第Ⅱ部門

Effect of Submerged Aquatic Vegetation on Water and Sediment Environment in the Southern Part of Lake Biwa -2023 Field Investigation and Laboratory Experiment-

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1. Introduction

In recent years, submerged aquatic vegetation (SAV) in the southern part of Lake Biwa has thrived during the summer since a severe drought in 1994. The Shiga Prefecture has been organizing SAV removal efforts. However, the complex effects of SAV on the lake's ecosystem, including dissolved oxygen (DO) production and consumption, nutrient exchange, light competition, and organic matter accumulation, have not been wholly explained[1]. This research conducted field surveys and water and sediment sampling in the southern part of Lake Biwa in 2023 to investigate the effects of SAV on the water and sediment environment.

2. Method

The field surveys were conducted by boat on July 12, August 2, September 1, and September 27, 2023. The vertical profiles of water temperature, chlorophyll, and DO were measured by a water quality profiler (Hydrolab, DS5X) at ten stations, as shown in **Fig.1.** Two underwater cameras oriented in different directions with lighting equipment were installed to capture videos of the SAV situation. Surface and bottom water and sediment were also sampled. An autoanalyzer (BLTEC, SWAAT) was used to analyze nitrogen and phosphorus concentrations. Ignition loss (IL) of the sediment samples was assessed by dry ashing processes with an electric furnace at 600°C for 2h.

3. Results and Discussion

(1) SAV growth and relationship to water quality

Table 1 summarizes SAV density at stations 2, 5, 8in, and 8out by video analysis. **Figure 2** shows the vertical profiles of DO, temperature, and chlorophyll at the same stations.

The observational results indicated that in the areas with lush SAV, the vertical profiles of DO, temperature, and chlorophyll decreased with depth.

Figure 1 Station information and equipment images. (a) station information, (b) underwater camera setup, (c) water quality profiler, (d) autoanalyzer, (e) electric furnace

Station	SAV Situation	Remark
Sta.2	Sparse	Situated near the navigation route.
Sta.5	No	Covered with "Lyngbya" in bottom.
Sta.8in	Lush	Behind a reclaimed island, water chestnut covered.
Sta.8out	No	Behind a reclaimed island, without water chestnut.

Table 1 SAV situation at four selected stations.

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In contrast, these parameters remained nearly constant in areas with no or sparse SAVs. However, chlorophyll showed an unexplained increase near the bottom at Stations 2 and 5. Benthic algae were not recorded on the video, but the algae or phytoplankton in the bottom may increase the concentration. Water chestnut covered surface at Stations 8in and 8out is close to there but outside the vegetation area. Although the profiles of temperature were similar, surface temperature was higher in the zone than outside in August. It would be caused by water chestnut coverage, resulting in a substantial decrease in bottom DO.

Figure 3 shows the nitrogen and phosphorus concentrations at the four stations. Bottom nutrient concentrations were higher at both stations 8in and 8out than those in other stations and the surface.

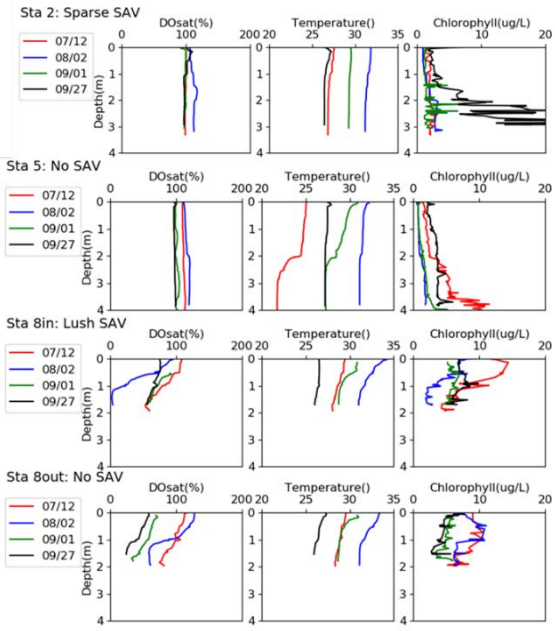

Figure 2 Vertical profiles of DO, water temperature, and chlorophyll in Sta. 2, Sta. 5, Sta. 8in, Sta. 8out.

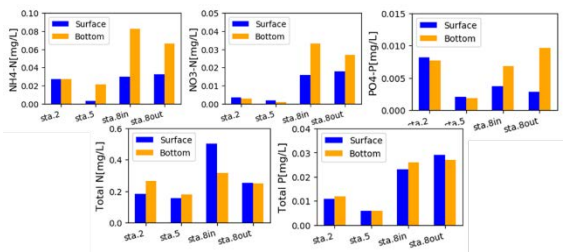

Figure 3 NH_4-N, NO_3-N, Total N, PO_4-P, and Total P concentrations at the four stations.

(2) Effects on Sediment Environment

Figure 4 shows the IL of the sediment at 10 stations. Although we hypothesized that the debris of SAV after death might affect the accumulation of organic matter in the sediment, IL showed a wide variation from 9% to 14% and was not correlated with vegetation growth. IL at Sta. 5 was highest and attributable to the presence of Lyngbya, which was contained in the sediment sample. This influence is difficult to eliminate in the experiments.

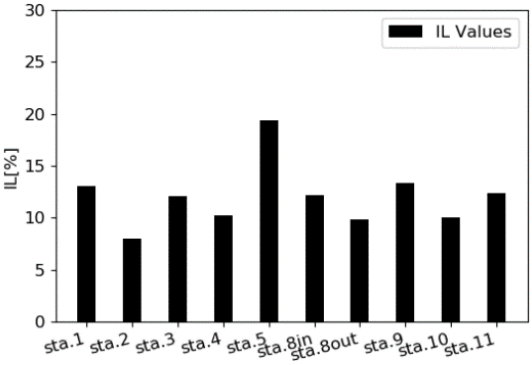

Figure 4 Ignition Loss values at ten stations.

4. Conclusion

This research focused on investigating the impacts of SAV on the water and sediment environment in the southern part of Lake Biwa, based on a series of field surveys and laboratory experiments in 2023. The results revealed that lush SAV can influence the vertical profiles of DO, water temperature, and chlorophyll. Additionally, areas with lush SAV tended to have higher concentrations of nutrients. However, the IL experiment did not reveal a definitive impact of lush SAV on the organic matter content in sediments.

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References

[1] Tiago Finkler Ferreira et al., The structuring role of submerged macrophytes in a large subtropical shallow lake: Clear effects on water chemistry and phytoplankton structure community along a vegetated-pelagic gradient, *Limnologica*, 2018.