



COMPARATIVE EFFICIENCY OF AQUATIC PLANTS IN IMPROVING WATER QUALITY ALONG NATURAL FLOW SYSTEMS AT THAKSIN UNIVERSITY, PHATTHALUNG CAMPUS

PAPHAYOM PHITTAYAKOM SCHOOL

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ABSTRACT

Natural water filtration is a key component of sustainable ecosystem management, but not all plants perform the same role. A recent study conducted at Thaksin University, Phatthalung Campus, explored how different aquatic plant communities influence water quality along a natural flow system.

The Study

Researchers monitored freshwater channels dominated by three distinct plant types:

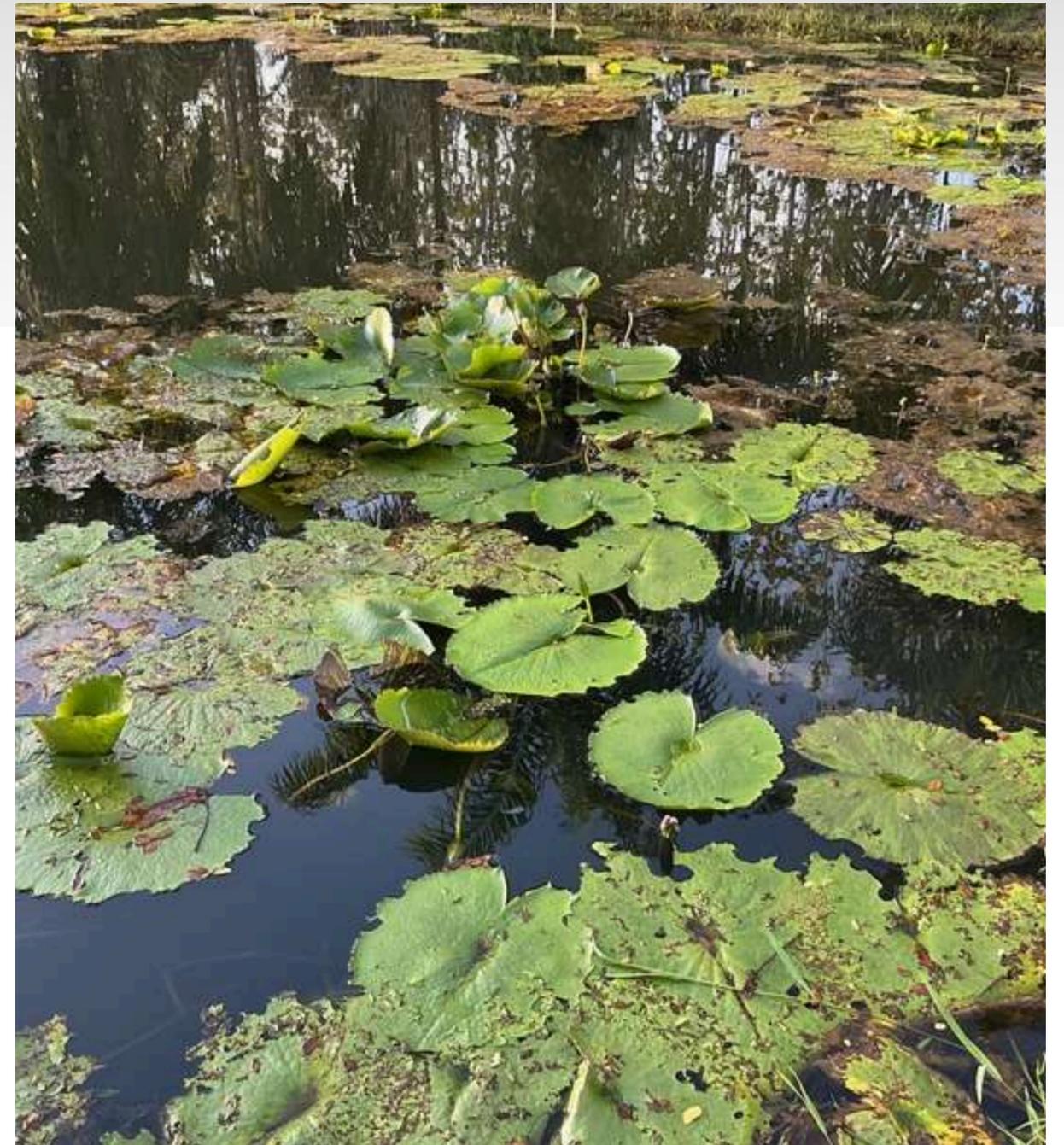
1. **Leafy Bladderwort** (*Utricularia aurea* Lour)
2. **Lotus** (*Nelumbo* sp.)
3. **Yellow Velvet Leaf** (*Limnocharis flava*)

Data was collected during three key seasonal periods: the early rainy season (October 2025), the flood period (November 2025), and the cool/dry period (January 2026). The team measured five critical water quality indicators—Dissolved Oxygen (DO), Electrical Conductivity (EC), Total Dissolved Solids (TDS), temperature, and pH—at upstream, midstream, and downstream points.

Key Findings: Not All Plants Are Equal

The study revealed that while the type of plant community did not significantly alter Dissolved Oxygen (DO) or pH levels, it had a major impact on Electrical Conductivity (EC), TDS, and water temperature. The **Leafy Bladderwort** and **Lotus** communities acted as effective natural filters. As water flowed through these reaches, measurements showed a trend of reduced EC and TDS, indicating an improvement in water quality.

• **The Outlier:** In contrast, the **Yellow Velvet Leaf** reach showed significantly higher EC, TDS, and water temperatures compared to the other two. Instead of filtering, this community frequently resulted in increased dissolved solids as water flowed downstream.



RESEARCH QUESTION

01

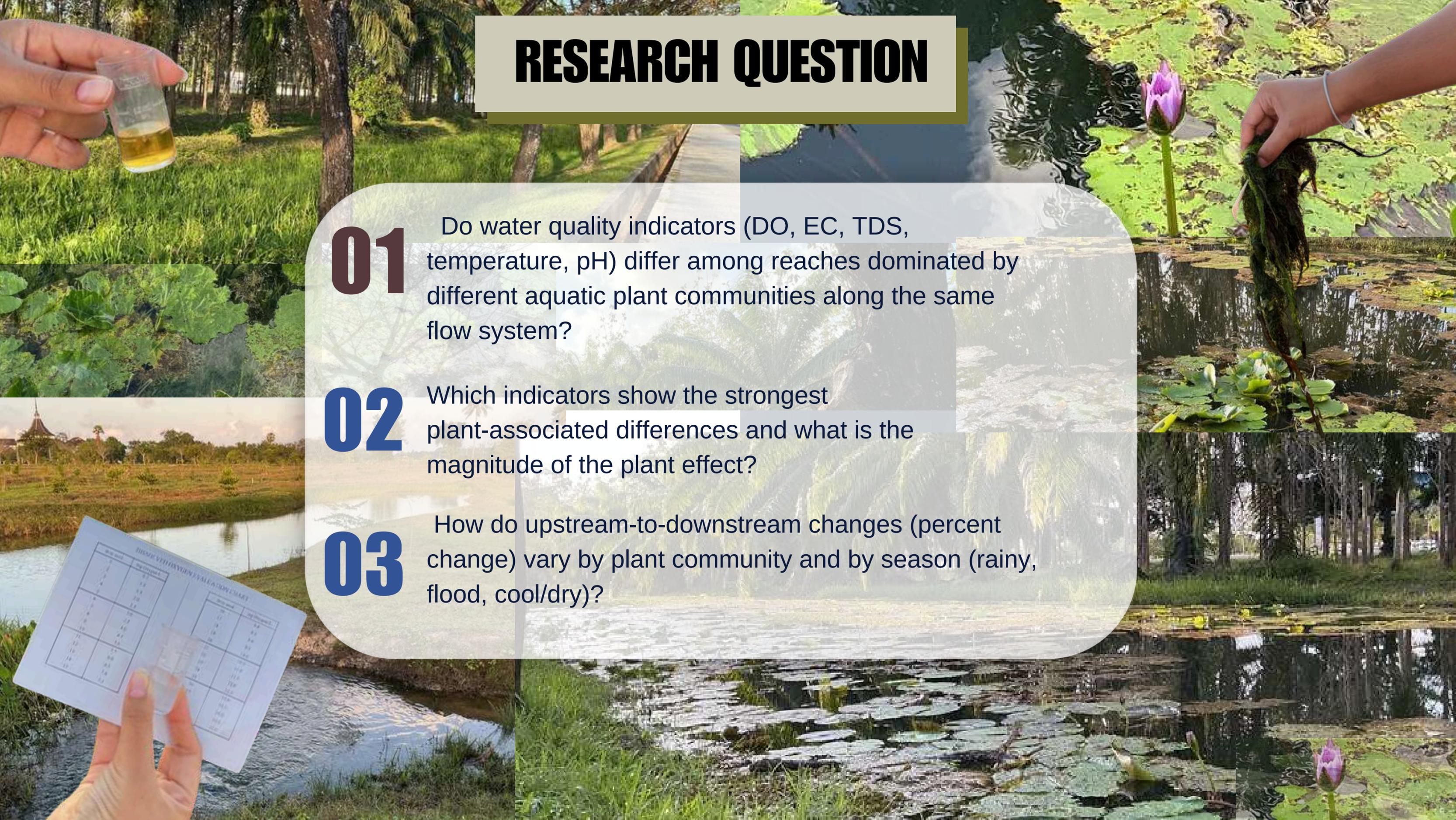
Do water quality indicators (DO, EC, TDS, temperature, pH) differ among reaches dominated by different aquatic plant communities along the same flow system?

02

Which indicators show the strongest plant-associated differences and what is the magnitude of the plant effect?

03

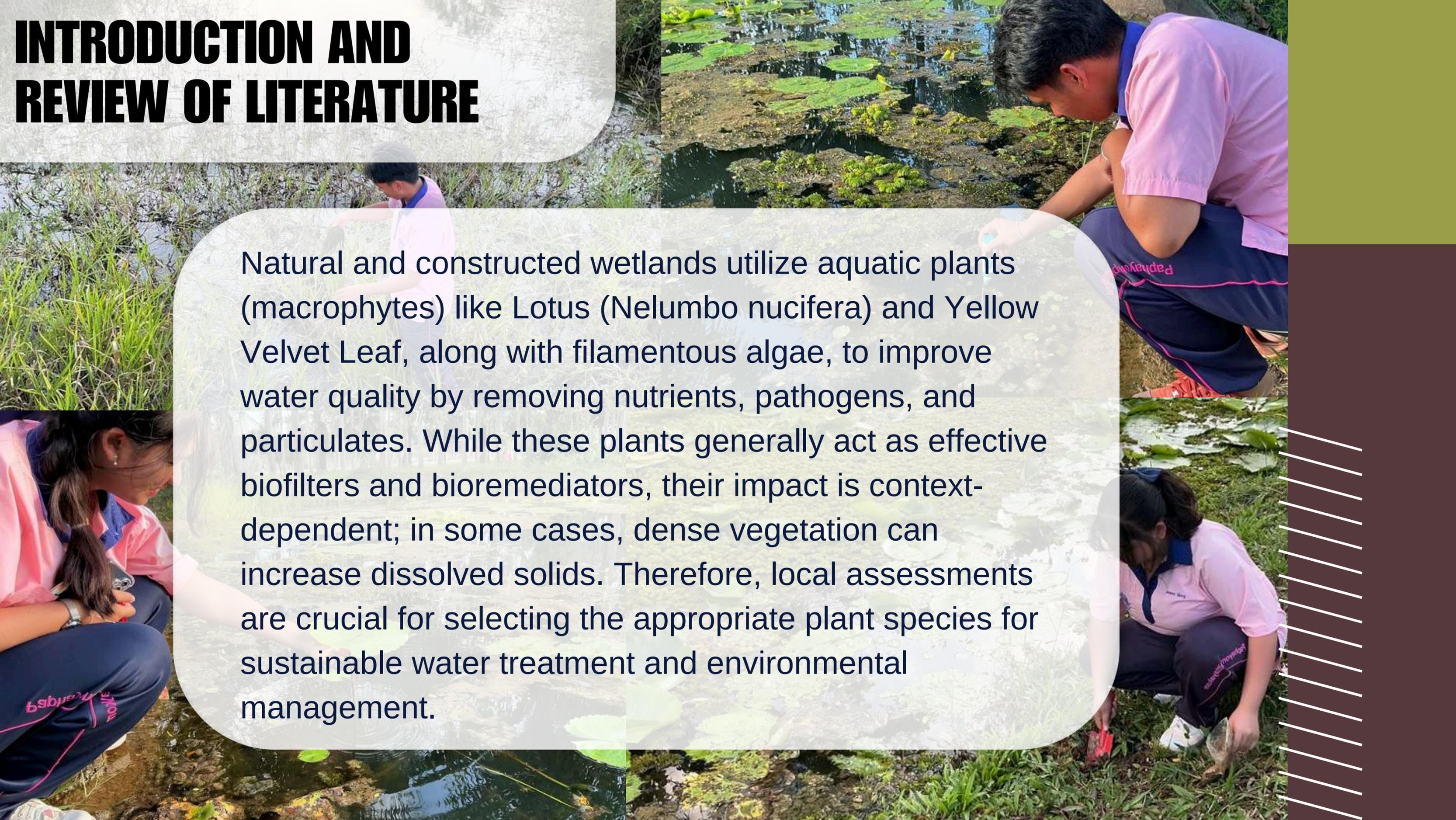
How do upstream-to-downstream changes (percent change) vary by plant community and by season (rainy, flood, cool/dry)?



Station	DO (mg/L)	EC (µS/cm)	TDS (mg/L)	Temp (°C)	pH
1	8.5	150	120	25	7.2
2	7.8	180	140	26	7.1
3	7.2	210	160	27	7.0
4	6.5	240	180	28	6.9
5	5.8	270	200	29	6.8
6	5.2	300	220	30	6.7
7	4.5	330	240	31	6.6
8	3.8	360	260	32	6.5
9	3.2	390	280	33	6.4
10	2.5	420	300	34	6.3

INTRODUCTION AND REVIEW OF LITERATURE

Natural and constructed wetlands utilize aquatic plants (macrophytes) like Lotus (*Nelumbo nucifera*) and Yellow Velvet Leaf, along with filamentous algae, to improve water quality by removing nutrients, pathogens, and particulates. While these plants generally act as effective biofilters and bioremediators, their impact is context-dependent; in some cases, dense vegetation can increase dissolved solids. Therefore, local assessments are crucial for selecting the appropriate plant species for sustainable water treatment and environmental management.



RESEARCH METHODS

01

Study site: The study was conducted in a connected campus water channel at Thaksin University, Phatthalung Campus, Thailand. Three consecutive reaches dominated by distinct plant communities were selected: Leafy Bladderwort reach (Site 1), Lotus reach (Site 2), and Yellow Velvet Leaf reach (Site 3). Within each reach, three sampling zones were defined: upstream (before the plant reach), midstream (within the plant reach), and downstream (after the plant reach).

02

Sampling schedule: Measurements were conducted three times to capture seasonal variability: October 2025 (early rainy season), November 2025 (flood period), and January 2026 (cool/dry period).

drop used	mg Oxygen/L	drop used	mg Oxygen/L
1	0.5	16	8.0
2	1.0	17	8.5
3	1.5	18	9.0
4	2.0	19	9.5
5	2.5	20	10.0
6	3.0	21	10.5
7	3.5	22	11.0
8	4.0	23	11.5
9	4.5	24	12.0
10	5.0	25	12.5
11	5.5	26	13.0
12	6.0	27	13.5
13	6.5	28	14.0
14	7.0	29	14.5
15	7.5	30	15.0



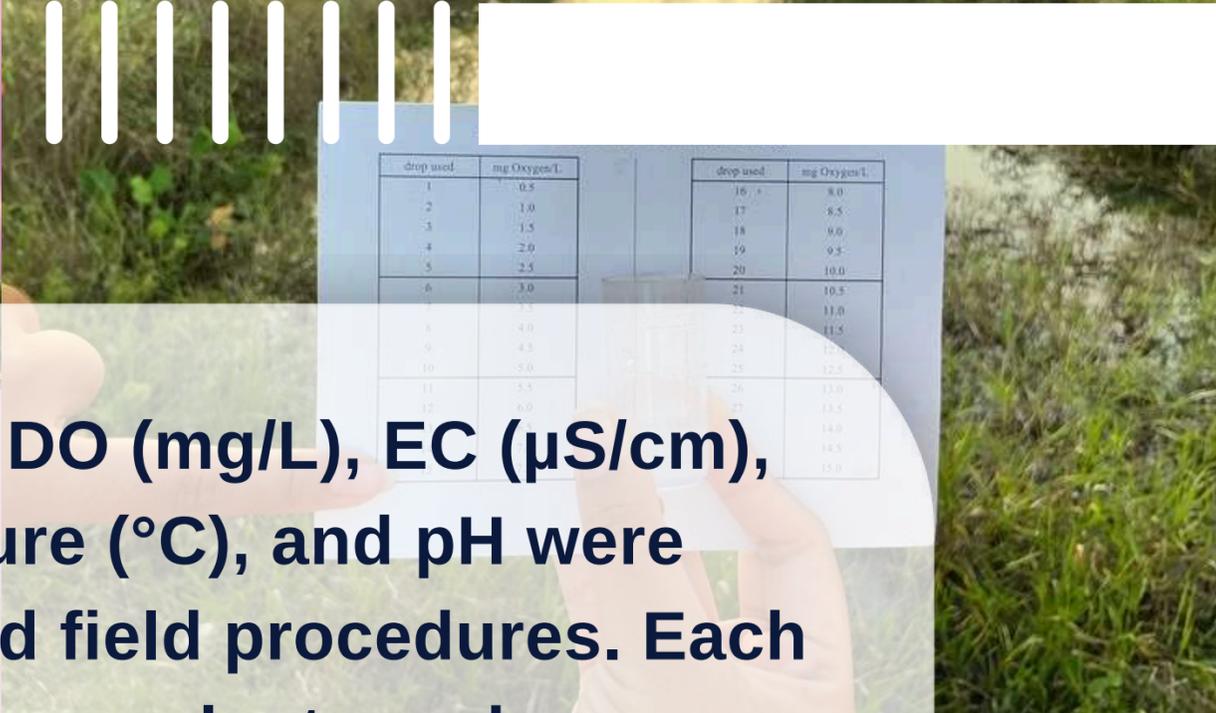
RESEARCH METHODS

03

Variables and instruments: DO (mg/L), EC ($\mu\text{S}/\text{cm}$), TDS (mg/L), water temperature ($^{\circ}\text{C}$), and pH were measured following standard field procedures. Each observation corresponds to one plant reach \times one zone \times one month (total $N = 27$).

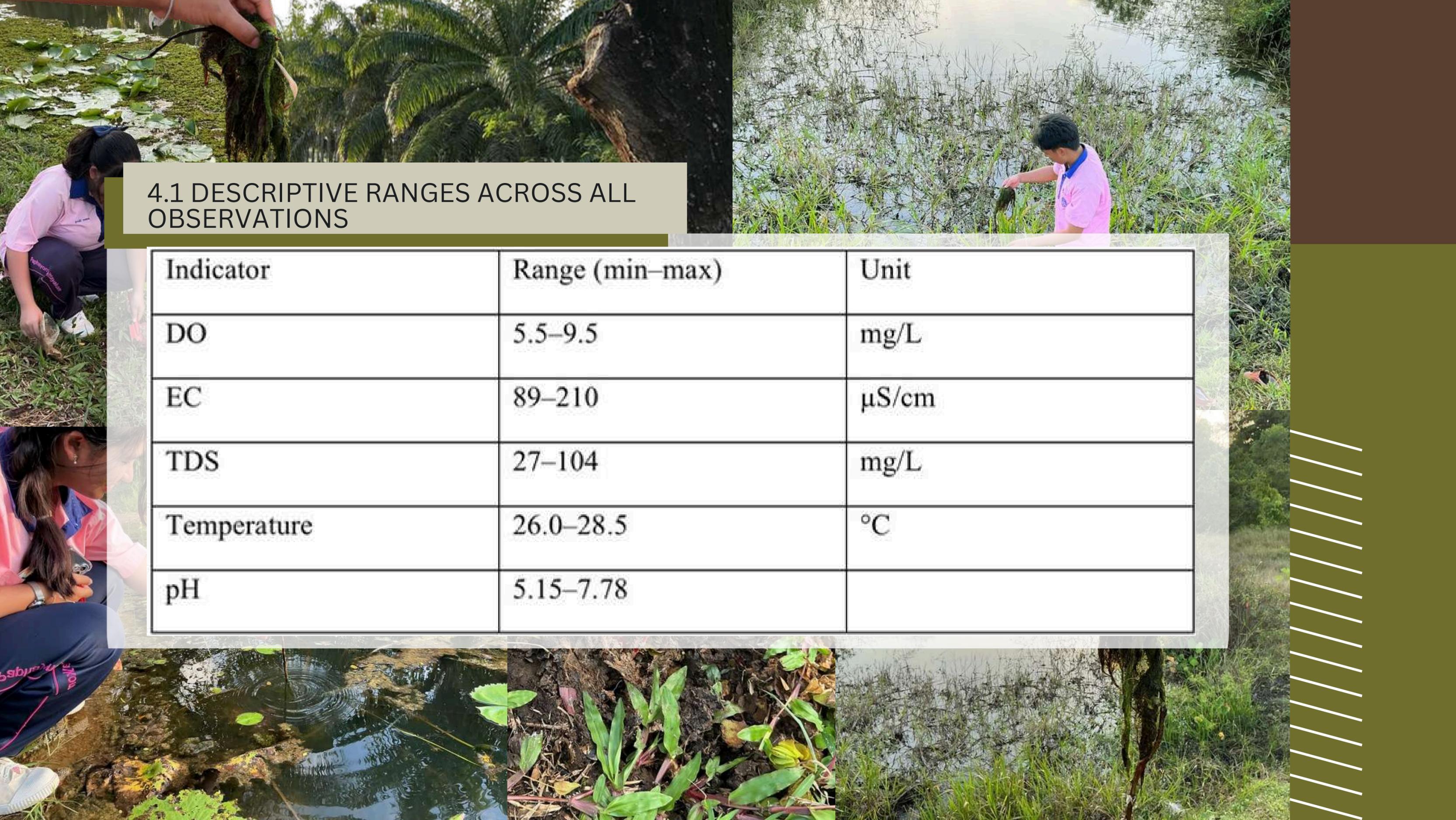
04

Statistical analysis: Descriptive statistics (mean, SD, minimum, maximum) were computed. One-way ANOVA tested differences among plant communities ($\alpha = 0.05$). Bonferroni post hoc comparisons were used to control family-wise error rate. In addition, upstream-to-downstream percent change was computed to interpret filtration-like performance along the flow path.



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7	3.5	22	11.0
8	4.0	23	11.5
9	4.5	24	12.0
10	5.0	25	12.5
11	5.5	26	13.0
12	6.0	27	13.5
			14.0
			14.5
			15.0





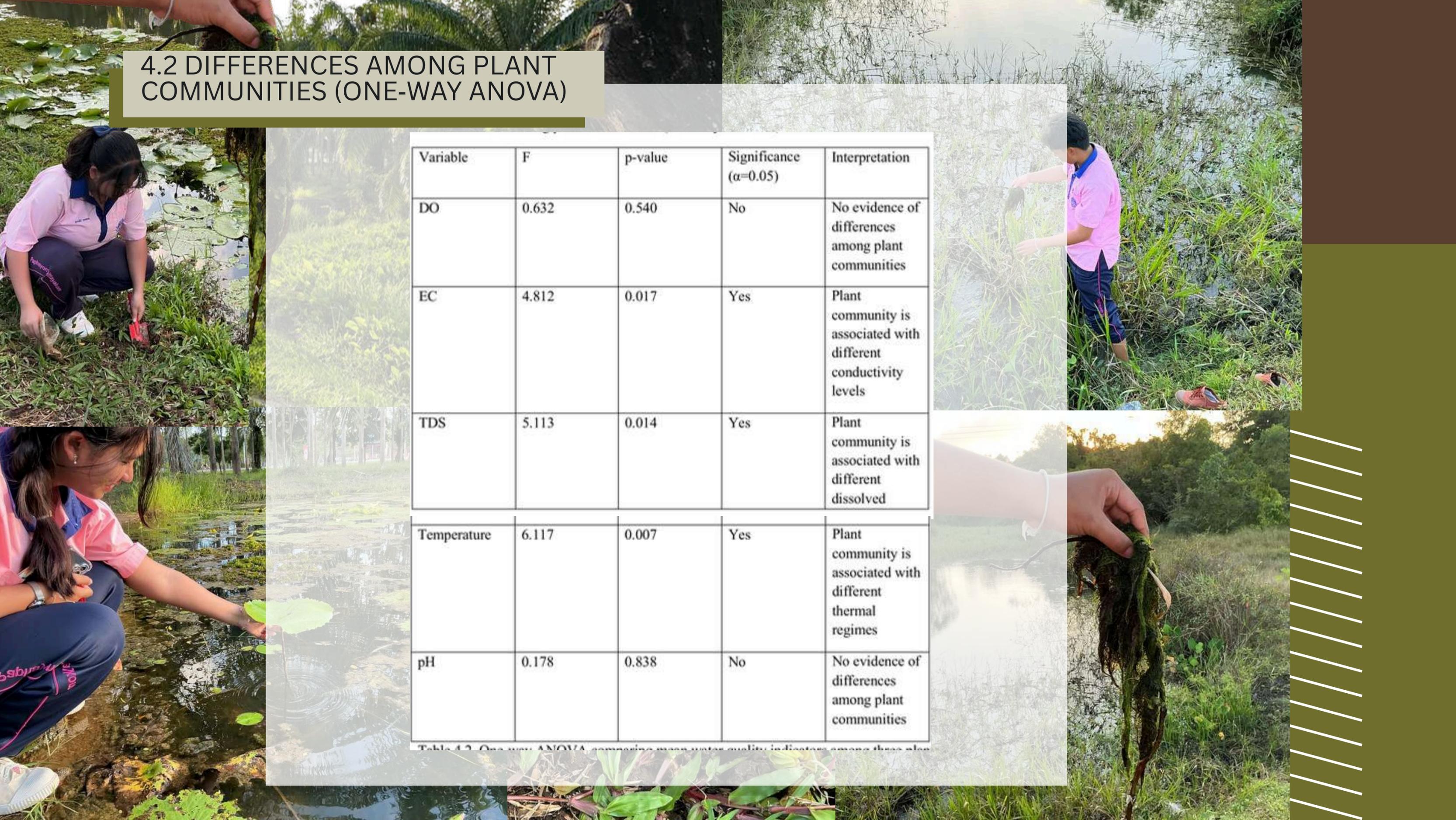
4.1 DESCRIPTIVE RANGES ACROSS ALL OBSERVATIONS

Indicator	Range (min–max)	Unit
DO	5.5–9.5	mg/L
EC	89–210	$\mu\text{S}/\text{cm}$
TDS	27–104	mg/L
Temperature	26.0–28.5	$^{\circ}\text{C}$
pH	5.15–7.78	

4.2 DIFFERENCES AMONG PLANT COMMUNITIES (ONE-WAY ANOVA)

Variable	F	p-value	Significance ($\alpha=0.05$)	Interpretation
DO	0.632	0.540	No	No evidence of differences among plant communities
EC	4.812	0.017	Yes	Plant community is associated with different conductivity levels
TDS	5.113	0.014	Yes	Plant community is associated with different dissolved
Temperature	6.117	0.007	Yes	Plant community is associated with different thermal regimes
pH	0.178	0.838	No	No evidence of differences among plant communities

Table 4.2. One-way ANOVA comparing mean water quality indicators among three plant communities.



4.3 PAIRWISE DIFFERENCES (BONFERRONI POST HOC)

Variable	Pair with significant difference	Mean difference (I-J)	p-value
EC	Leafy Bladderwort vs Yellow Velvet Leaf	-37.67	0.048
EC	Lotus vs Yellow Velvet Leaf	-40.33	0.032
TDS	Leafy Bladderwort vs Yellow Velvet Leaf	-18.00	0.012
Temperature	Leafy Bladderwort vs Yellow Velvet Leaf	-0.88	0.006

FIGURE 4.1. BOXPLOT OF DISSOLVED OXYGEN (DO) BY PLANT REACH (N = 9 PER REACH).

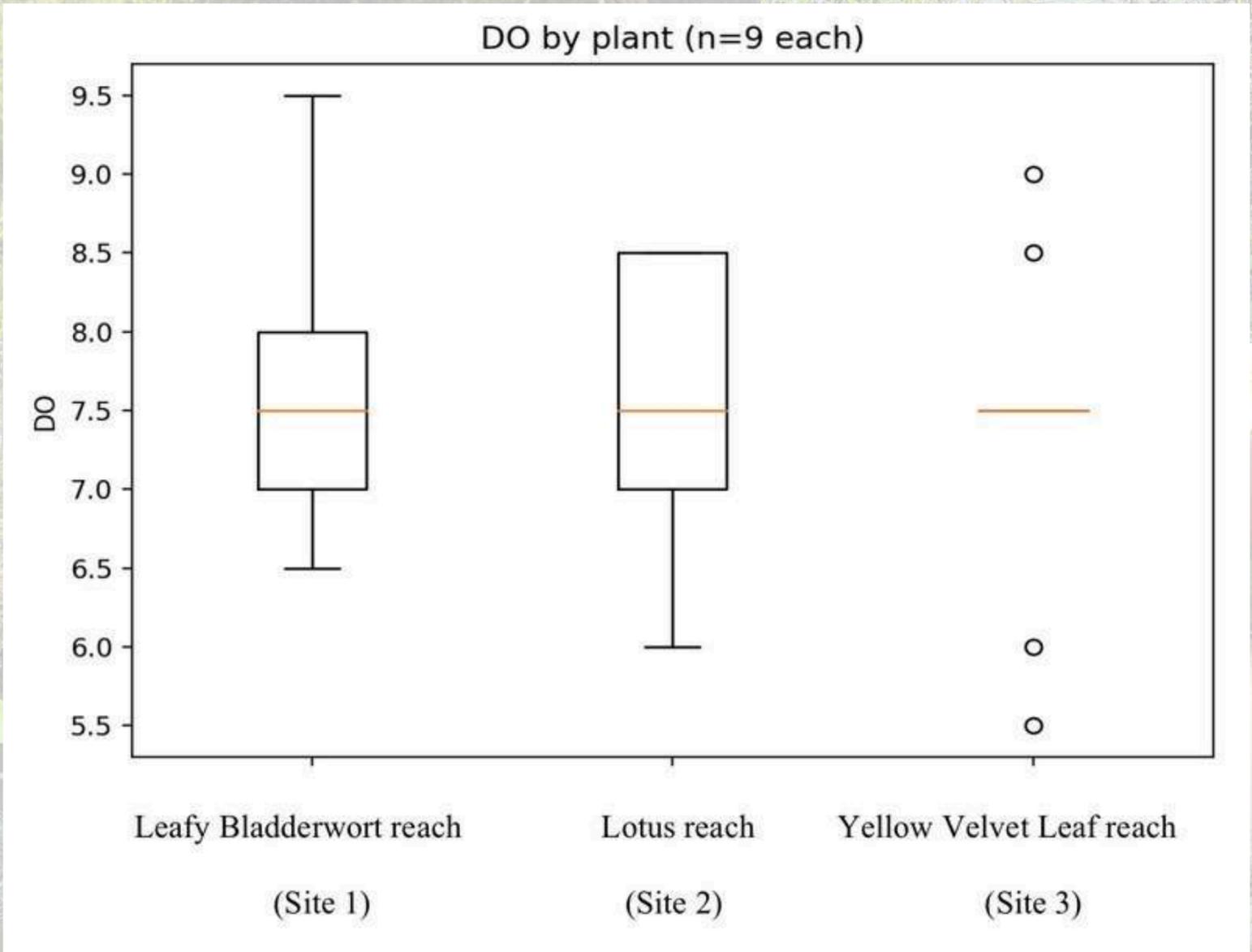


FIGURE 4.2. BOXPLOT OF ELECTRICAL CONDUCTIVITY (EC) BY PLANT REACH (N = 9 PER REACH).

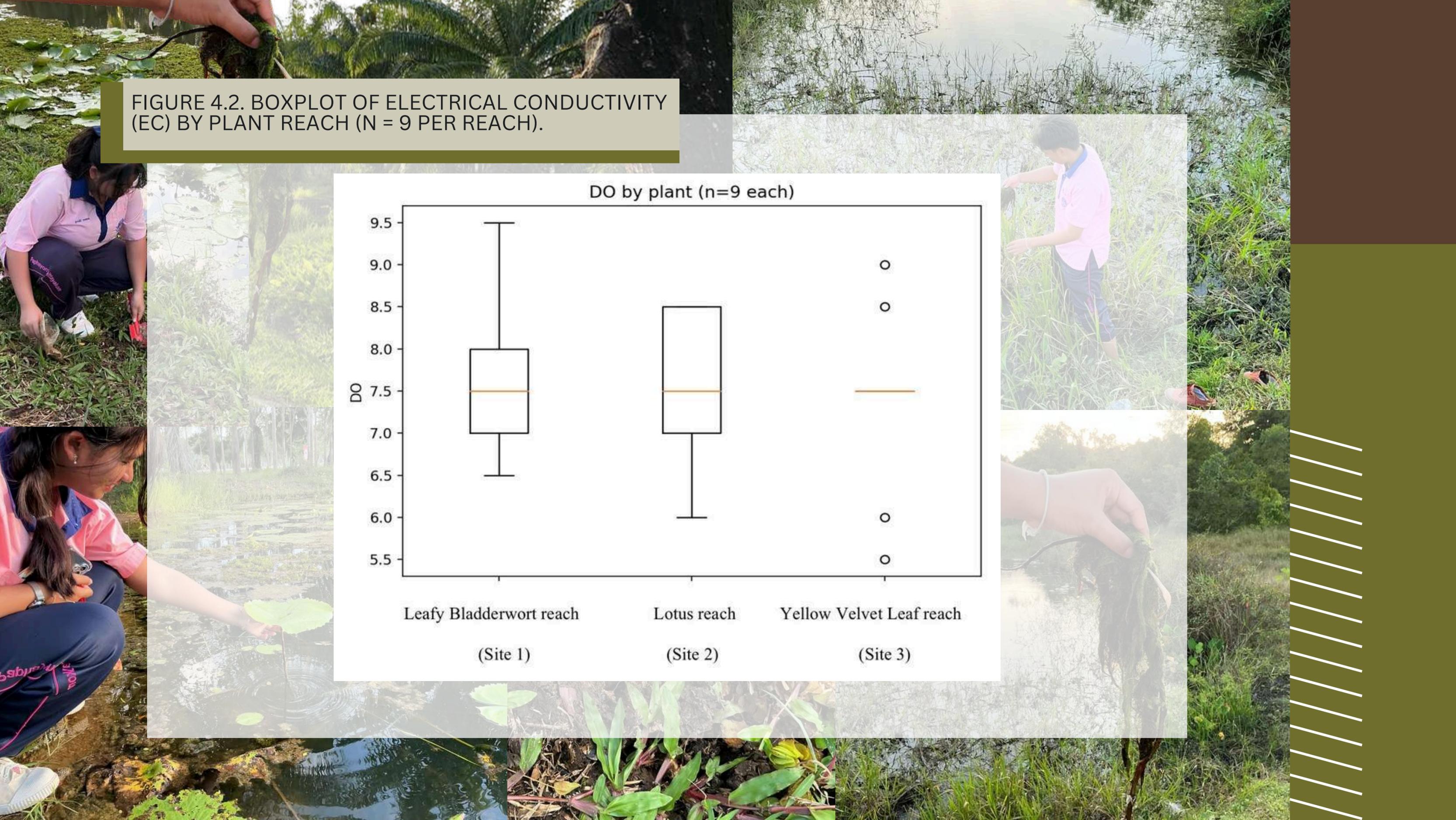
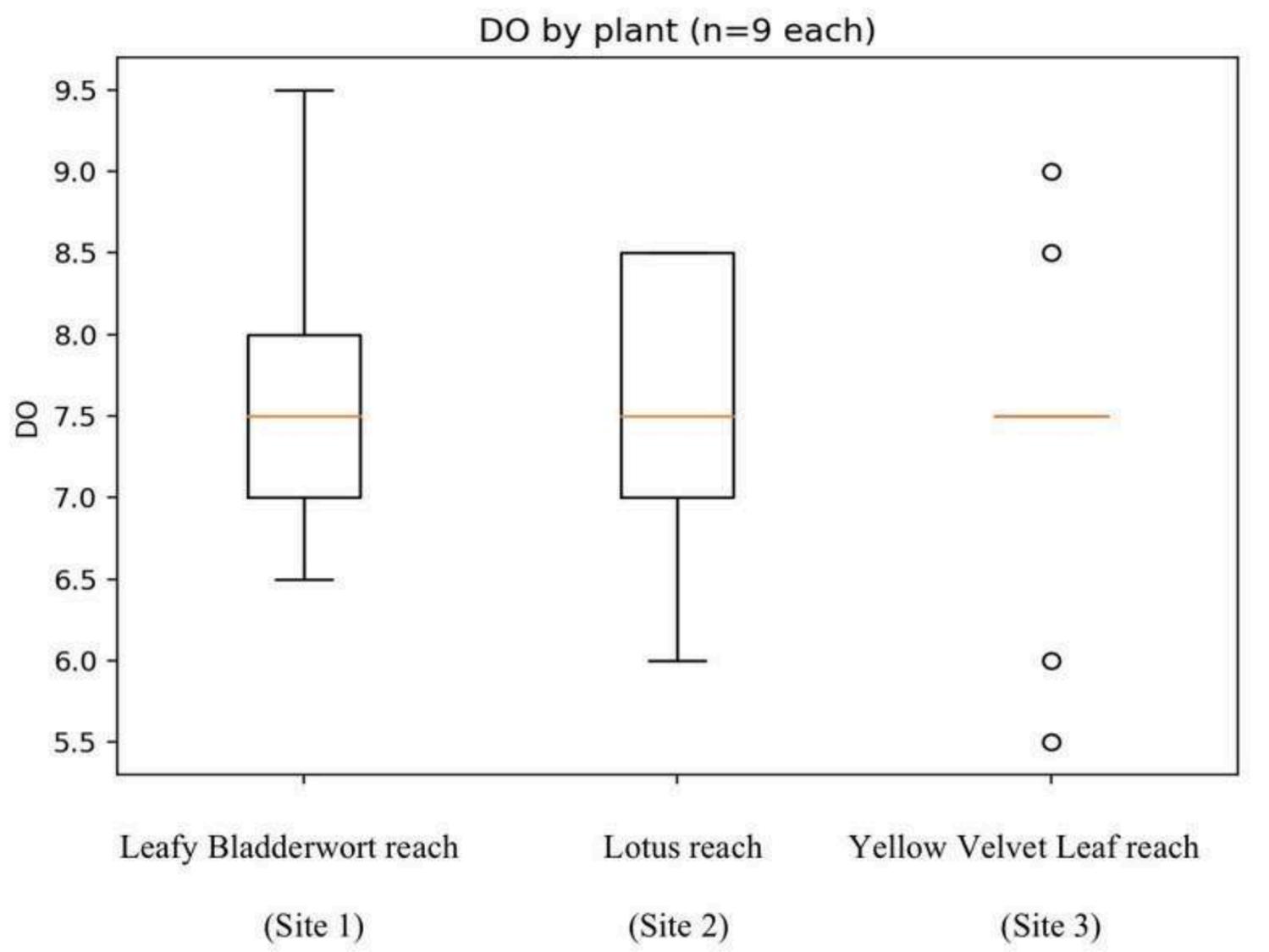


FIGURE 4.3. BOXPLOT OF TOTAL DISSOLVED SOLIDS (TDS) BY PLANT REACH (N = 9 PER REACH).

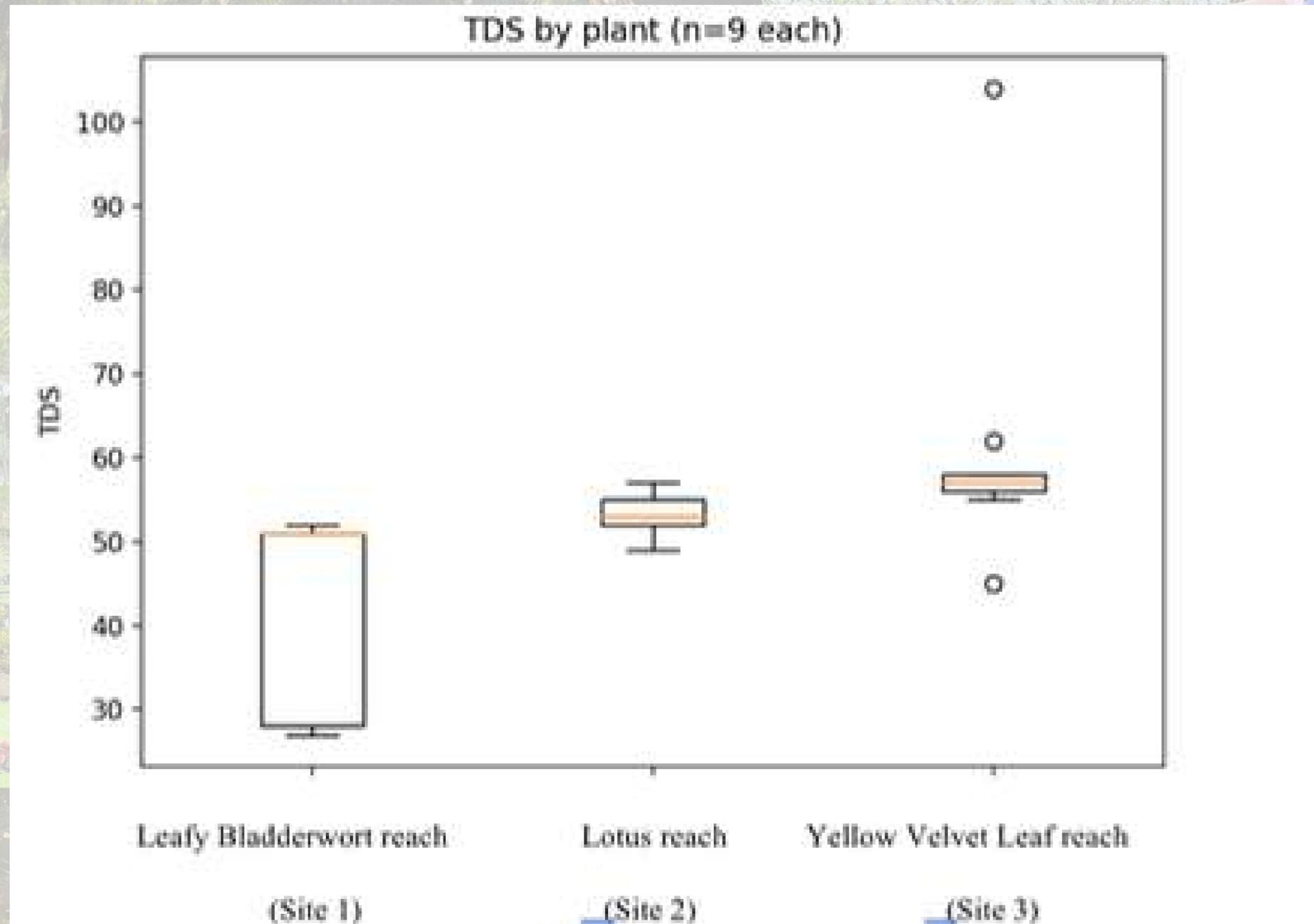


FIGURE 4.4. BOXPLOT OF WATER TEMPERATURE BY PLANT REACH (N = 9 PER REACH).

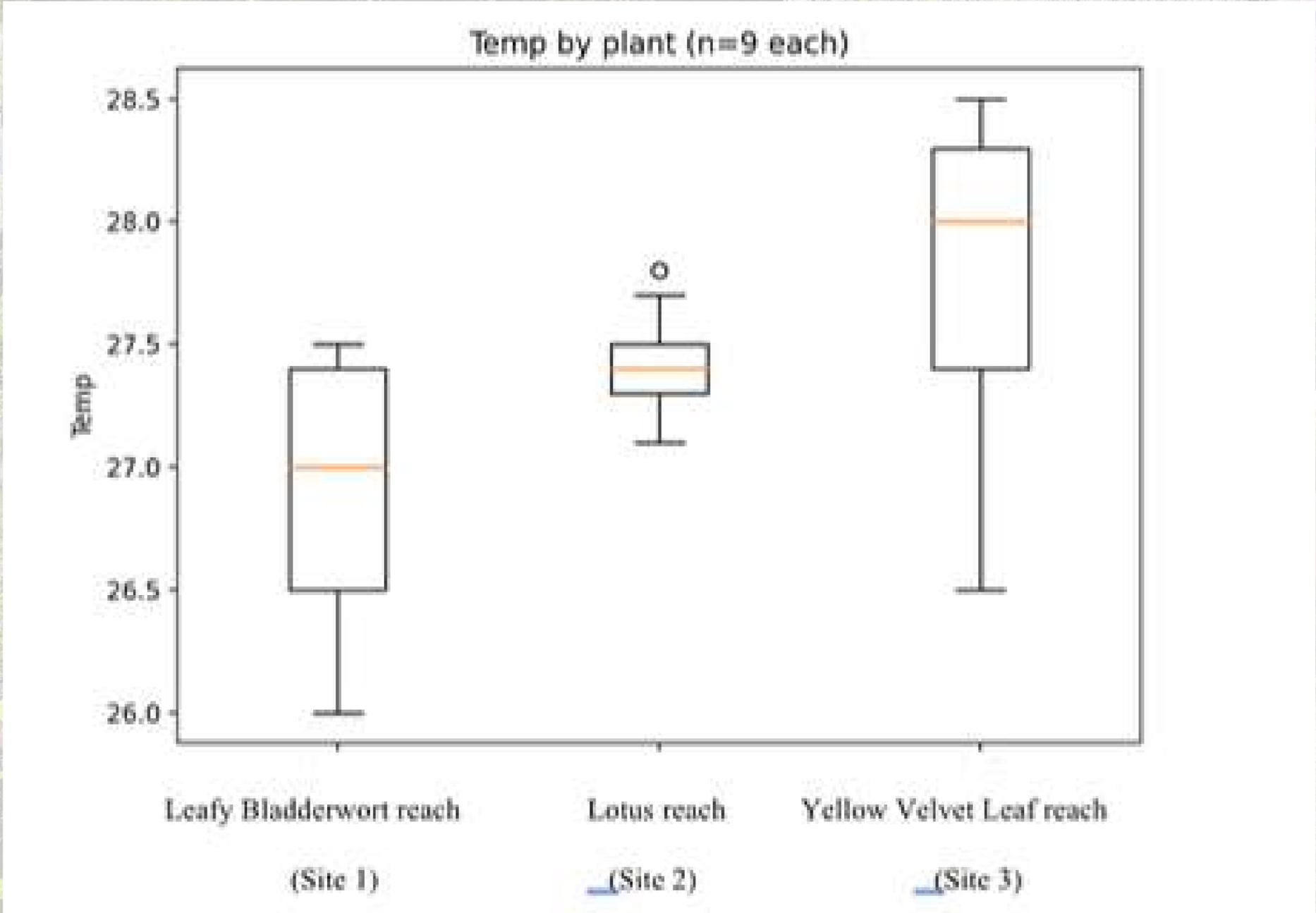


FIGURE 4.5. BOXPLOT OF PH BY PLANT REACH (N = 9 PER REACH).

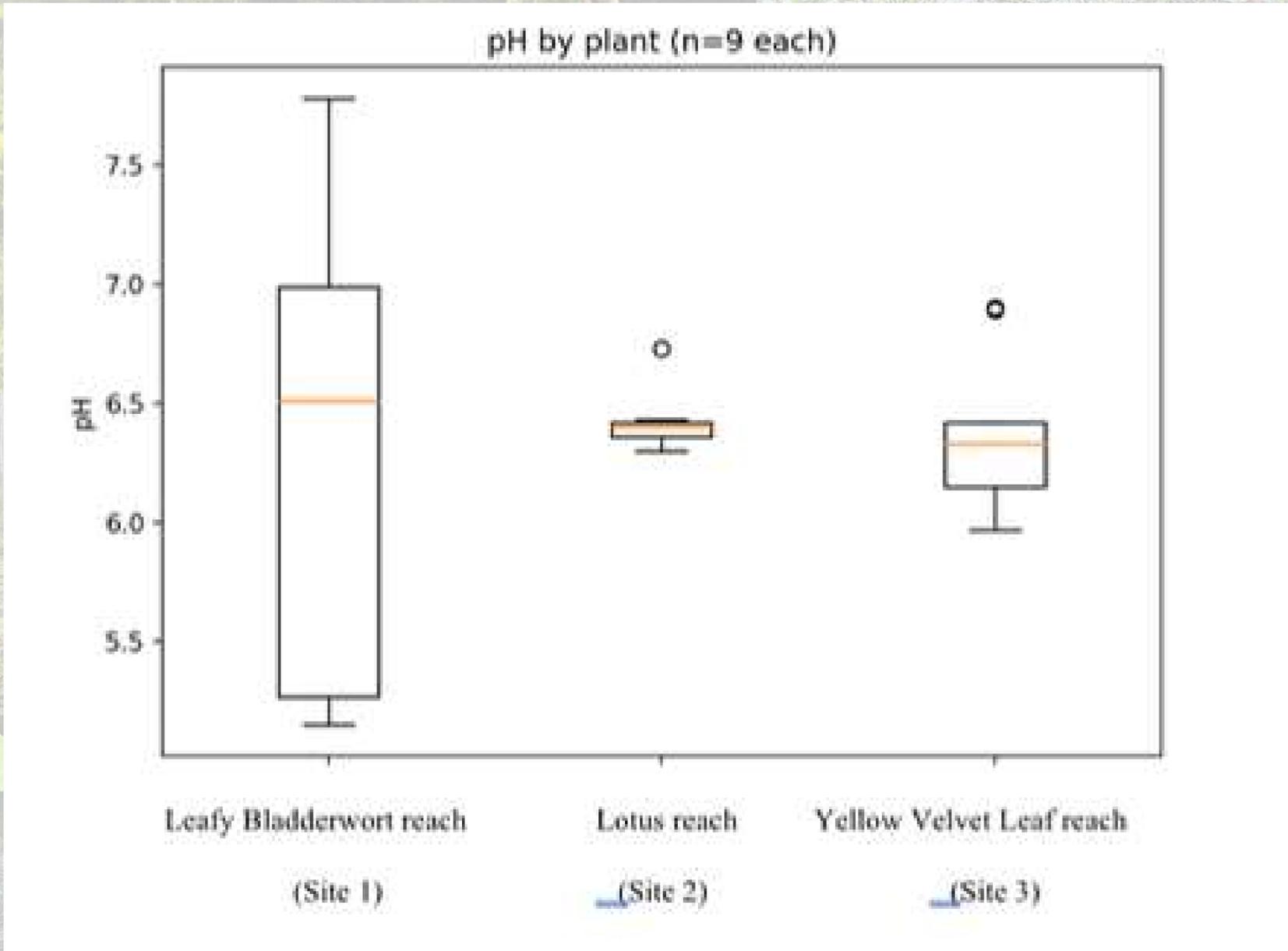


FIGURE 4.6. EC PROFILES FROM UPSTREAM TO DOWNSTREAM ZONES FOR EACH PLANT REACH ACROSS MONTHS.

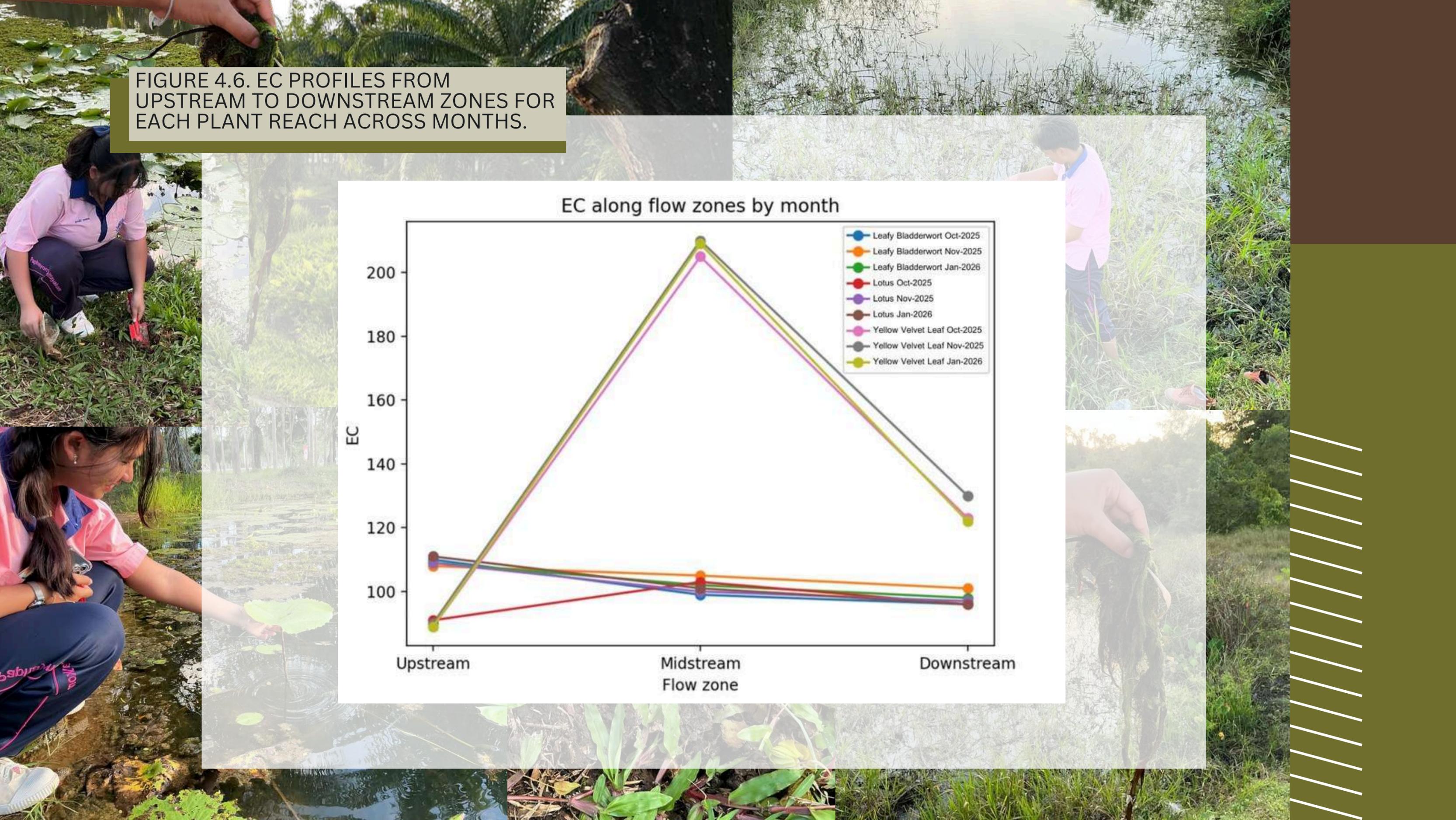
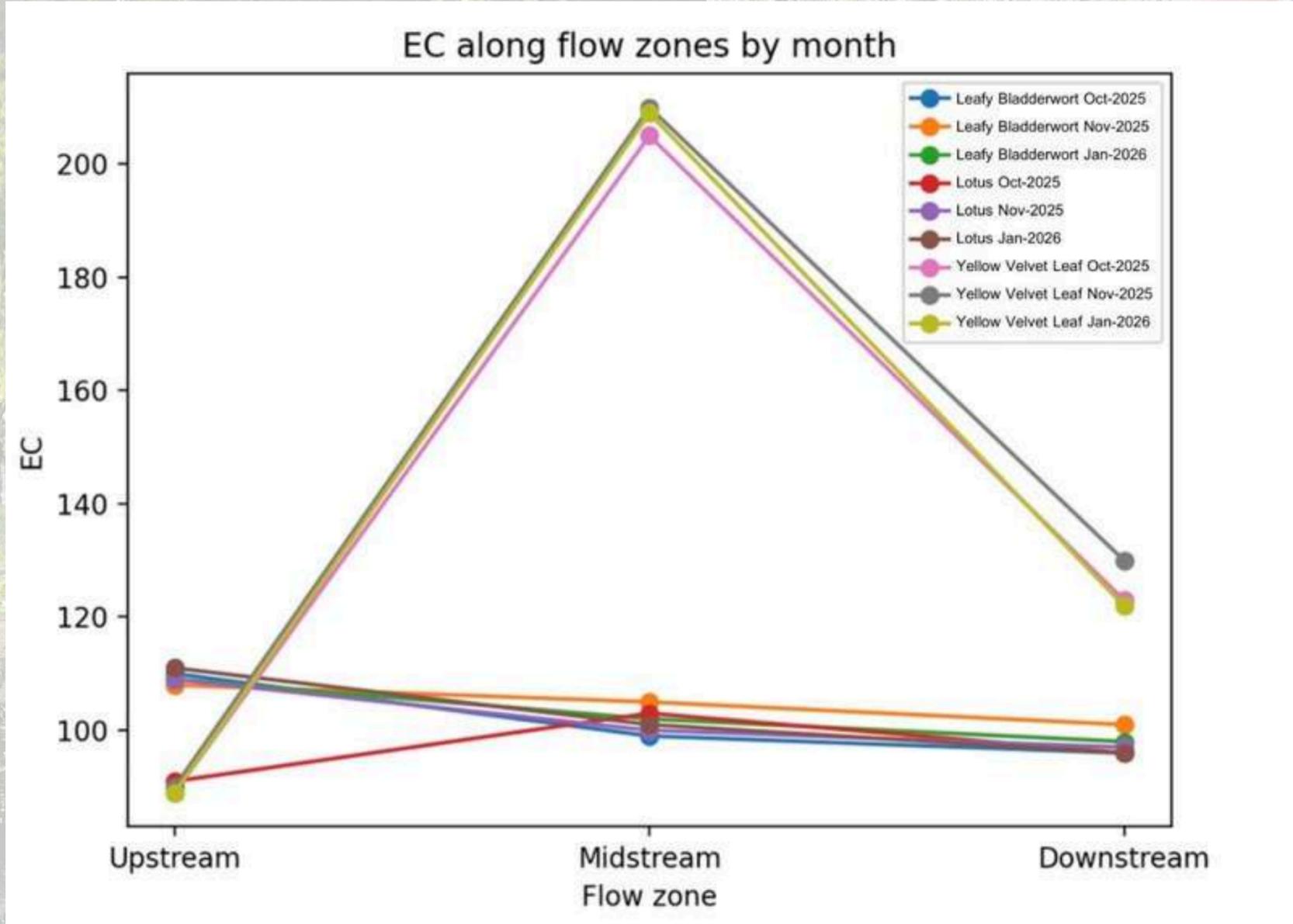


FIGURE 4.7. TDS PROFILES FROM UPSTREAM TO DOWNSTREAM ZONES FOR EACH PLANT REACH ACROSS MONTHS.

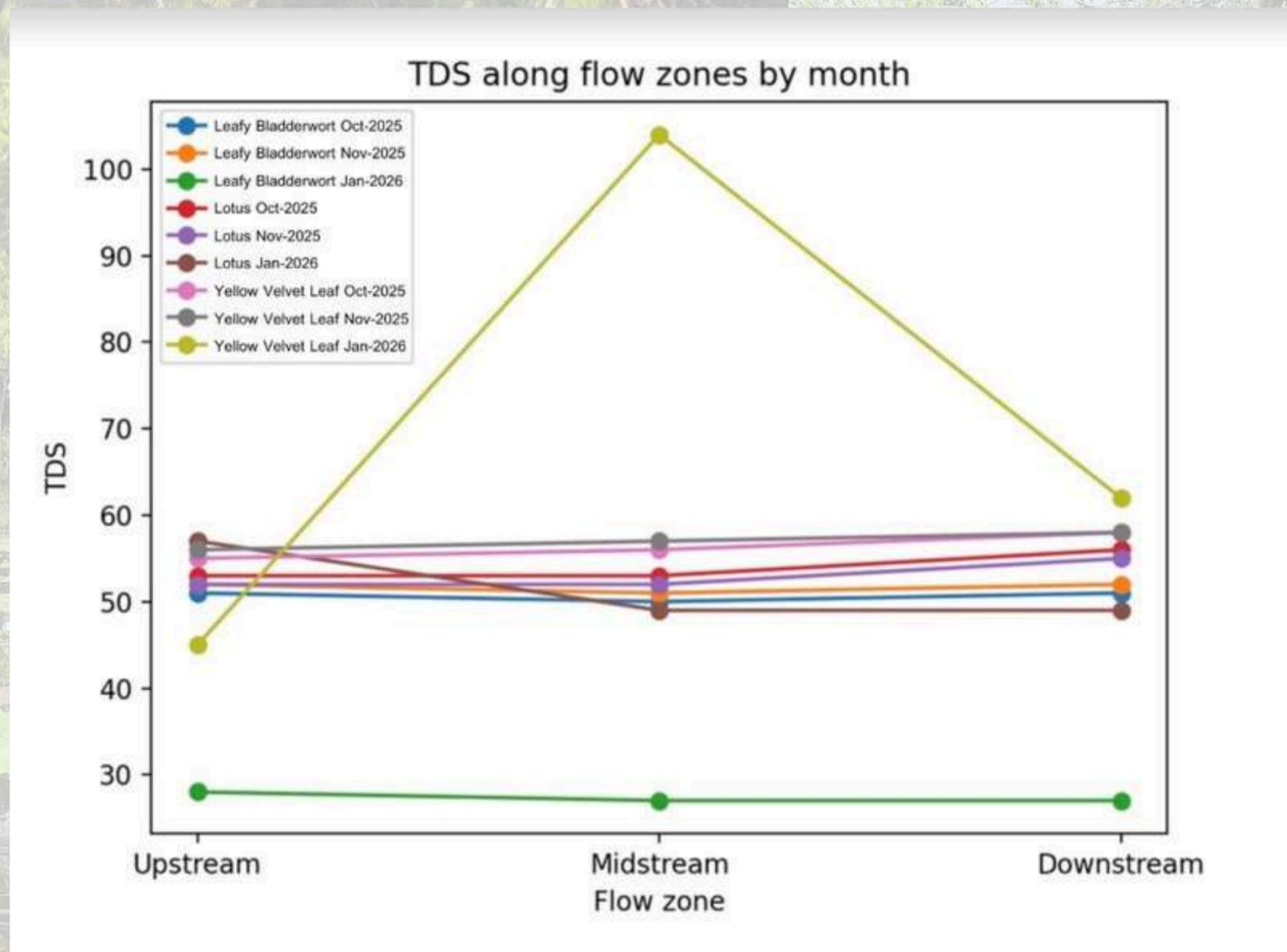
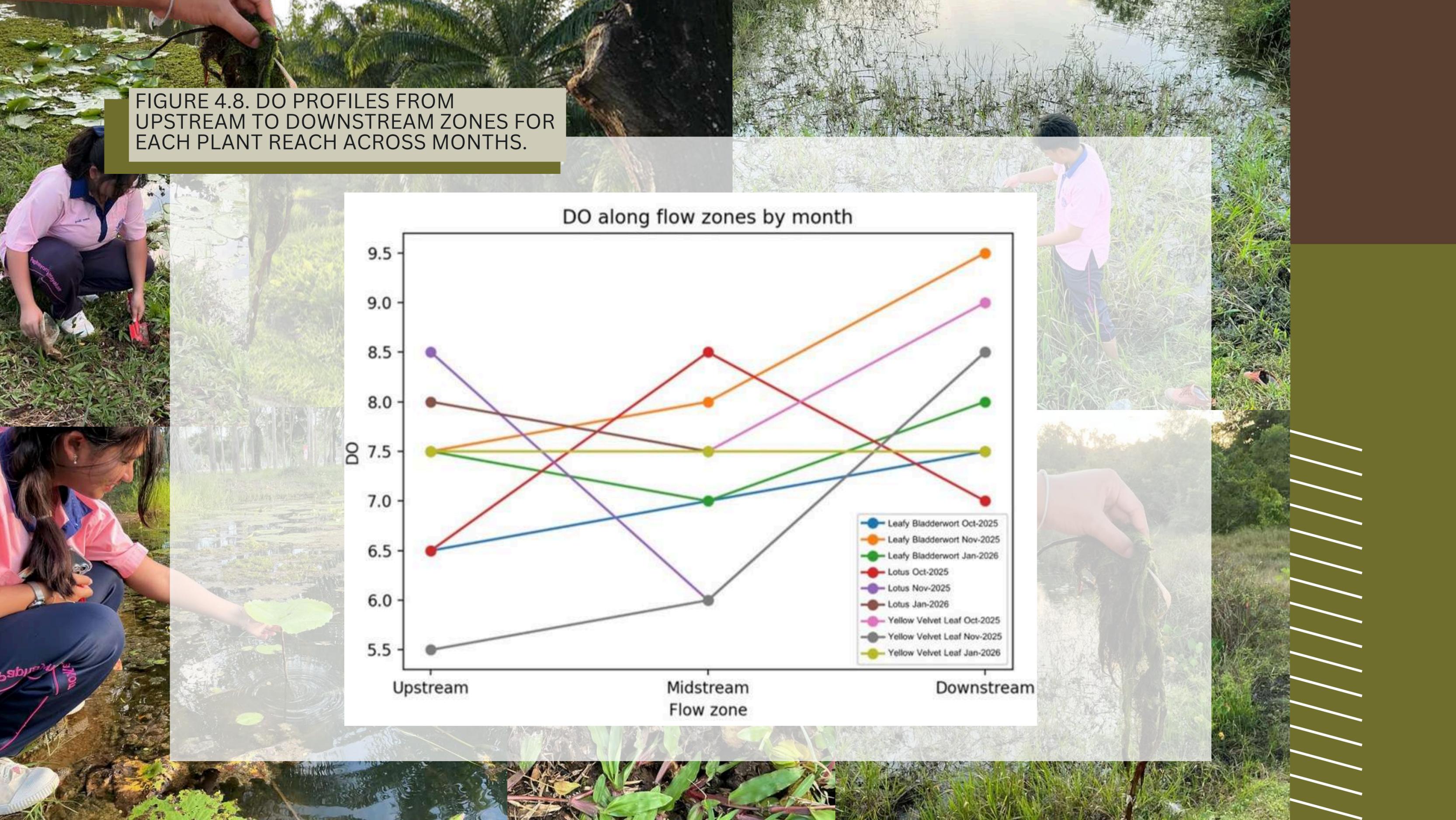
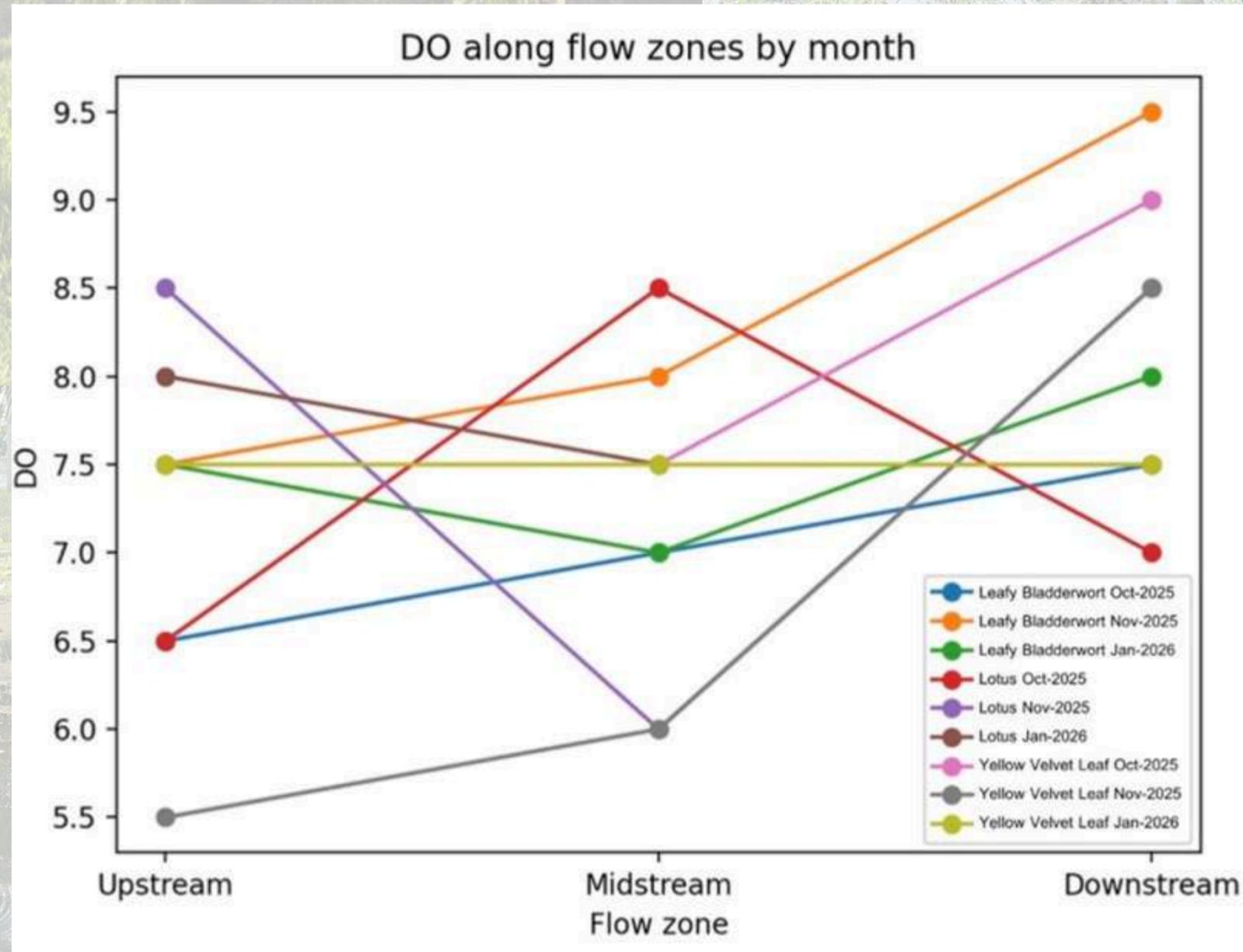
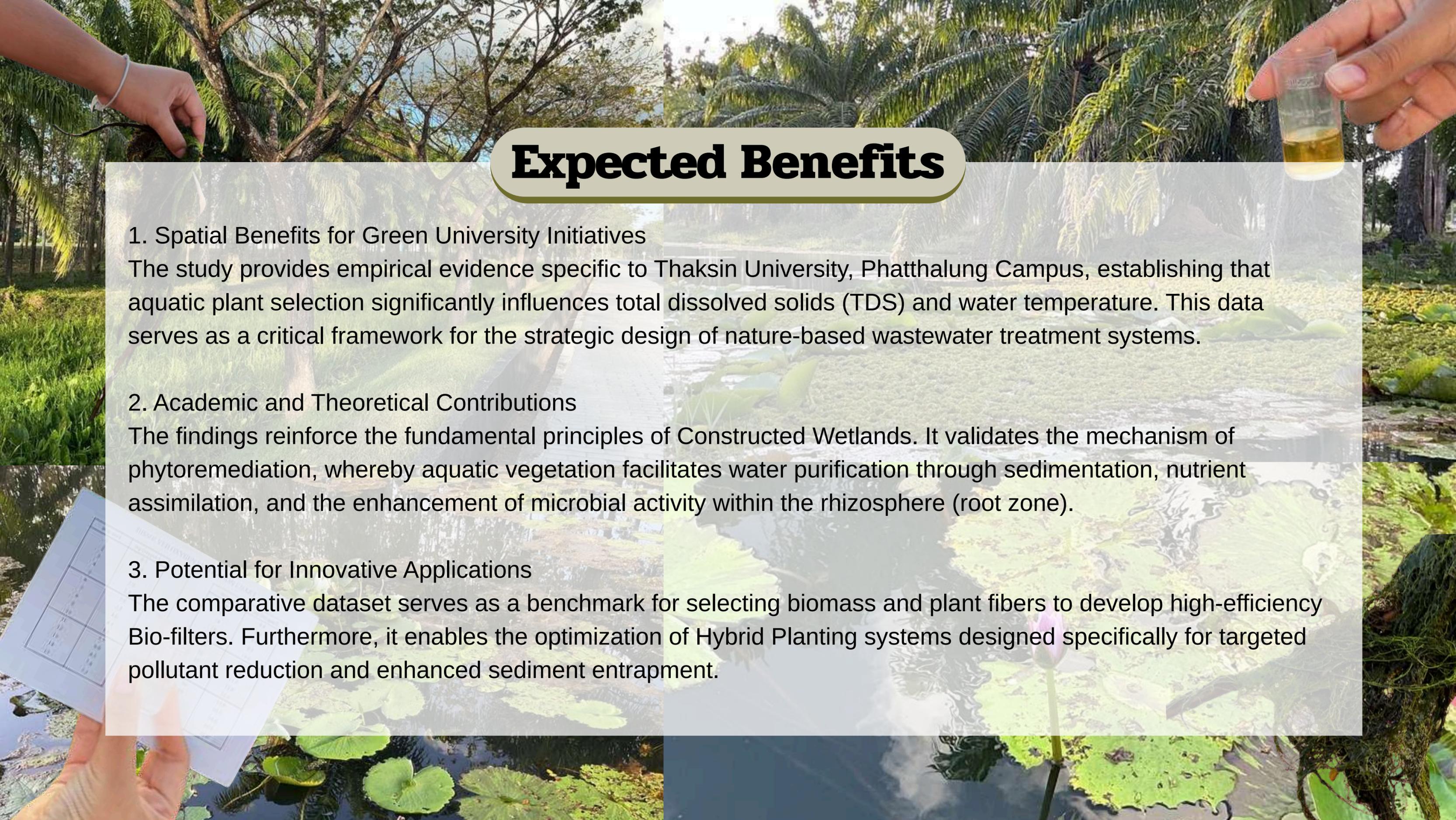


FIGURE 4.8. DO PROFILES FROM UPSTREAM TO DOWNSTREAM ZONES FOR EACH PLANT REACH ACROSS MONTHS.



Discussion

The discussion reveals that plant community structure significantly influences water quality, specifically regarding **EC, TDS, and temperature**. The **Yellow Velvet Leaf reach** exhibited higher EC and TDS levels, likely due to slower water flow, increased sediment interaction, and organic matter leaching from dense root zones. In contrast, the **Leafy Bladderwort reach** showed lower EC and TDS, attributed to the biofiltration capabilities of filamentous algae mats that trap particles and ions. While **DO and pH** remained stable across all reaches due to channel-scale mixing and buffering, and seasonality affected the magnitude of these changes, the distinct impact of different plant types on EC and TDS remained consistent.



Expected Benefits

1. Spatial Benefits for Green University Initiatives

The study provides empirical evidence specific to Thaksin University, Phatthalung Campus, establishing that aquatic plant selection significantly influences total dissolved solids (TDS) and water temperature. This data serves as a critical framework for the strategic design of nature-based wastewater treatment systems.

2. Academic and Theoretical Contributions

The findings reinforce the fundamental principles of Constructed Wetlands. It validates the mechanism of phytoremediation, whereby aquatic vegetation facilitates water purification through sedimentation, nutrient assimilation, and the enhancement of microbial activity within the rhizosphere (root zone).

3. Potential for Innovative Applications

The comparative dataset serves as a benchmark for selecting biomass and plant fibers to develop high-efficiency Bio-filters. Furthermore, it enables the optimization of Hybrid Planting systems designed specifically for targeted pollutant reduction and enhanced sediment entrapment.

THANK YOU

