INDICATOR: GROUND-LEVEL OZONE

STRATEGIC DIRECTION: Reduce Threats

TARGET: N/A

THEME: Pressures on Ontario's Biodiversity

Background Information:

Ground-level ozone is a secondary pollutant, formed by chemical reactions between nitrogen oxides and volatile organic compounds in the presence of heat and sunlight. Nitrogen oxides are emitted by natural sources and by human sources such as cars, trucks, and industrial plants. Volatile organic compounds may be emitted by natural sources, such as plants and trees, or by human activities. In addition to having impacts on human health, there is substantial evidence that ground-level ozone can have significant impacts on biodiversity. The most important and well documented impacts are reported for terrestrial vegetation with reductions in crop production, tree growth, and changes in species composition observed (Hayes et al. 2007; Wittig et al. 2009), all of which have downstream consequences for ecosystem services (Royal Society 2008). Evidence suggests that these impacts are likely to occur where ozone concentrations are above a threshold of 40 ppb, a limit which is currently exceeded in most countries around the world, including Canada (Royal Society 2008; Environment and Climate Change Canada 2014).

This indicator is used to assess trends in the seasonal means of ground-level ozone at sites across Ontario, as well as the annual peak (4^{th}-highest) daily maximum 8-hour concentration.

Data Analysis:

Data to assess trends in the seasonal means of ground-level ozone concentrations in Ontario from 1980 to 2015 (Fig. 1) were obtained from the Air Quality in Ontario Reports 2007, 2012, 2014 and 2015 (OMOE2008; OMOECC 2014; OMOECC 2015; OMOECC 2017). Seasonal means were based on data from several ozone monitoring stations operated across Ontario. A 75% data completeness criterion was used to derive trends. Ozone long-term trends were derived from 19 sites for 1980 to 2007 (OMOE 2008), from 37 sites from 2003 to 2012 (OMOECC 2014), from 40 sites from 2005-2014 (OMOECC 2015) and from 39 sites from 2006 to 2015 (OMOECC 2017). The stations were largely based in metropolitan areas in Ontario.

Data used to assess annual peaks (4^{th} highest) for daily maximum 8-hour ground-level ozone concentration from 1998 to 2014 (Fig. 2) were obtained from the Canadian Environmental Sustainability Indicators Report 2016 (Environment and Climate Change Canada 2016) which includes data from National Air Pollution Surveillance Program (NAPS) and the Canadian Air and Precipitation Monitoring Network (CAPMoN). The annual peaks for ground-level ozone are calculated using an approach that is aligned with the Canadian Ambient Air Quality Standards (CAAQS). Annual peaks are based on data collected from 36 monitoring stations in southern Ontario. Peaks are based on the 4th-highest of the daily maximum 8-hour average concentrations measured over a given year. Annual peaks for Ontario were obtained for this indicator by averaging all the 4th-highest values from stations in this region.

- [Link to Environment and Climate Change Canada Data]

Results:

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

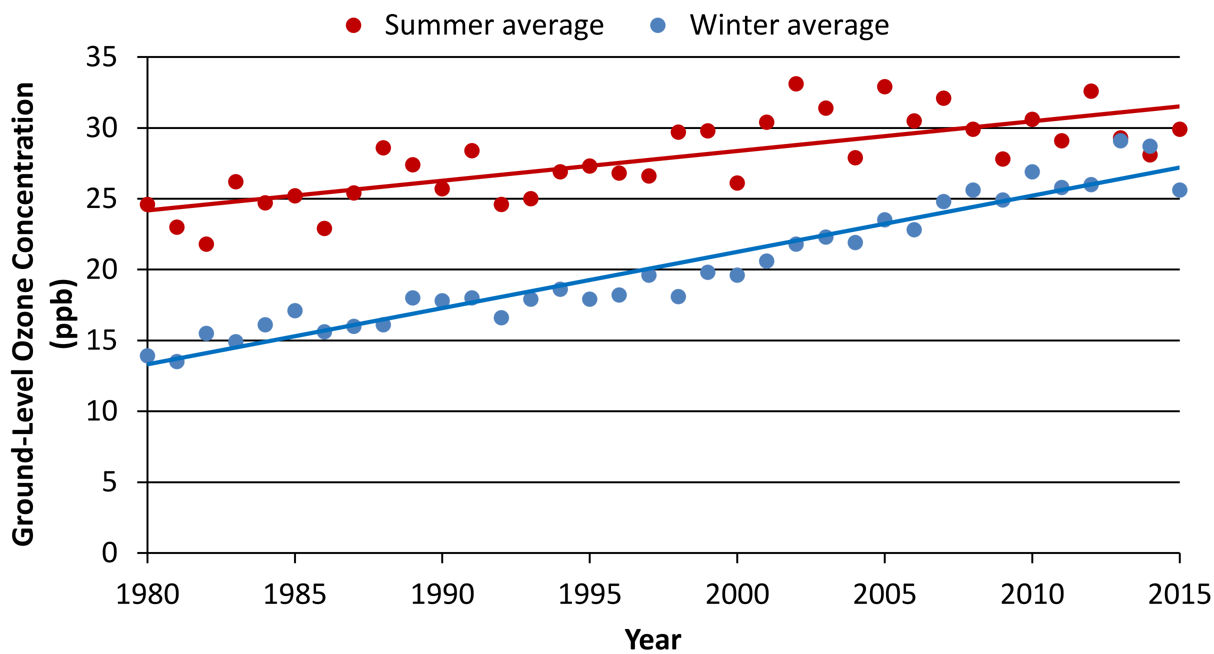

Figure 1. Seasonal means of ground-level ozone at sites across Ontario 1980-2015 (Source: OMOECC 2008, 2014, 2015 and 2017).

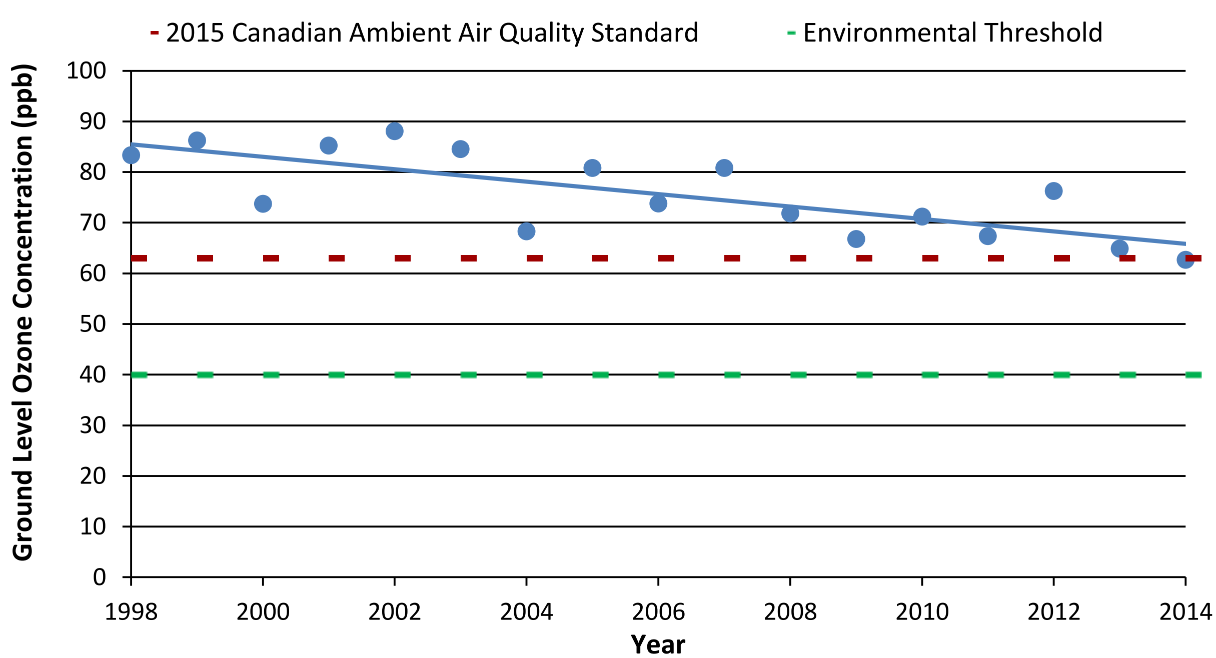

Figure 2. Annual peak (4th-highest) daily maximum 8-hour ground-level ozone concentration at sites across southern Ontario 1998-2014 (*n* = 36) (Source: Environment and Climate Change Canada 2016) (Note: The red horizontal dashed line represents the value of the Canadian Ambient Air Quality Standards (CAAQS) for 2015 and is shown for indicative purposes only, and not for evaluation of the achievement status of the standard. The green horizontal dashed line represents the environmental threshold above which impacts are likely on vegetation (Royal Society 2008).

Status:

- Between 1980 and 2015 seasonal means of ground-level ozone in Ontario increased in both the summer and winter seasons. Summer average ground-level ozone concentrations were consistently higher than winter average concentrations, except in 2014, when the winter average ozone concentration exceeded that of the summer average by 0.6 ppb. The elevated winter ozone averages are mainly attributed to rising global background concentrations.
- A decreasing trend was detected in the annual peak concentrations of ground-level ozone from 1998 to 2014, representing a decrease of 25% (or an average of 1.4% per year) over that period. A reduction in emissions of ground-level ozone precursor gases (nitrogen oxides and volatile organic carbons) from Canada and the United States is likely an important factor in this downward trend. The annual peak ground-level ozone concentrations were above the 2015 environmental threshold for all years. By 2014, the annual peak ground-level ozone concentrations were below the 2015 Canadian Ambient Air Quality Standard.

Links:

Related Targets: 8. By 2015, the release of pollutants harmful to biodiversity is reduced.

Related Themes: N/A

Web Links:

Canadian Environmental Sustainability Indicators http://www.ec.gc.ca/indicateurs-indicators/default.asp?lang=En

Ontario Ministry of Environment and Climate Change Air Quality Reports http://www.airqualityontario.com/press/publications.php

National Air Pollution Surveillance Program (NAPS) http://www.ec.gc.ca/rnspa-naps/

Canadian Air and Precipitation Monitoring Network (CAPMoN) https://www.ec.gc.ca/rs-mn/default.asp?lang=En&n=752CE271-1

Canadian Ambient Air Quality Standards (CAAQS) http://www.ec.gc.ca/default.asp?lang=En&n=56D4043B-1&news=A4B2C28A-2DFB-4BF4-8777-ADF29B4360BD

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