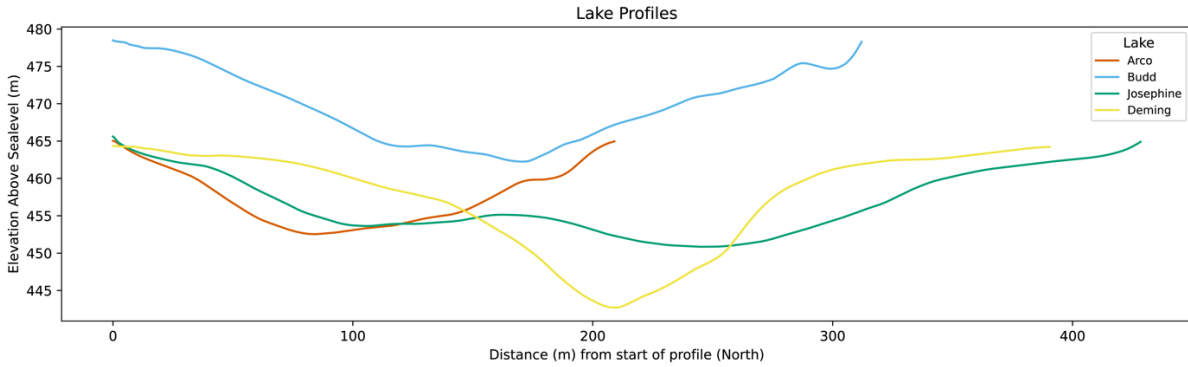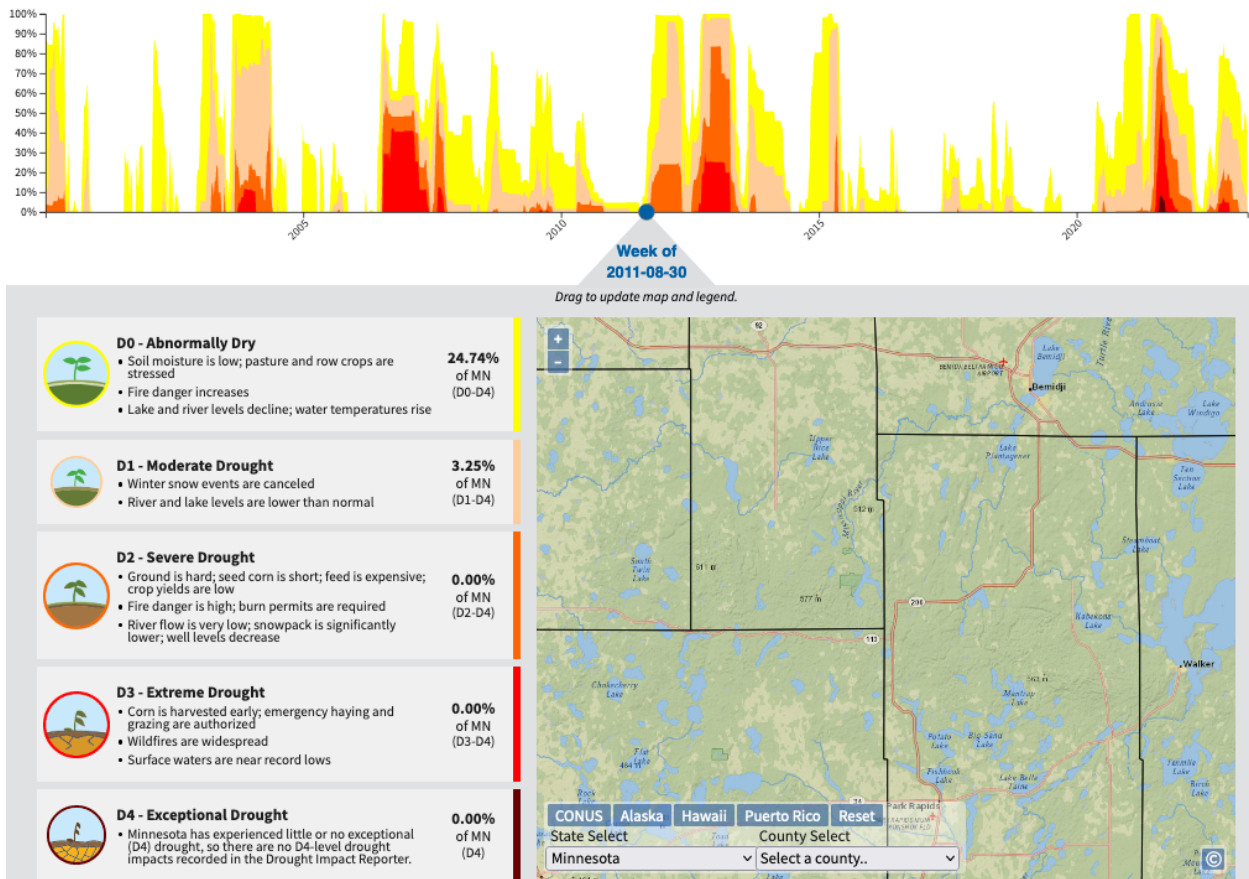# Supplementary Material for Thermal stratification and meromixis in four dilute temperate zone lakes


Supplementary Figure 1. Profiles of the lakes (in meters above mean sea level) along the fence diagrams in Figure 1.


Supplementary Figure 2. Historical drought information for the counties encompassing Itasca State Park during the period of 2000-2023. Graphics were generated by the National Integrated Drought Information System.
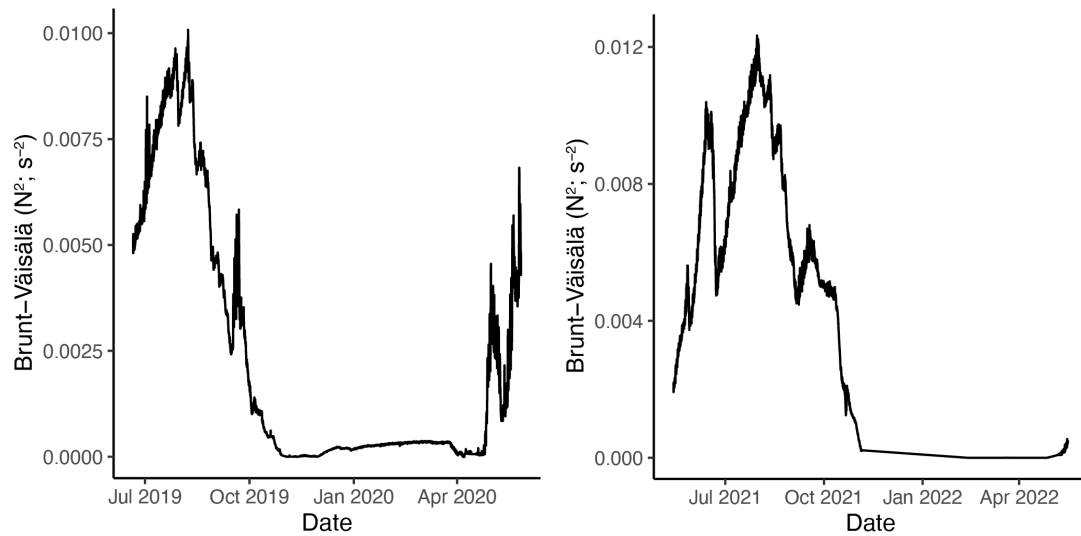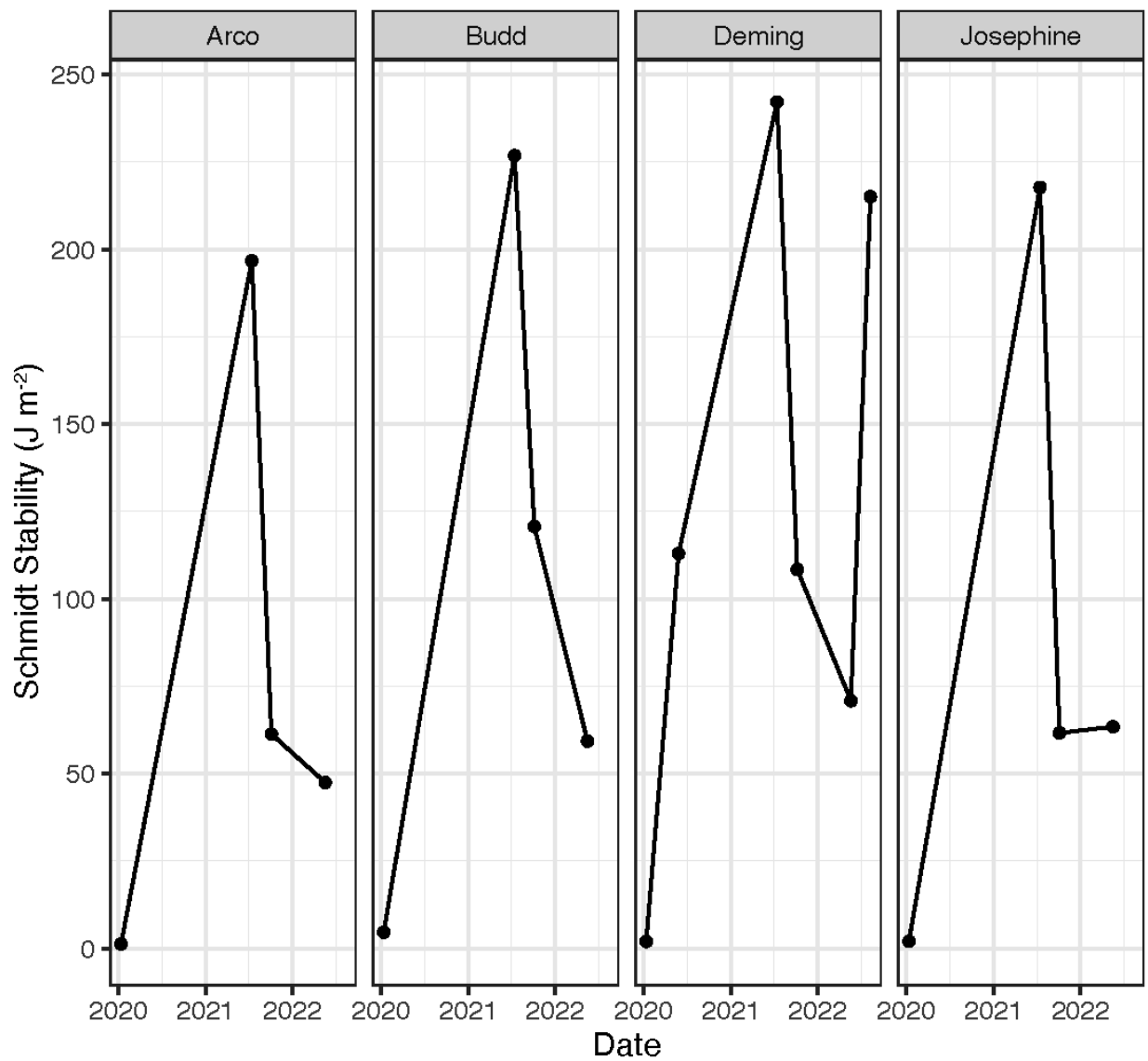
Supplementary Figure 3. The Brunt-Väisälä or buoyancy frequency (N^2, s^{-2}), calculated from the temperature time series for Deming Lake from June 2019 to May 2020 (left), and Arco Lake from May 2021 to May 2022 (right). Higher values indicate greater stability.
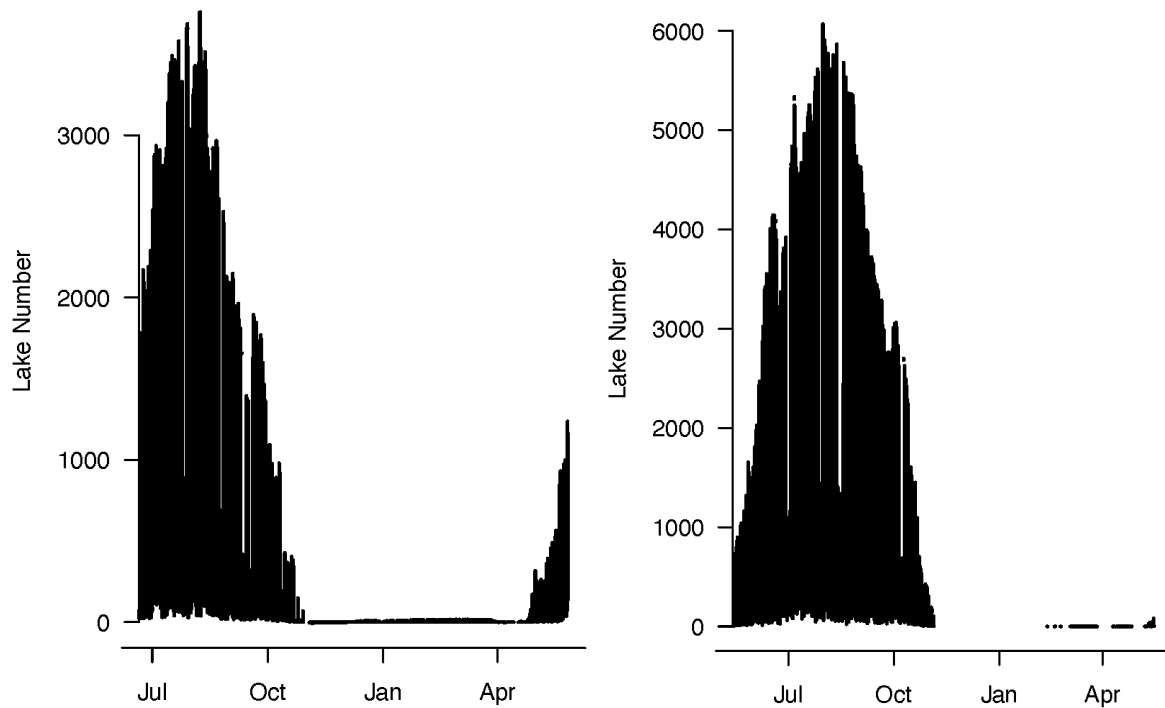
Supplementary Figure 4. The dimensionless lake number was calculated using wind speeds from the ITCM5 weather station and the temperature time series for Deming Lake from June 2019 to May 2020 (left), and Arco Lake from May 2021 to May 2022 (right). Higher values indicate greater stability.
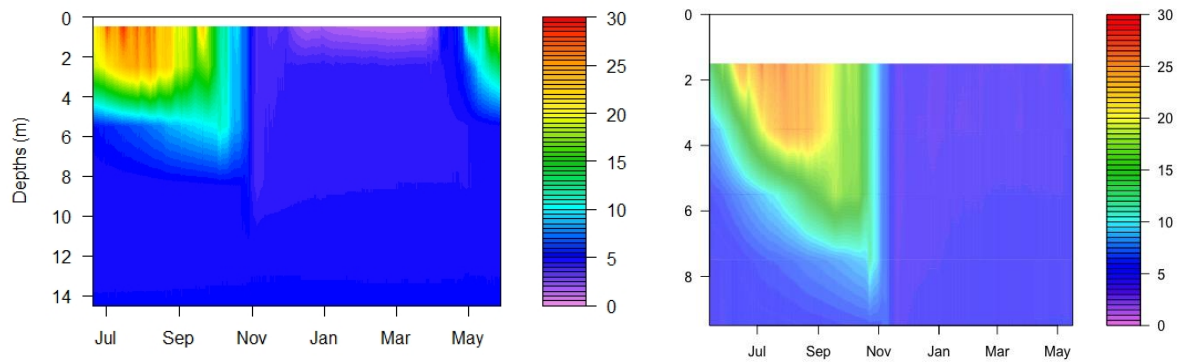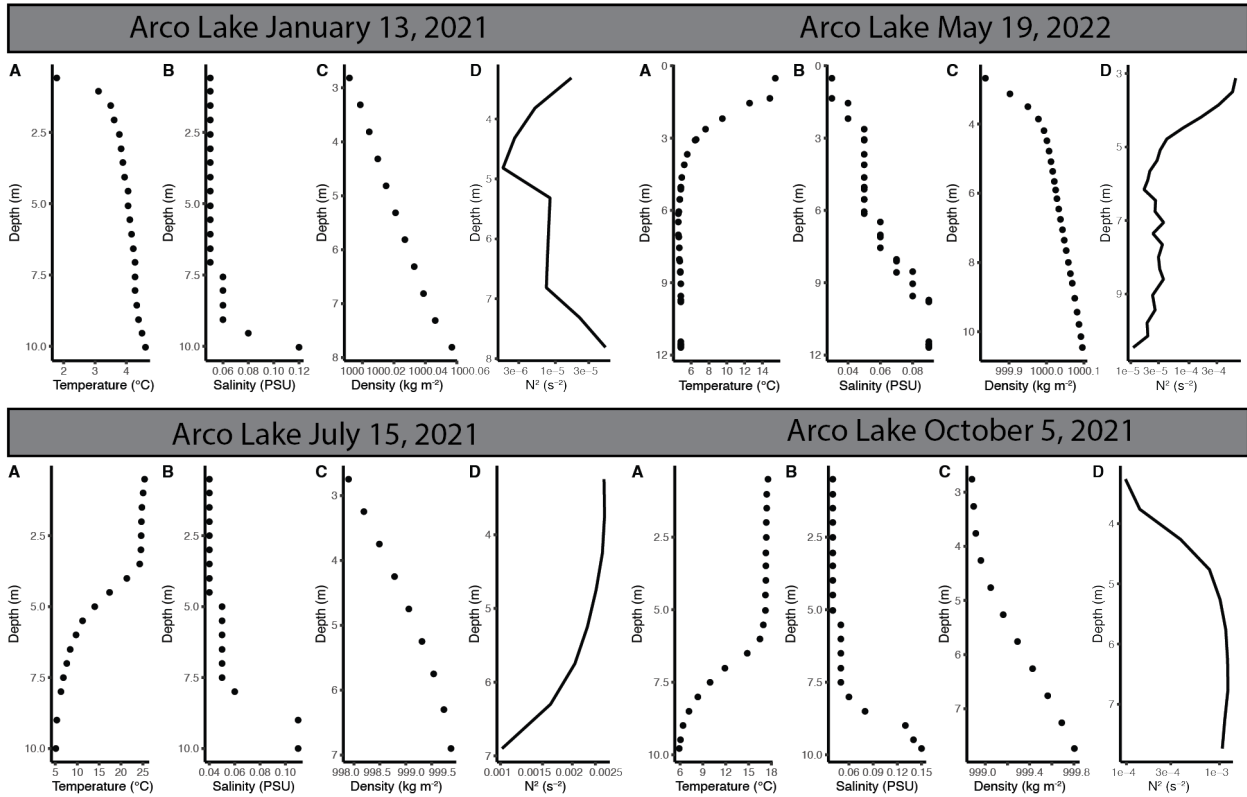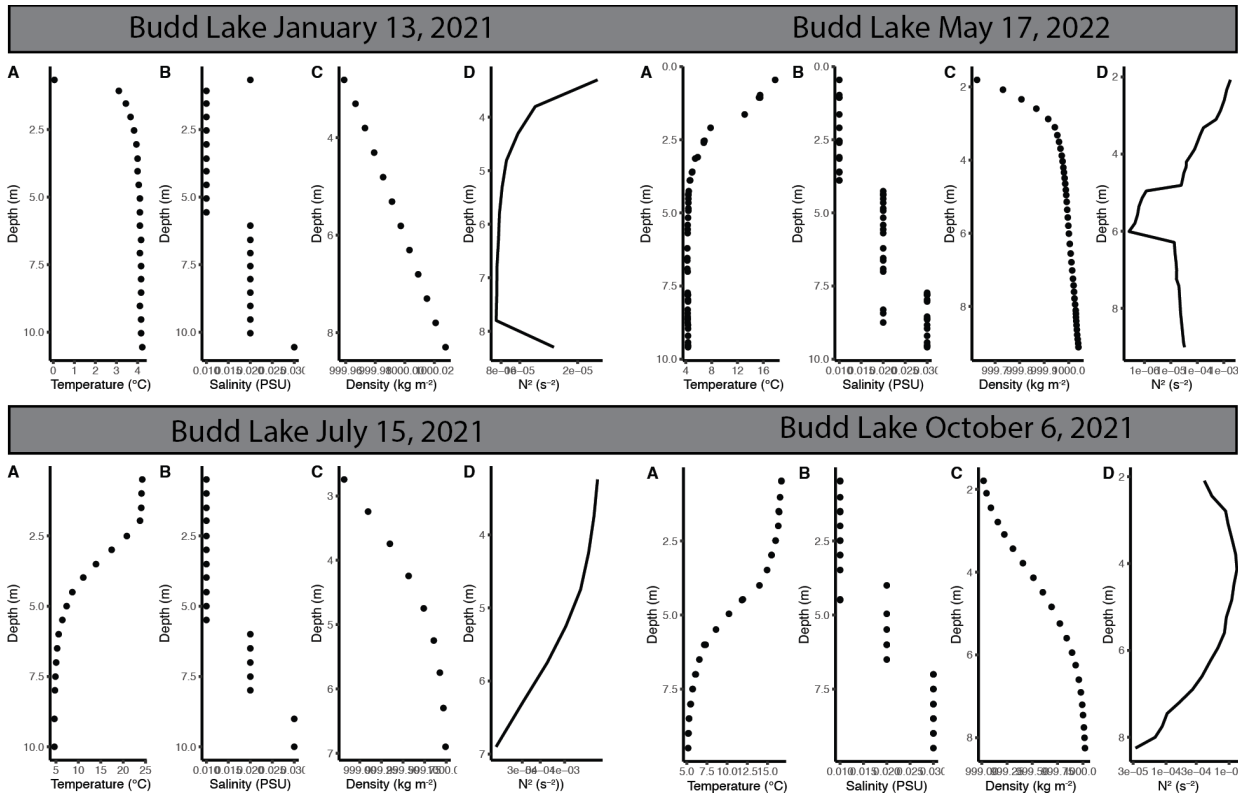
Supplementary Figure 5. Deming Lake temperatures (°C) from June 2019 to May 2020 (left). Arco Lake temperatures (°C) from May 2021 to May 2022 (right).

Supplementary Figure 6. Plots of Schmidt Stability for each of the four study lakes from January 2021 to August 2022. Higher values indicate greater stability.
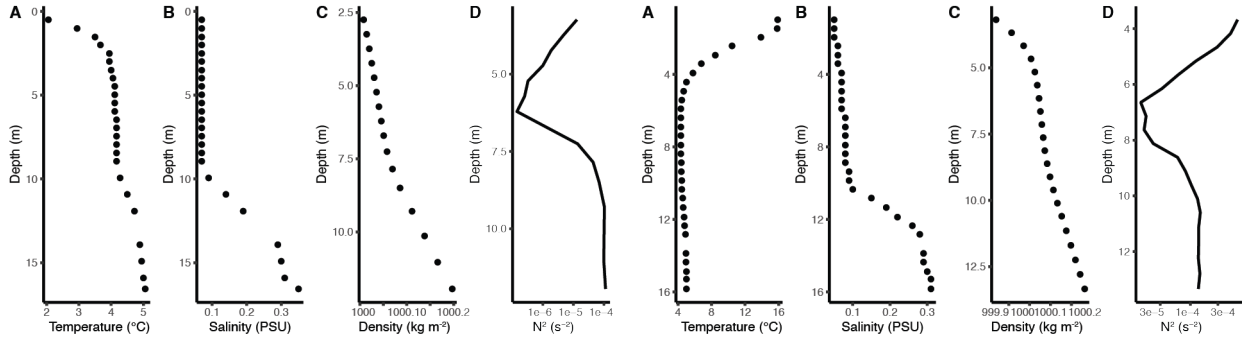

Supplementary Figure 7. The Brunt-Väisälä or buoyancy frequency (N², s⁻²), calculated from the temperature and salinity profiles from Arco Lake from January 2021 to May 2022. Higher values indicate greater stability.

Supplementary Figure 8. The Brunt-Väisälä or buoyancy frequency (N², s⁻²), calculated from the temperature and salinity profiles from Budd Lake from January 2021 to May 2022. Higher values indicate greater stability.
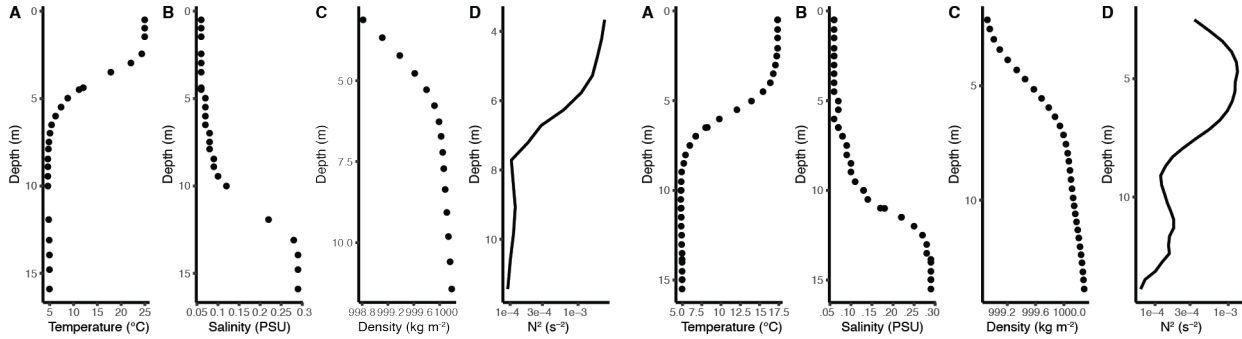
Supplementary Figure 9. The Brunt-Väisälä or buoyancy frequency (N^2, s^{-2}), calculated from the temperature and salinity profiles from Deming Lake from January 2021 to May 2022. Higher values indicate greater stability.
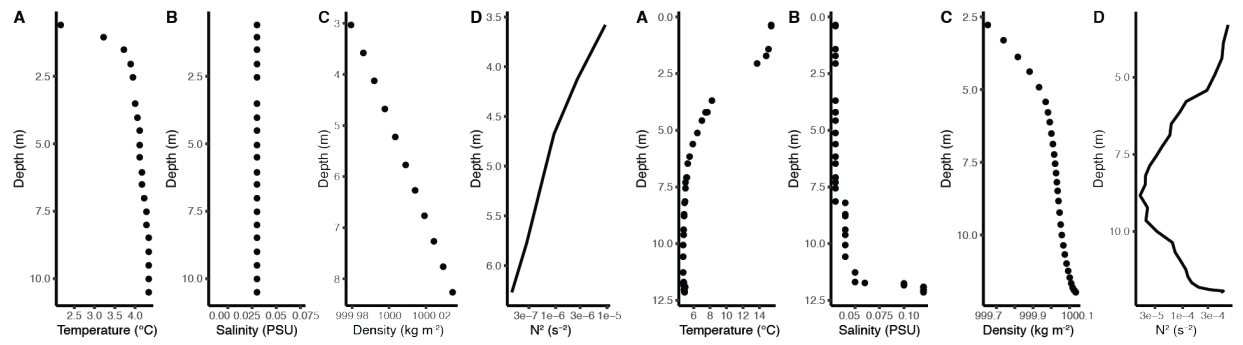
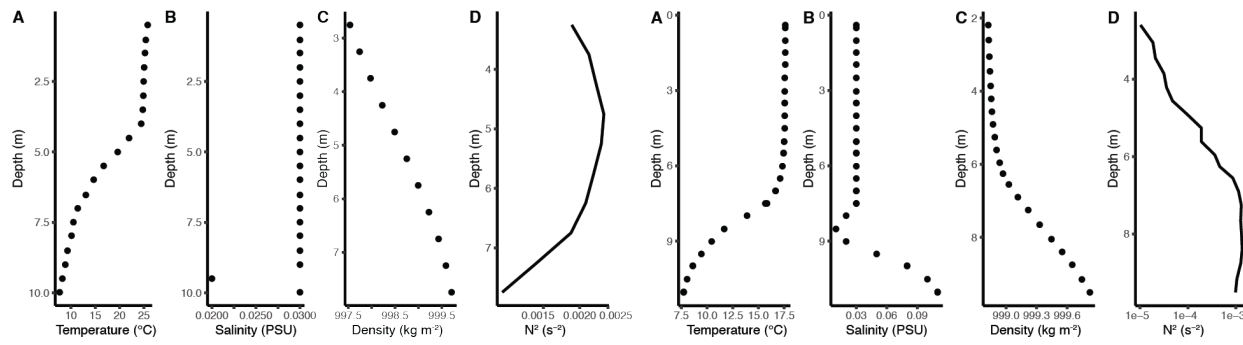**Supplementary Figure 10.** The Brunt-Väisälä or buoyancy frequency (N^2, s^{-2}), calculated from the temperature and salinity profiles from Josephine Lake from January 2021 to May 2022. Higher values indicate greater stability.
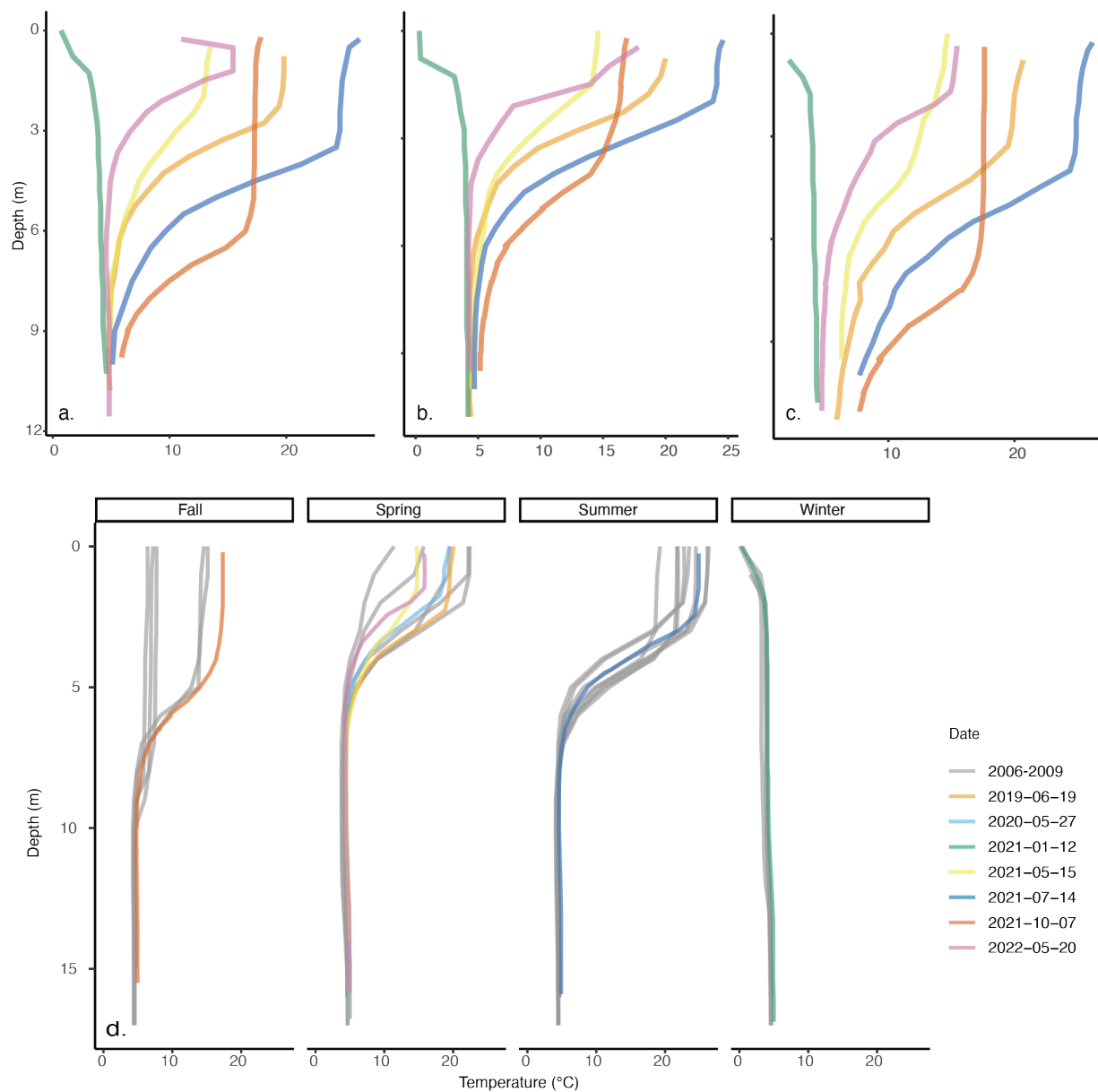
Supplementary Figure 11. Temperature profiles of a) Arco Lake, b) Budd Lake, c) Josephine Lake, and d) Deming Lake. For Deming Lake, seasons were classified according to solstice and equinox dates.

Supplementary Table 1. Water color in mg Pt L-1. The depths of individual samples (in meters) are given in parentheses.

	Arco	Budd	Deming	Josephine
Depth 1	1.4 (4)	32.87 (2)	8.0 (3.5)	3.1 (2)
Depth 2	3.1 (5)	27.9 (4.5)	8.0 (4.5)	1.4 (4.5)
Depth 3	4.71 (5.5)	24.6 (9)	8.0 (5)	1.4 (9)

Average	3.1	28.4	8.0	2.0
Standard dev.	1.7	4.2	0	1.0
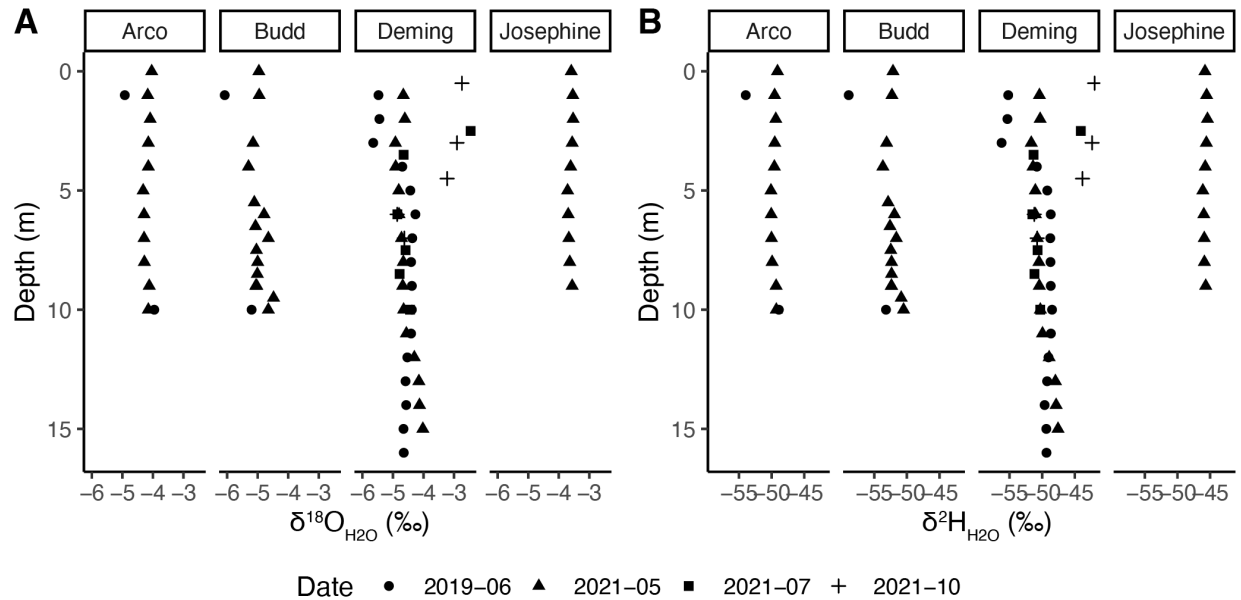
Supplementary Figure 12. Trends in $\delta^{18}O_{H2O}$ and $\delta^{2}H_{H2O}$ with depth in the four study lakes. Deming was the only lake sampled in all seasons. Analytical precision is within the symbol size.

Supplementary Table 2. Stable isotopes of spring and bog water.

| Site Name	Latitude	Longitude	$\delta^{18}O_{H2O}$ (‰)	$\delta^{2}H_{H2O}$ (‰)
Deming Bog	47.169440	-95.167162	-6.83	-10.90
Nicollet Creek	47.193874	-95.230539	-10.90	-81.36
Elk3	47.190478	-95.211350	-10.23	-77.36
Elk4	47.190478	-95.211350	-9.34	-73.92

The combined uncertainty (analytical uncertainty and average correction factor) for $\delta^{18}O$ is ± 0.04‰ VSMOW) and $\delta^{2}H$ is ± 0.25‰ (VSMOW), respectively.

Supplementary Figure 13. Left: marsh marigold in boggy areas around Deming Lake with 3x4" field notebook for scale. Right: iron mineralization at Elk springs.
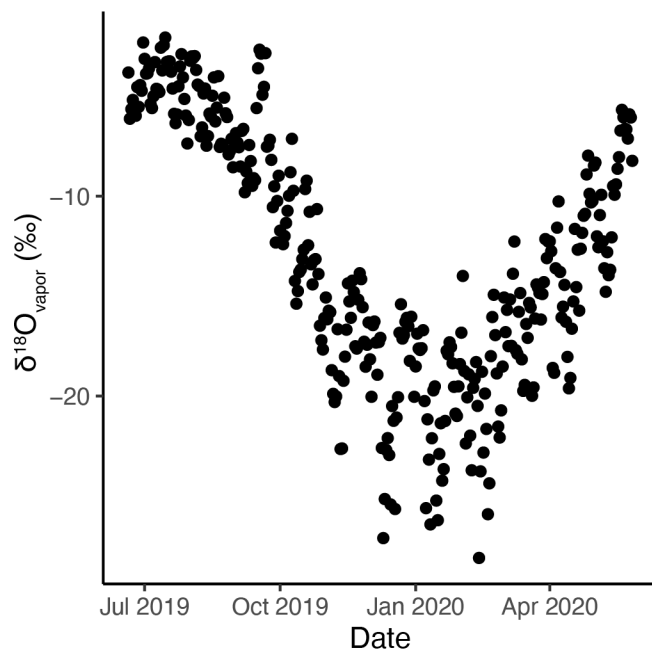

Supplementary Figure 14. The range of $\delta^{18}O_{H2O}$ calculated for water vapor based on temperature records from the ITCM5 station calculated according to Engel & Magner, 2019.
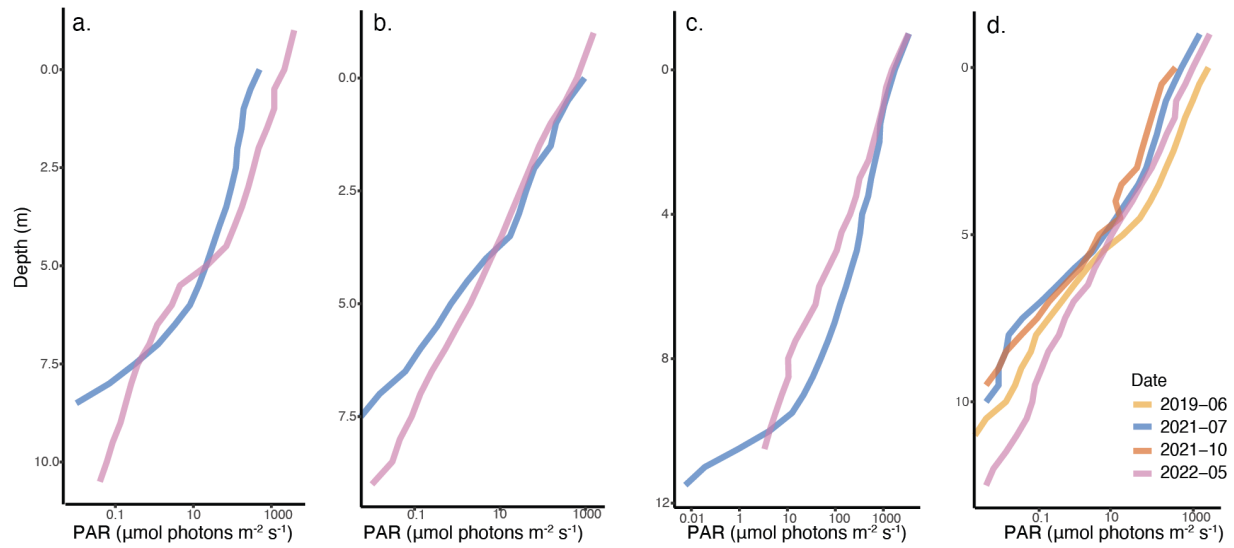
Supplementary Figure 15. Photosynthetically active radiation (PAR) profiles of a) Arco Lake, b) Budd Lake, c) Josephine Lake, and d) Deming Lake.
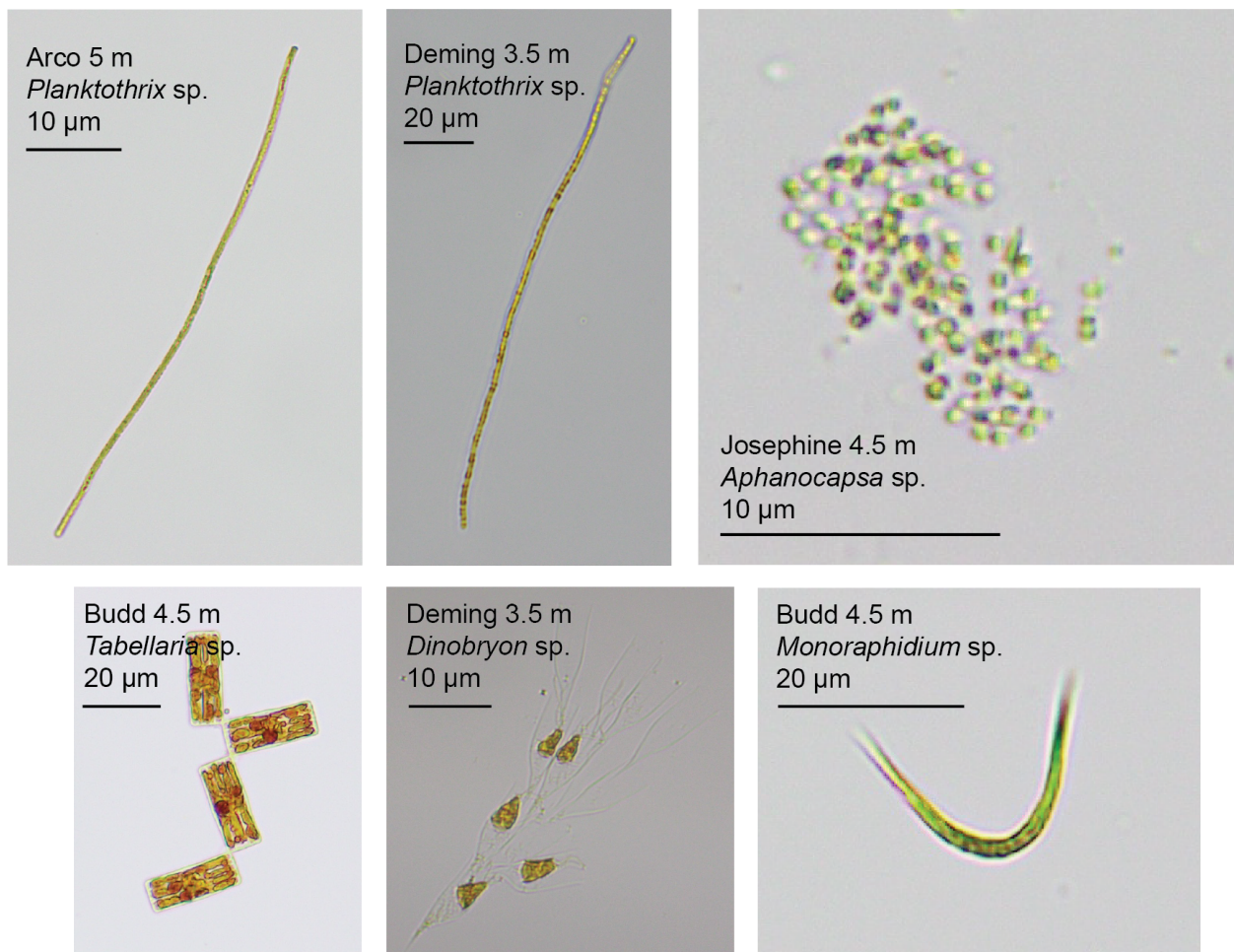
Supplementary Figure 16. Cyanobacteria (top row) and eukaryotic algae (bottom row) observed in the study lakes in May 2022.
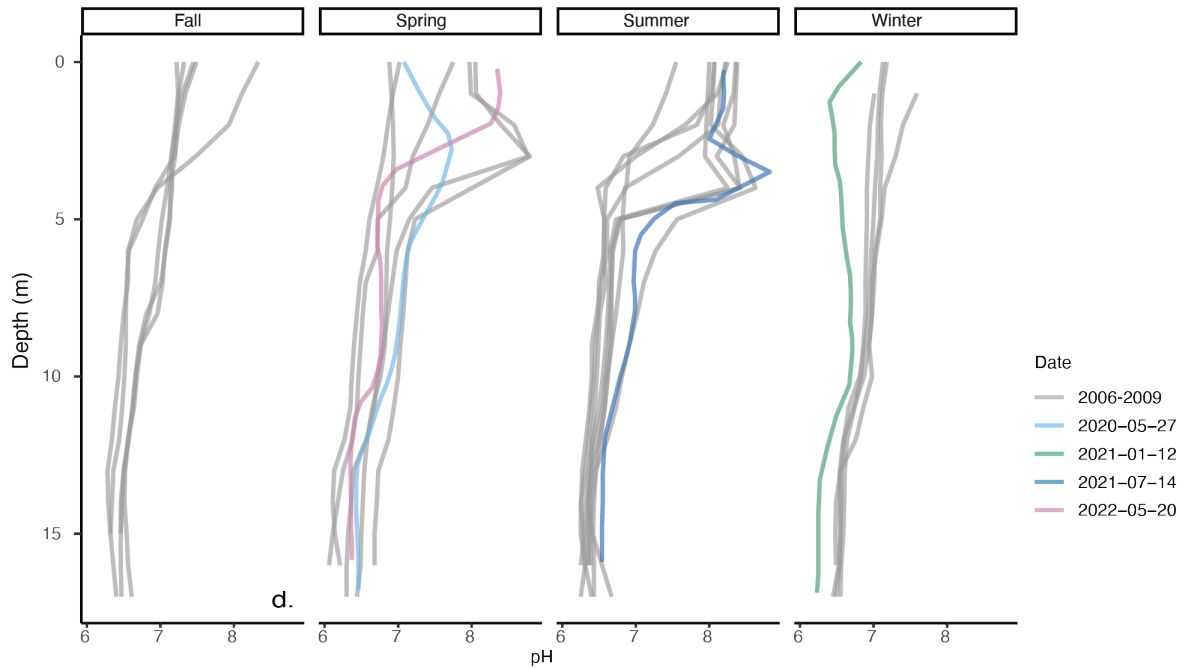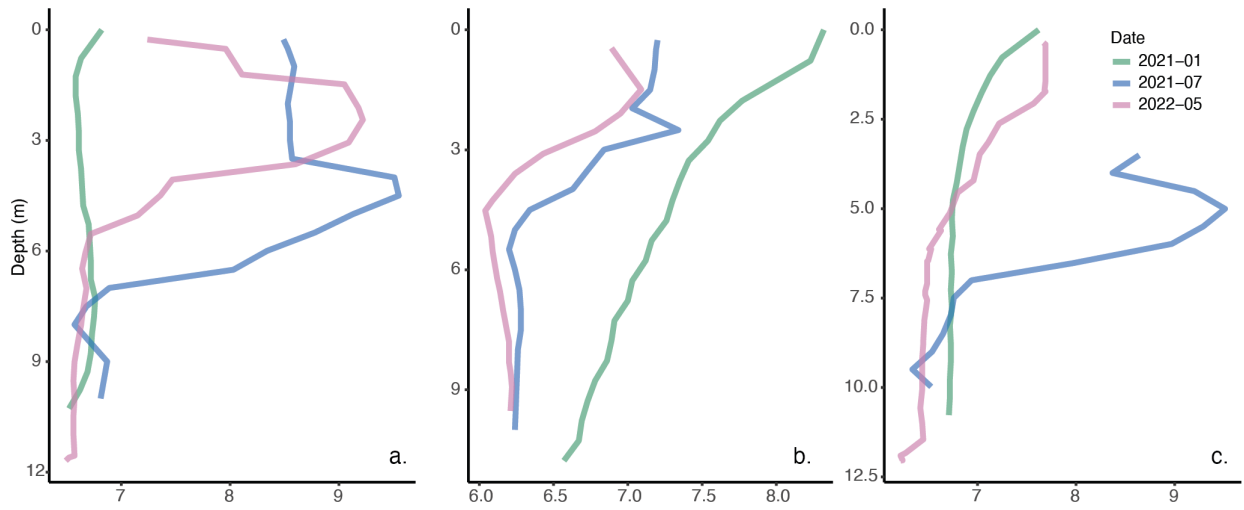
Supplementary Figure 18. pH profiles of a) Arco Lake, b) Budd Lake, c) Josephine Lake, and d) Deming Lake. For Deming Lake, seasons were classified according to solstice and equinox dates.
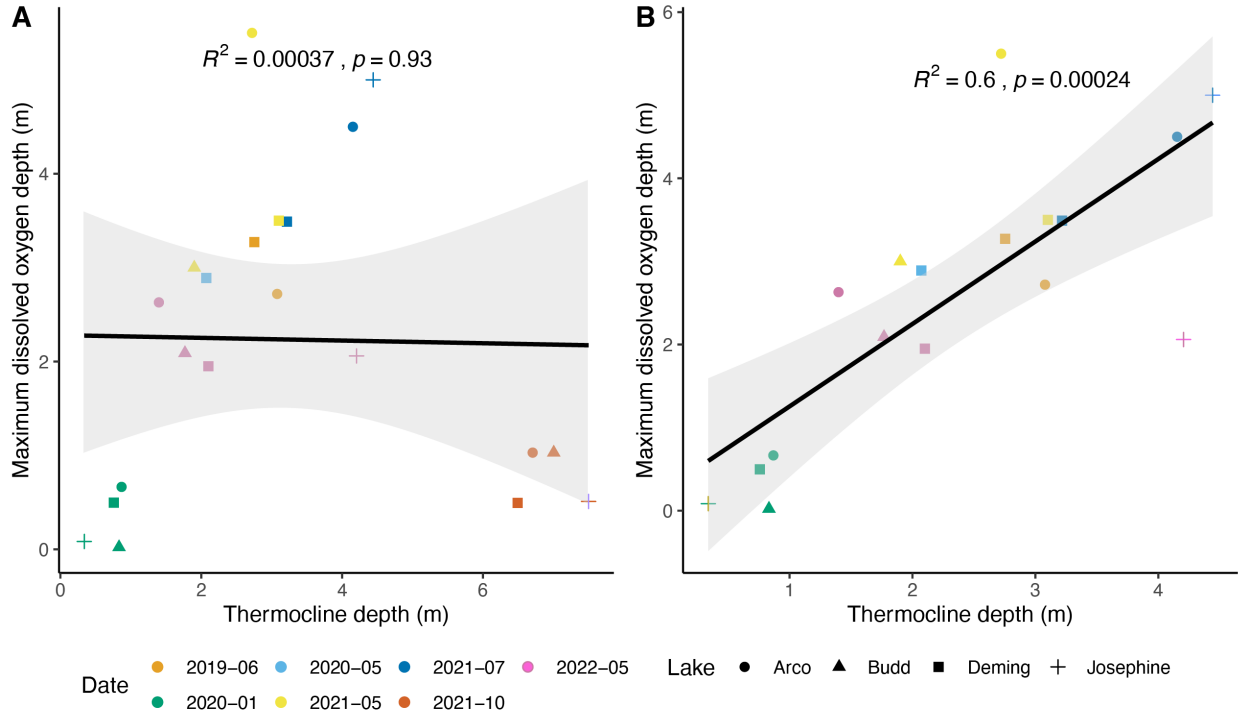
Supplementary Figure 19. Co-variation between the thermocline depth and the depth of the maximum in dissolved oxygen, and the SCML. Panel A includes data from all dates, and panel B lacks data from October 2021. The correlation is significant when October 2021 datapoints are removed.