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Survey of Reservoir Greenhouse gas Emissions

Atagahi Lake Water Quality Survey

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07 June, 2022

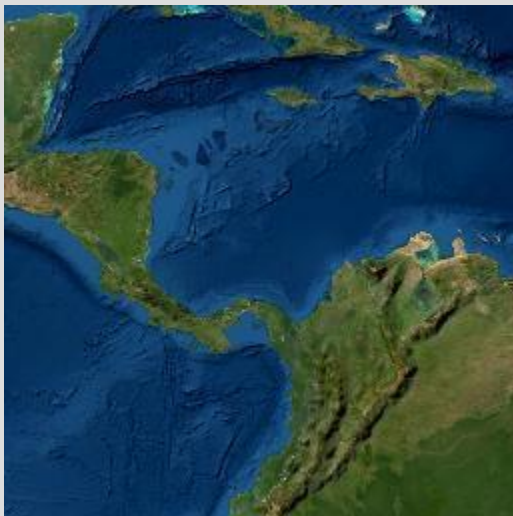
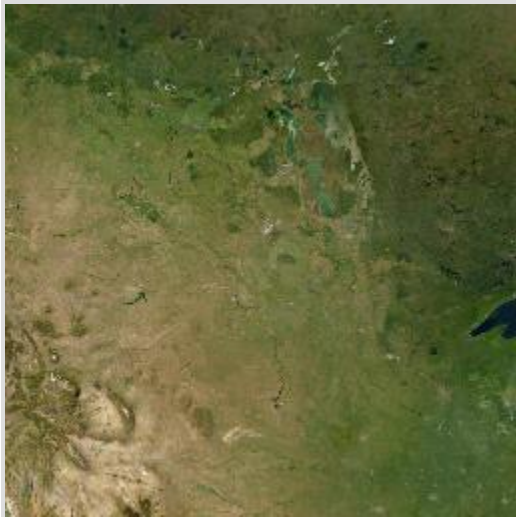
1. Background

Between 2020 and 2023 the US Environmental Protection Agency (USEPA) will survey water quality and greenhouse gas (GHG) emissions from 108 reservoirs distributed across the United States (Figure 1). The objective of the research is to estimate the magnitude of GHG emissions from US reservoirs.

All reservoirs included in this study were previously sampled by the USEPA during the 2017 National Lakes Assessment (2017 NLA). Data from the 2017 NLA can be found at the [EPA website](#). Data for Atagahi Lake can be found under SITE_ID NLA17_NC-10004.

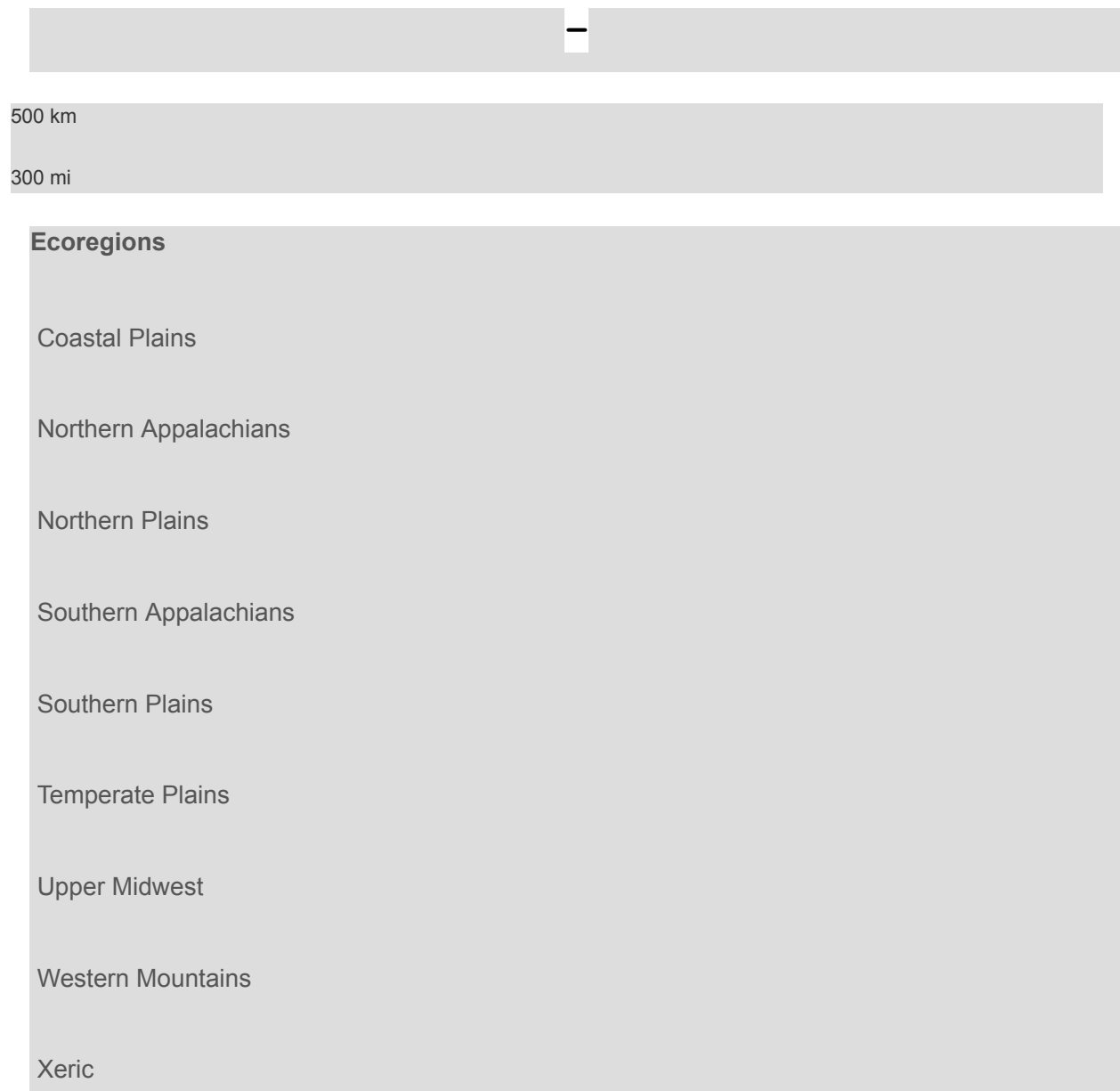
A field sensor is used to measure chlorophyll a, dissolved oxygen, pH, specific conductivity, water temperature, and turbidity near the water surface at a minimum of 15 locations within each reservoir. Water samples are collected from the deepest site for analysis of nutrients and chlorophyll a.

This preliminary report presents water quality results for Atagahi Lake. These data will be included in a formal peer-reviewed publication to be submitted for publication in 2024.





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Figure 1. Location of the 108 Reservoirs Included in Study.

2. Atagahi Lake Survey Design

The Atagahi Lake survey design included 15 sampling sites that were sampled on 2020-09-01. Water chemistry samples were collected from a 12.2m deep site toward the north end of the lake (Figure 2). Click on any of the sites to see the site id, water temperature, pH, turbidity, and dissolved oxygen at the water surface.





Sample sites

sensor sites

water chemistry site

100 m

500 ft

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Figure 2. Location of the 15 sampling sites in Atagahi Lake.

3. Lake Disturbance and Trophic Status

Lakes are often classified according to their trophic state. There are four trophic state categories that reflect nutrient availability and plant growth within a lake. A eutrophic lake has high nutrients and high algal and/or macrophyte plant growth. An oligotrophic lake has low nutrient concentrations and low plant growth. Mesotrophic lakes fall somewhere in between eutrophic and oligotrophic lakes and hypereutrophic lakes have very high nutrients and plant growth. Lake trophic state is typically determined by a wide variety of natural factors that control nutrient supply, climate, and basin morphometry. A metric commonly used for defining trophic state is the concentration of chlorophyll a (chla), an indicator of algae abundance, in the water column. Chlorophyll a concentration was 2 ug/L during the sampling, indicating the lake was mesotrophic.

Analyte	Oligotrophic	Mesotrophic	Eutrophic	Hypereutrophic
chlorophyll a (ug/L)	<=2	>2 and <=7	>7 and <=30	>30

In addition to classifying lakes by trophic status, lakes can be classified by degree of disturbance relative to undisturbed lakes (i.e. reference lakes) within the ecoregion. Degree of disturbance can be based on a wide variety of metrics, but here we use nutrients (total phosphorus (tp), total nitrogen (tn)), suspended sediment (turbidity), chlorophyll a, and dissolved oxygen (do). All lake disturbance values are least disturbed.

Threshold Values

Observed Values

parameter	units	least disturbed	moderately disturbed	most disturbed	concentration	status
do	mg/l	>5	>3 & <5	<3	8	least disturbed
turbidity	NTU	<2.83	>2.83 & <3.94	>3.94	0.00	least disturbed
tp	ug/l	<19	>19 & <33	>33	11	least disturbed
tn	ug/l	<309	>309 & <407	>407	136	least disturbed
chlorophyll a	ug/l	<5.23	>5.23 & <11.5	>11.5	2.3	least disturbed

4. Within-lake Spatial Patterns

A field sensor was used to measure water temperature, pH, dissolved oxygen, and turbidity near the water surface at all sampling sites. Data are reported in figures and tables below. Hover the cursor over any point in the figures to reveal the siteID corresponding to the adjacent data table. Alternatively, click on any row in the data table to reveal the location of the sampling site on the map.

Turbidity is highest near the river inflows, but decreases toward the dam as water velocity decreases and suspended sediment drops out of the water column. Water temperature is greatest close to the dam, reflecting gradual warming of river water as it moves through the reservoir. Dissolved oxygen and pH are often greatest near the dam, reflecting high rates of algal metabolism in the relatively warm and clear water near the dam. At the time of sampling, highest dissolved oxygen concentrations were observed on the south end of the lake.





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Water

Temp.

(°C)

24.224.424.624.825.025.225.425.625.8

300 m

1000 ft

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siteID	water temp
1	25.6
2	25.5
3	25.9
4	25.8
5	25.5
6	24.3
7	25.7
8	25.6
9	25.4
10	25.7
11	25.7
12	25.5
13	24.2
14	25.7
15	25.9





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pH

6.66.87.07.27.47.6

300 m

1000 ft

siteID	pH
1	6.7
2	6.7
3	6.8
4	6.8
5	6.8
6	6.6
7	7.5
8	6.9
9	6.8
10	7.8
11	6.8
12	6.9
13	6.6
14	6.9
15	6.8





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Turbidity

(NTU)

012345

300 m

1000 ft

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siteID	Turbidity (NTU)
1	0.5
2	0
3	0
4	0
5	0
6	2.3
7	0
8	0
9	0
10	0
11	0
12	0
13	5.8
14	0
15	0





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Dissolved

Oxygen

(mg/L)

7.88.08.28.48.68.8

300 m

1000 ft

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siteID	DO (mg/L)
1	7.9
2	7.9
3	7.9
4	7.9
5	7.9
6	8.8
7	7.8
8	7.9
9	7.8
10	7.8
11	8
12	7.9
13	8.9
14	7.9
15	7.9

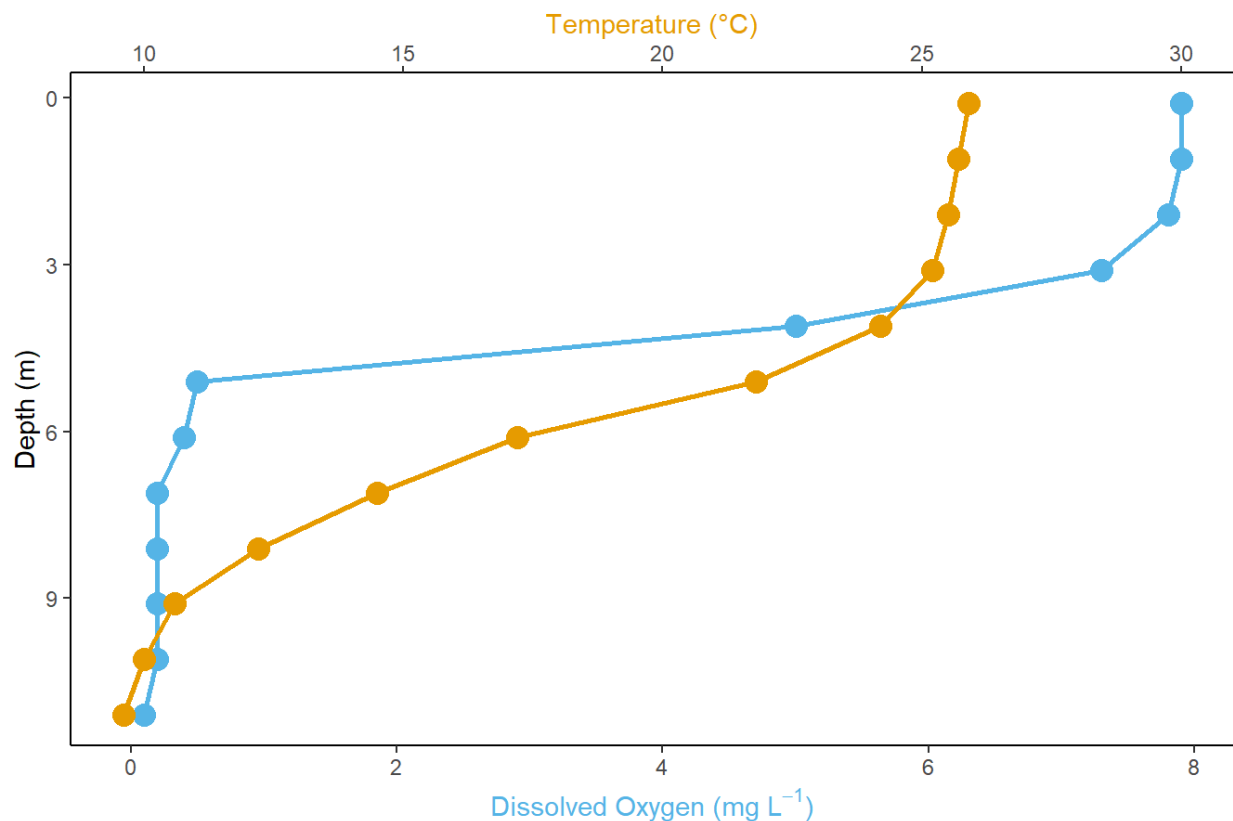
5. Depth Profiles

Dissolved oxygen is one of the most important environmental factors affecting aquatic life. The biological demand for oxygen is often greatest near the sediment where the decomposition of organic matter consumes oxygen through aerobic respiration. Near the surface of lakes, photosynthesis by phytoplankton produces oxygen, often leading to a general pattern of decreasing oxygen availability with increasing depth. This pattern can be exacerbated by thermal stratification. Thermal stratification occurs when lake surface waters are warmed by the sun, causing the water to

become less dense and float on top of the deeper, cooler lake water. Since the deeper layer of water cannot exchange gases with the atmosphere, the dissolved oxygen content of the deep water cannot be replenished from the atmosphere. As a result, the deep water can become progressively depleted of oxygen as it is consumed by biological activity, sometimes causing dissolved oxygen to become sufficiently scarce to stress oxygen sensitive organisms including some fish and insects.

The deepest sampling location in Atagahi Lake was 12.2 m deep. In shallow lakes, wind induced mixing of the water column is often sufficient to prevent thermal stratification. Atagahi Lake had moderate thermal stratification and dissolved oxygen was nearly depleted near the lake bottom, indicating strong biological oxygen demand in lake sediment.

Atagahi Lake Depth Profiles



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