Suppressed total antibody responses were observed in herring gulls at AOCs and Grand Traverse Bay, and the total antibody response was suppressed in both herring gulls and Caspian terns at AOCs. Growth in herring gulls varied across both years and site, with normal mean growth rates in hatching gulls for 14-20 g/day (Grasman et al. 1996). At Monroe and L. Charity Is. in the Saginaw Bay, herring gulls were significantly lower than at the reference site (total: 5.5, site: p < 0.0001). For Caspian terns, no significant growth trends differed: the mean rate was lower at the reference site, while AOCs showed normal average rates. Although mean growth in hatching gulls on the SB CDF was compared to reference site during 2010-2012, growth was dramatically lower in 2014 and only 1.5 g/day and <29 g/day, respectively. Mean growth in healthy Caspian terns is 4-8 g/day (Grasman et al. 1996). In 2013-15 mean growth rates varied at the reference site ranging from 5.6-10.5 g/day, while growers on the SB CDF in 2010-12 and 2014 was 2.0-8.4 g/day, even though Caspian terns are a more coastal species than herring gulls. Embryonic mortality (nonviability) varied across years and sites, with the highest mean nonviability rates in herring gulls, 11% at Two Tree Is. and 5.0% in the Saginaw Bay, a site with medium PCB concentrations, but high contamination due to higher failed development, hence these eggs were designated as undetermined.

Phytohemagglutinin (PHA) Skin Test for T Cell-mediated Immunity

Herring gulls and Caspian terns were tested for T cell-mediated immune responses at all AOC colonies and Grand Traverse Bay compared to reference sites (Two-way ANOVA site-by-year (p < 0.001)). The total antibody response was significantly different at the reference site (Tukey p < 0.05) (Fig. 5A). Gulls in Grand Traverse Bay had a 45.7% lower response on the PHA skin test compared to in herring gulls on the SB CDF (45.7% lower response at the reference site vs Two Tree Is. (p < 0.001). Black-browed night gulls on the CBD showed a 39% lower T cell response compared to the reference site (p < 0.05). The total antibody response was significantly different at the reference site (t-test p < 0.001). High contamination due to higher failed development, hence these eggs were designated as undetermined.

High contamination due to higher failed development, hence these eggs were designated as undetermined. Adverse health effects, including a decreased immune response and (or) decreased productivity, which were consistent with past studies. Suppressed T-cell mediated immune response in hatching gulls, Caspian terns, and black-browed night gulls in the Saginaw Bay AOC exhibited adverse health effects, including a decreased immune response and (or) decreased productivity, which were consistent with past studies. Suppressed T-cell mediated immune response in hatching gulls, Caspian terns, and black-browed night gulls in the Saginaw Bay AOC exhibited adverse health effects, including a decreased immune response and (or) decreased productivity, which were consistent with past studies.

Study Sites: (See Fig 1: Saginaw Bay AOC: Pipe Island Terns (gulls, 2010-14), Saginaw Bay CDF (gulls and terns 2010-14, herring 2014). Tree Island (terns 2014). River Raisin AOC: Charlevoix Island (terns, 2010, 2014). Grand Traverse Bay: L. Charity Is. (gulls and terns 2004, 2011). Herring gulls from the reference colonies chosen for this study (Fig. 1) were based on concentrations of organochlorine compounds compared to the Saginaw Bay and River Raisin AOCs to Great Lakes Bay (Kadlec and Kadlec 2004). Embryonic Nonviability (Nonviability) was measured during laying

Nonviability was assessed during mid-laying incubation (approximately 21 days) and post-hatching (Grasman et al. 2004).

Nonviability eggs were exposed to ammonia, urea, and formalin, and to other synthetic compounds with reduced growth and survival of chicks (Grasman et al. 2004).

Productivity was calculated as the number of 3-week-old chicks divided by the number of incubated eggs.

Phytohemagglutinin (PHA) Skin Test for T Cell-mediated Immunity

Herring gulls and Caspian terns were tested for T cell-mediated immunity at all AOC colonies and Grand Traverse Bay compared to reference sites (Two-way ANOVA site-by-year (p < 0.001)). The total antibody response was significantly different at the reference site (Tukey p < 0.05) (Fig. 5A). Gulls in Grand Traverse Bay had a 45.7% lower response on the PHA skin test compared to in herring gulls on the SB CDF (45.7% lower response at the reference site vs Two Tree Is. (p < 0.001). Black-browed night gulls on the CBD showed a 39% lower T cell response compared to the reference site (p < 0.05). The total antibody response was significantly different at the reference site (t-test p < 0.001). High contamination due to higher failed development, hence these eggs were designated as undetermined.

Herring gulls on the River Raisin CDF showed decreased immune response and reproductive success, consistent with past studies. Suppressed T-cell mediated immune response in hatching gulls, Caspian terns, and black-browed night gulls in the Saginaw Bay AOC exhibited adverse health effects, including a decreased immune response and (or) decreased productivity, which were consistent with past studies. Suppressed T-cell mediated immune response in hatching gulls, Caspian terns, and black-browed night gulls in the Saginaw Bay AOC exhibited adverse health effects, including a decreased immune response and (or) decreased productivity, which were consistent with past studies. Suppressed T-cell mediated immune response in hatching gulls, Caspian terns, and black-browed night gulls in the Saginaw Bay AOC exhibited adverse health effects, including a decreased immune response and (or) decreased productivity, which were consistent with past studies. Suppressed T-cell mediated immune response in hatching gulls, Caspian terns, and black-browed night gulls in the Saginaw Bay AOC exhibited adverse health effects, including a decreased immune response and (or) decreased productivity, which were consistent with past studies. Suppressed T-cell mediated immune response in hatching gulls, Caspian terns, and black-browed night gulls in the Saginaw Bay AOC exhibited adverse health effects, including a decreased immune response and (or) decreased productivity, which were consistent with past studies. Suppressed T-cell mediated immune response in hatching gulls, Caspian terns, and black-browed night gulls in the Saginaw Bay AOC exhibited adverse health effects, including a decreased immune response and (or) decreased productivity, which were consistent with past studies.