainability Indicators. [Available at: https://www.ec.gc.ca/indicateurs-indicators/default.asp?lang=En]
- Lee, J.A. 1998. Unintentional experiments with terrestrial ecosystems: ecological effects of sulphur and nitrogen pollutants. Journal of Ecology 86:1–12.
- Lovett, G.M., T.H. Tear, D.C. Evers, S.E.G. Findlay, B.J. Cosby, J.K. Dunscomb, C.T, Driscoll, and K.C. Weathers. 2009. Effects of air pollution on ecosystems and biological diversity in the eastern United States. BioScience 1162:99-135.
- Scheuhammer, A.M., M.W. Meyer, M.B. Sandheinrich, and M.W. Murray. 2007. Effects of environmental methylmercury on the health of wild birds, mammals, and fish. AMBIO: A Journal of the Human Environment 36: 12-16

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