Unusually late occurrence of a *Dolichospermum* bloom in a Nova Scotia lake

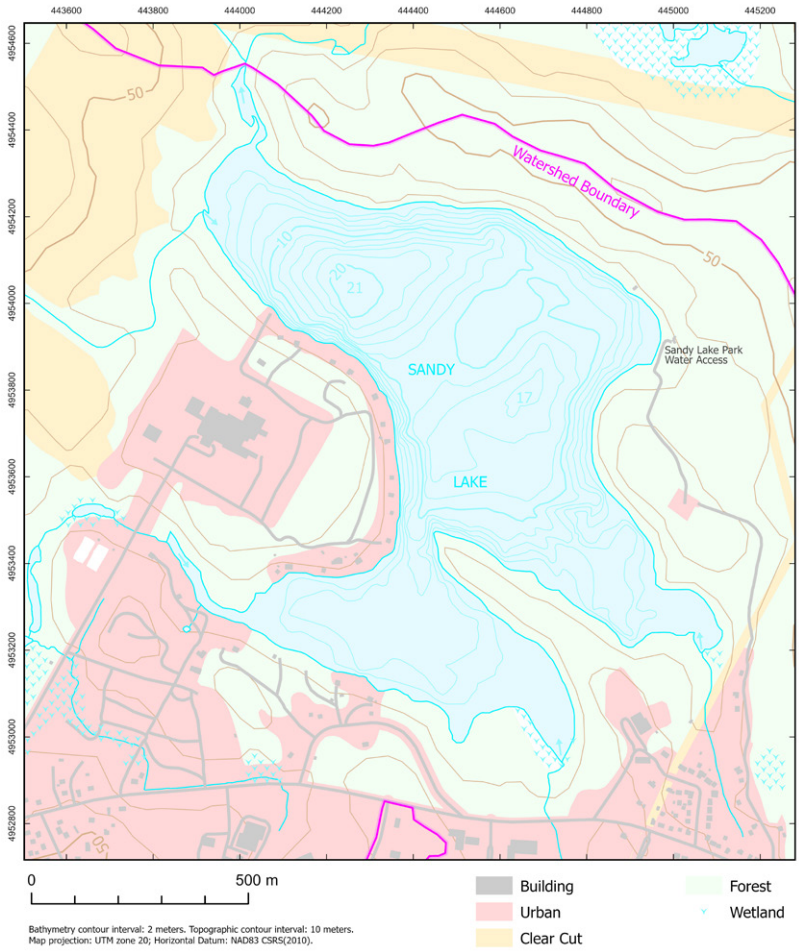

Fig. 1. Map of Sandy Lake.

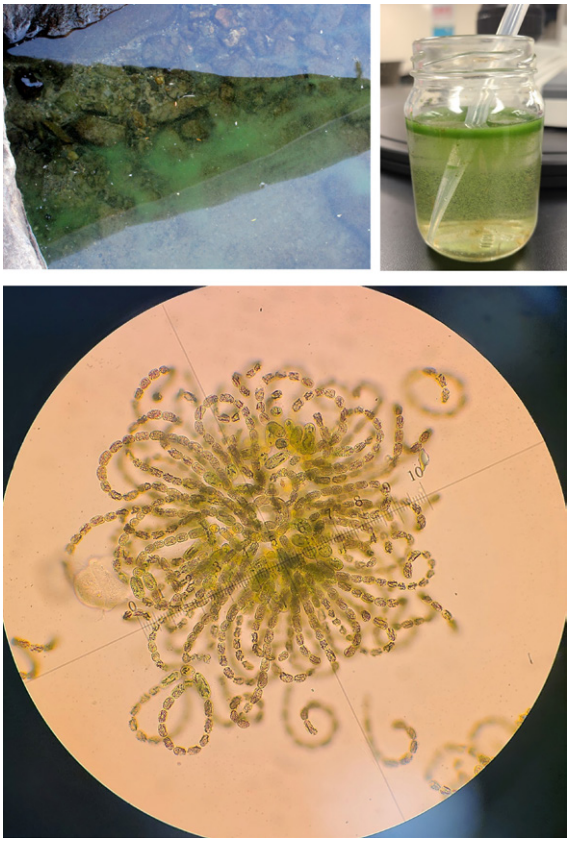

Fig. 2. Top Left image shows the occurrence of the November 6, 2024 Dolichospermum *bloom along the Sandy Lake shoreline. Top Right image shows the sample collected from the lake. Bottom image shows light microscopy image (100x power) of a cluster of* Dolichospermum *sp. cells from Sandy Lake (Bedford).*

Dolichospermum (formerly *Anabaena*) is a cosmopolitan buoyant N-fixing cyanobacterial genus found in Canadian lakes. *Dolichospermum* sp. can be very productive under high-P conditions with prolonged thermal stratification [1]. *Dolichospermum* blooms can lead to the production of numerous secondary cyanotoxin metabolites, including anatoxins, saxitoxins, microcystins, cytotoxins, and dermatoxins [1]. Cyanobacterial algae blooms in Nova Scotia lakes typically occur between June and September [2]. Here, we report an unusually late *Dolichospermum* bloom in an eastern Canadian lake.

Sandy Lake is a small urban dimictic freshwater lake (74 ha, 5.1×10^6 m^3, maximum depth of 22 m, 44.737750N, 63.704345W) located in Bedford, Halifax Regional Municipality (HRM) (Fig. 1). Sandy Lake has had only a single government report of an unspecified algal bloom in June 2022 [2]. Sandy Lake is a popular destination with a swimming beach, hiking trails throughout the watershed, dog walking (and dog wading) as well as boating and angling. The Sandy Lake watershed contains a mix of businesses (a dairy cooperative, two small technology services and several small stores), residential areas and a designated protection area under consideration [3]. Annual limnological observations have been collected on Sandy Lake since 2017 by DP [4] with the help of volunteers from the Sandy Lake Conservation Association [5], and since 2022 with the support of the HRM "LakeWatchers" program [6]. There are several major roads along the southern portion of the lake (Fig. 1) treated with road salt and other de-icing chemicals in the winter [7]. Finally, the major Tantallon forest fire of 2023 [8] affected a small portion of the watershed leading to Sandy Lake.

On November 6, 2024, a resident, D.S., noticed a distinctive array of blue-green growths floating in shallow water along the western shore of the lake (Fig. 2) and immediately collected a small sample for identification. The next day, the growth visibly disappeared. Given the very short temporal nature of this event, we were unable to sample the lake more thoroughly during the bloom event. After examining the sample under a light microscope a few days later, we were able to identify the algae as *Dolichospermum lemmermannii* (Fig. 2).

The weather on November 6th was unseasonably warm and sunny, with air temperatures reaching 20°C in the Halifax area; however, the next day, air temperatures fell to 7°C. On prior dates, volunteers measured surface water temperatures on October 2 (18.9°C) and November 3 (10.5°C). We do not have day-of-sampling water quality or toxin data because we did not have the necessary equipment ready at hand

Table 1. Historical trends of total phosphorus for Sandy Lake, Bedford. Data compiled by D. Patriquin. from unpublished consulting reports & HRM Lakewatchers Program datasets.

Date	Surface (0.5) TP mg/L	Deep (>15 m) TP mg/L
Sept 3, 2008	11	15
May 24, 2010	10	26
August 8, 2011	6	5
August 16–23 2021	~8.0	~23
August 22, 2022	-	4.7
August 14, 2023	8.8	8.7
August 12, 2024	5.2	40

when the bloom was observed.

The last water quality profile collected for the lake was on August 12, 2024 (Fig. 3). On this date, chlorophyll-a concentrations at the surface (6.85 µg L^{-1}) were higher than Chl-a at 20 m (1.48 µg L^{-1}), while total phosphorus (TP) trends were reversed with lower concentrations at surface (5.2 µg L^{-1}) compared to 20 m (40 mg L^{-1}). Specific conductivity was higher (170–185 mS/cm) in deeper layers below 16 m (Fig. 4) which also had hypoxic (DO < 2 mg/L, 9 – 6% saturation) and acidic (pH 6.5-6.7) conditions, compared the more oxygenated surface waters (8.3 mg L^{-1} DO, 10% saturation, ~175 mS/cm, pH 7, respectively; Fig. 3). We also note that the TP concentration at 20 m for August 2024 is highest-ever measured for Sandy Lake compared to historical TP values (see Table 1).Hypoxic (<2–3 mg L^{-1}) and acidic conditions in deeper waters can lead to the release of internal P, Fe and Mg from sediments [9] during prolonged stratification events. We suspect that as surface water cooled to 10°C in November from 24°C in August, there was a sudden destratification event leading to deeper water containing higher TP being mixed throughout the water column. This would have led to the sudden expansion of the N-fixing *Dolichospermum* bloom very late in the season. As a result, an early-warning monitoring framework [e.g., 10] implemented over a longer seasonal period (April – November) is recommended for Sandy Lake and other urban lakes in Nova Scotia.

Acknowledgements

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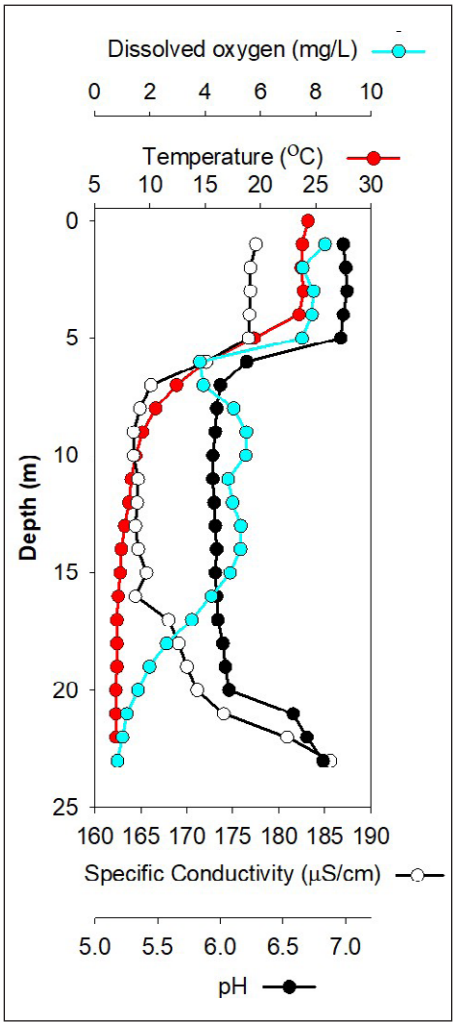

Fig. 3. A water quality depth profile for Sandy Lake (Bedford, HRM, Nova Scotia) for August 12, 2024. The colours of symbols and lines are next to the X-axis label for each corresponding parameter. Secchi depth, 2.2 m. Water quality information for surface: 5.2 µg L^{-1} total phosphorus, 6.85 µg·L^{-1} chlorophyll-a, no chloride measurements. At 20 m depth: 40 mg L^{-1} TP, 1.48 µg·L^{-1} Chl-a and 36 mg·L^{-1} Cl.

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