Sustainable Rivers Program

Kaskaskia River
Environmental Pool Management
Implementation 2024

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Above: Emergent vegetation at Carlyle Lake, Tamalco Access (USACE photo).

Contents

1 Introduction

The Kaskaskia River Basin encompasses parts or all of 22 counties in Illinois, with 30 main tributaries and 5,840 square miles of drainage (Figure 1). It is a major tributary of the Mississippi River, with headwaters just west of Champaign, Illinois and flows southwesterly across the state for approximately 325 miles to its confluence with the Mississippi River about eight miles north of Chester, Illinois at river mile (RM) 117. Two reservoirs, Lake Shelbyville and Carlyle Lake, and one lock and dam, the Jerry F. Costello Lock and Dam (Jerry Costello L&D) were constructed and are operated by the Corps. As identified in the 2019 Sustainable Rivers Midwest Regional Meeting (USACE 2020), opportunity exists at Carlyle Lake, Lake Shelbyville, and Jerry Costello L&D for the implementation of water level management.

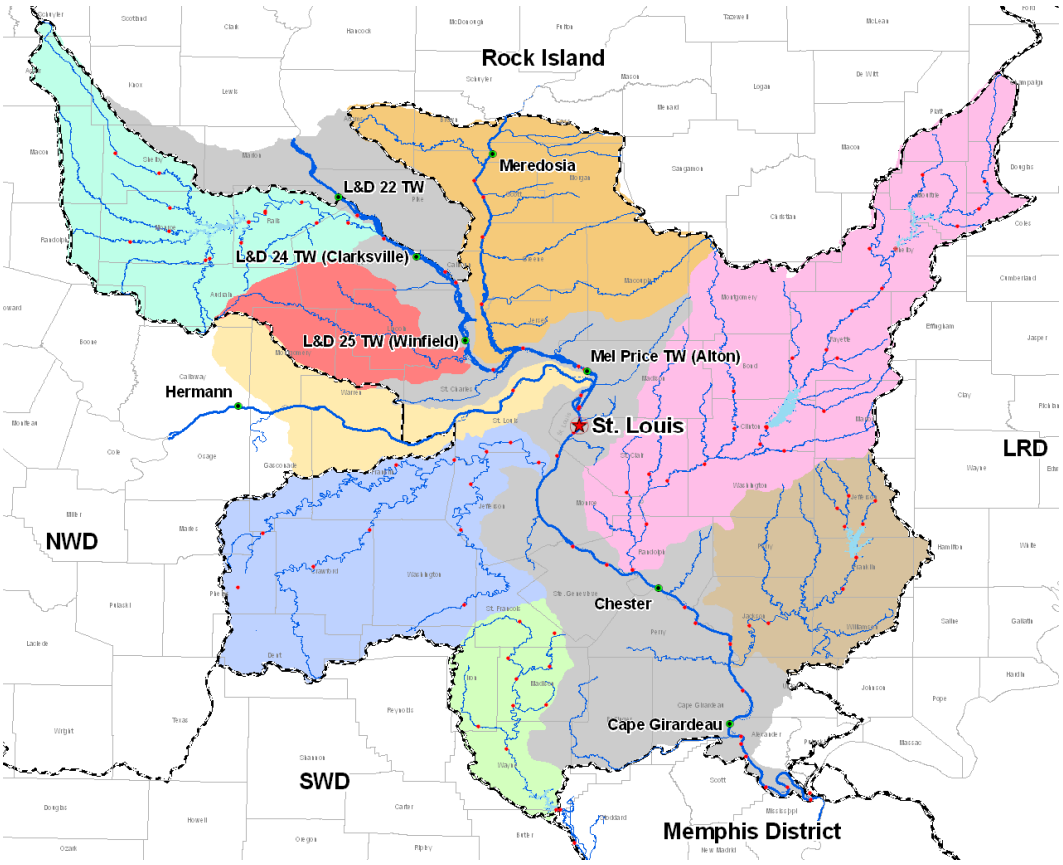

Figure 1. Watershed map of St. Louis District. The Kaskaskia River Basin falls within the pink area.

Lake Shelbyville was completed in 1970 and is approximately 11,100 water surface acres in size. Normal lake levels during the summer are held at a stage of 599.7 feet above mean sea level. The upstream portions, where the Kaskaskia River and West Okaw River flow into the lake, contain areas that would be the most likely to benefit from a drawdown during the growing season. Carlyle Lake was completed in 1967 and is approximately 62,420 water surface acres in size. Normal lake levels during the summer are held at a stage of 445.0 feet. The upstream portions, where the Kaskaskia River flow into the lake, contain areas most likely to be exposed by and benefit from a drawdown during the growing season.

Downstream of Carlyle Lake, Jerry Costello L&D provides a nine-foot navigation channel for approximately 36 miles from the Mississippi River to Fayetteville, IL. Within this stretch the navigation channel was straightened during construction, resulting in the creation of a large number of remnant oxbows and additional shoreline that could be exposed with water level management to grow vegetation. Normal pool above the Kaskaskia River Lock and Dam is at a stage of 368.8 feet.

This effort would be similar in nature to Environmental Pool Management (EPM) on the Mississippi River, which has been successful nearly every year since 1994. The intent for the Kaskaskia reservoirs was to implement a seasonal 0.5 ft drawdown to evaluate the environmental benefits that could be achieved. This drawdown would be within the operation elevations described in the approved water control plans for all 3 locations. A summary of EPM operations, including target management elevations for the 2021 growing season is provided in Section 1.1 EPM Operations.

Lake Shelbyville and Carlyle Lake are authorized and operate for flood risk management, recreation, navigation, water quality, fish and wildlife conservation and water supply. Jerry Costello L&D is authorized and operates for navigation, recreation, and fish and wildlife conservation.

1.1 EPM Operations

The goal for Lake Shelbyville, Carlyle Lake, and Jerry Costello L&D was to draw pool elevations down to approximately a half a foot during the growing season (May through September). Implementation of drawdowns and the selected drawdown levels at each of the three sites fall within current project authorities and are allowable under the current water control plan. While the goal was the same at each project, the hydrologic and hydraulic constraints vary for each project, which affected the ability to accomplish the desired drawdown at the different pools. The following sections highlight the constraints and what drawdowns, if any, were accomplished at the projects.

1.1.1 Lake Shelbyville

Lake Shelbyville is a headwater flood risk management reservoir with 1,054 mi^2 of unregulated drainage upstream. Lake Shelbyville primary purpose is to reduce flooding downstream with control points at Cowden, Ramsey, and Vandalia. The drainage area between Lake Shelbyville and Vandalia is unregulated and covers 886 mi^2. The constraints of inflow coming into the lake from upstream and regulating for downstream local flows coming into the Kaskaskia River between Lake Shelbyville and Vandalia, drive reservoir pool stages. To accomplish a half foot drawdown during the growing season, relatively low inflows and low local flows downstream are needed for the months of April through September so that reservoir pool stages can be maintained at or near seasonal guide curve and accomplish the desired drawdown. Drier than normal to drought like conditions are the ideal conditions to accomplish the desired drawdown regulation during the growing season.

The 2024 season started off with a pool stage above the seasonable guide curve due to substantial rain events throughout the months of April and May across the Kaskaskia Basin. By the end of June, pool stage was lowered to the seasonal guide curve but another heavy rain in July caused to pool to rise. The pool returned to the seasonal rule curve in August. The weather was extremely dry for the next 2-3 months and the pool was able to be drawn down to EPM levels for almost the next three months. Figure 2 shows the 2024 pool stage hydrograph and the zone rules and targets required of the water control plan.

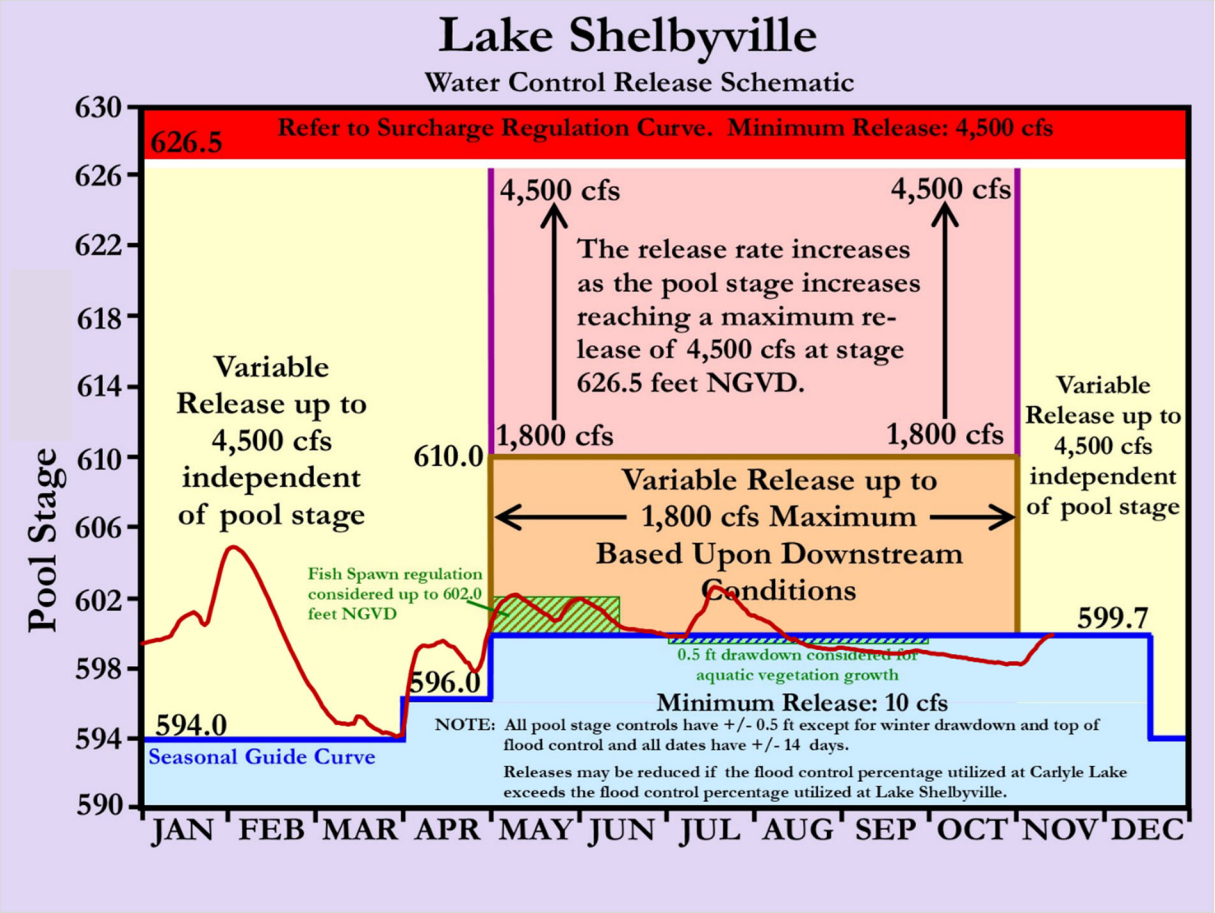

Figure 2. Lake Shelbyville water control plan release schematic and 2024 pool stage hydrograph.

1.1.2 Carlyle Lake

Carlyle Lake is a flood risk management reservoir located approximately in the center of the Kaskaskia River watershed with a total drainage area of 2,717 mi^2, 1,054 mi^2 upstream of Lake Shelbyville and 1,663 mi^2 between Lake Shelbyville and Carlyle Lake. In addition to the upstream drainage area, Carlyle regulates for downstream local flows to Venedy Station, which has a local drainage area of 1,676 mi^2 below Carlyle Dam. Though the Upper Kaskaskia River watershed is regulated by Lake Shelbyville, water that flows into Lake Shelbyville must be released over time. Large inflows can result in sustained releases from Lake Shelbyville and result in sustained elevated inflows to Carlyle Lake, thereby increasing the chances that local rainfall events between Lake Shelbyville and Carlyle Lake will further elevate inflows resulting in increased Carlyle Lake pool stages. In addition to these upstream factors, release constraints to reduce flooding downstream of Carlyle can also result in higher pool stages.

The 2024 season started off with a pool stage above the seasonable guide curve due to substantial rain events throughout the months of April and May across the Kaskaskia River Basin. By the end of June, the pool stage was lowered to the seasonal guide curve but another heavy rain in July caused the pool to rise. The pool returned to the seasonal rule curve in August. The weather was dry for the next 2-3

months with the exception of a small rain at the end of September and the pool could be drawn down to EPM levels for almost the next three months. Figure 3 shows the 2024 pool stage hydrograph and the zone rules and targets required of the water control plan.

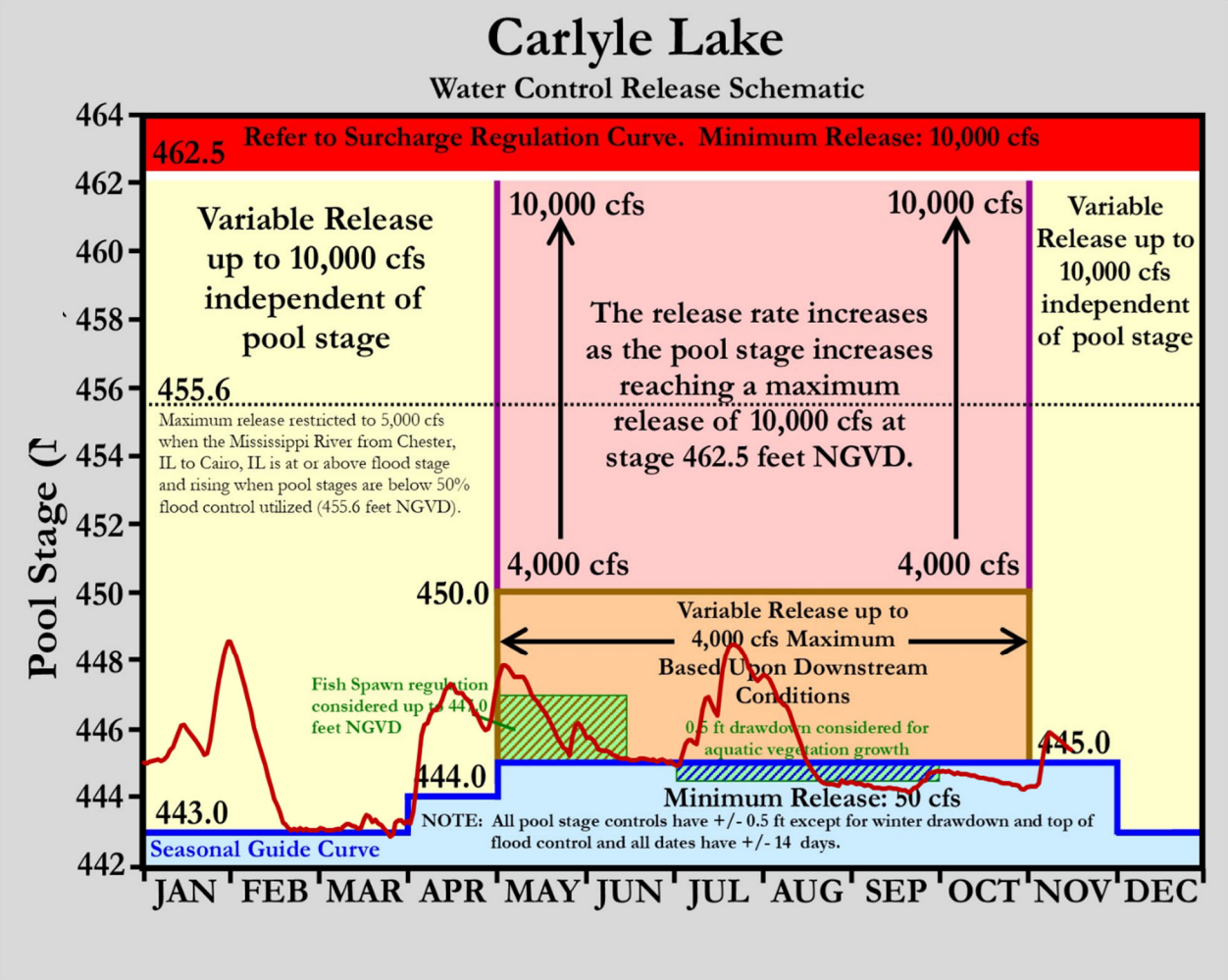

Figure 3. Carlyle Lake water control plan release schematic and 2024 pool stage hydrograph.

1.1.3 Jerry F. Costello Lock and Dam

Jerry Costello L&D is a navigation lock and dam located 0.7 mi upstream of the outlet of the Kaskaskia River basin. There is a total of 5,840 mi^2 of drainage area. 2,717 mi^2 are upstream of Carlyle Dam and 3,123 mi^2 of largely unregulated drainage area are located downstream of Carlyle Lake. Jerry Costello L&D is a hinge point operated run of the river lock and dam project and pool stages are driven by inflow to meet hinge point operating limits and influenced by backwater from the Mississippi River during high flow events. Figure 4 illustrates how Jerry Costello L&D is operated with varying river conditions.

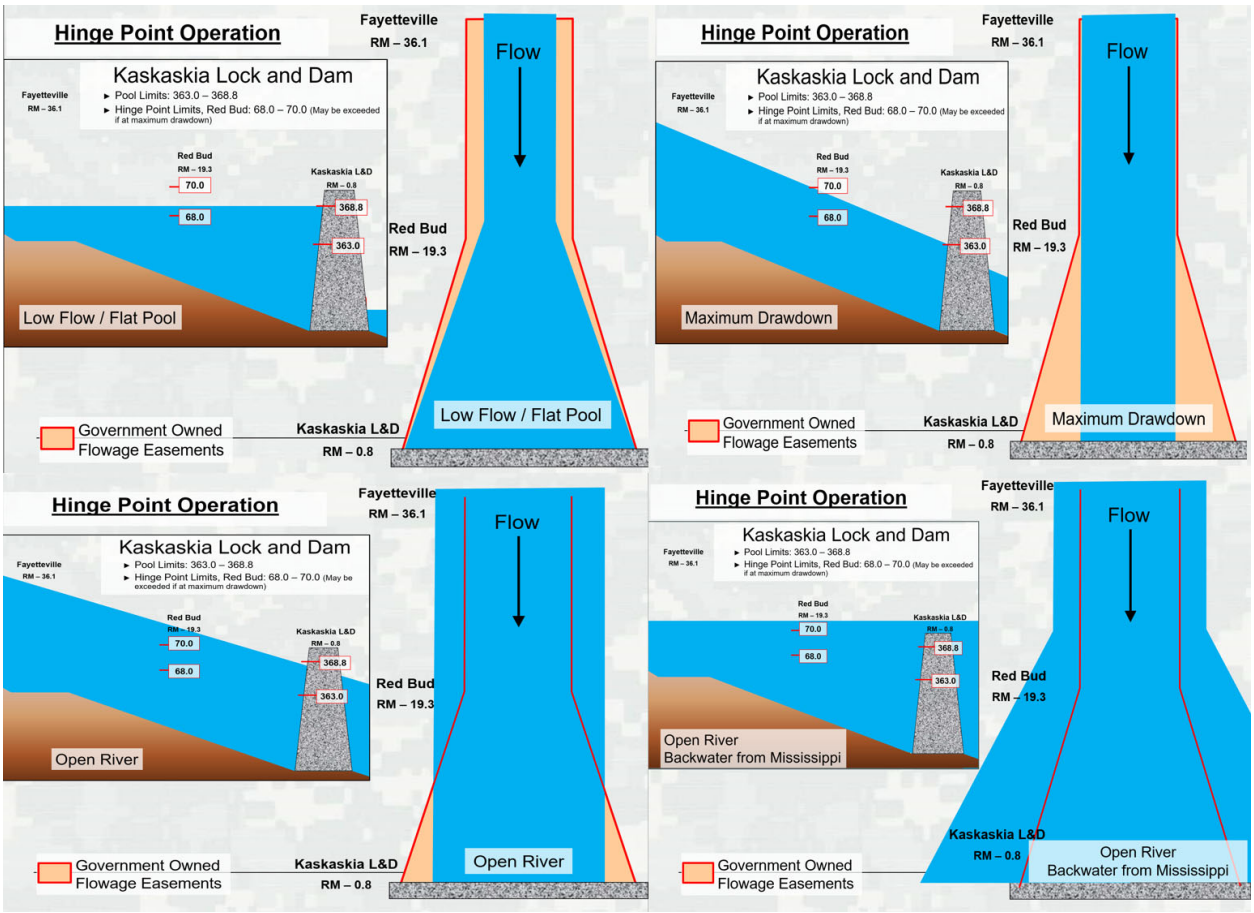

Figure 4. Jerry F. Costello Lock and Dam illustrative operating limits.

Accomplishing Environmental Pool Management (EPM) at Jerry Costello L&D requires high enough inflows (>1,500 cfs) to sustain sufficient navigation depths while accomplishing a half foot drawdown and inflows cannot be too high (>10,000 cfs) to maintain hinge point stage low enough to attain the desired drawdown benefits. Additionally, the Mississippi River must remain low enough not to cause open river conditions due to backwater. Ideal conditions for regulating Jerry Costello L&D for EPM involves relatively low Mississippi River stages/flows and sustained inflows above 1,500 cfs either from timely events downstream of Carlyle Lake or events that cause sustained elevated outflows from Lake Shelbyville and/or Carlyle Lake.

Conditions leading into the 2024 growing season appeared favorable as the weather was fairly wet with a drawdown starting in August. However, the basin quickly turned from wet to dry and the flows from the two reservoirs upstream were curtailed precluding a full EPM drawdown. Figure 5 shows the 2024 pool stage hydrograph and operating constraints throughout the year.

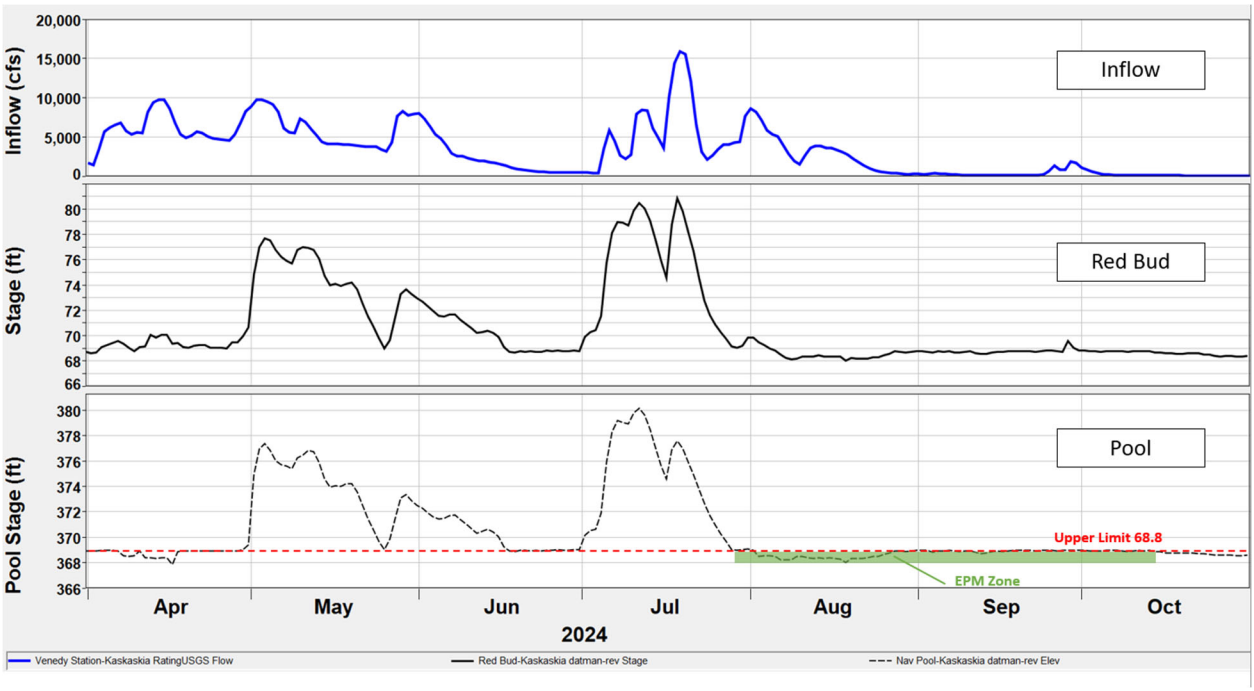

Figure 5. Jerry F. Costello Lock and Dam 2024 pool stage hydrograph and operating constraints.

2 Vegetation

2.1 Site Selection

At Lake Shelbyville, 12 of the 14 sampling sites (Figure 6) were visited on 15 September 2024 and 21 October 2024 to assess conditions. Two sites were omitted from sampling because local conditions were not influenced by the drawdown in the same ways as at other sites (Site 7 was hydraulically disconnected from Shelbyville pool and Site 12 was near a water control structure that created a sub impoundment within Shelbyville pool). Vegetation from two locations (sites 10 and 11) were sampled on both sampling dates with the Integrated Waterbird Monitoring and Management protocol while vegetation was still developing. Transect data was gathered at two locations (sites 10 and 11) on 11 September 2024 and one location (site 10) on 21 October 2024.

At Carlyle Lake, the four sites sampled in 2021 (USACE 2023) (Figure 7; sites 1-4) were revisited on 11 September 2024 to assess plant response from the current growing season. A second site visit to three sites (sites 2-4) occurred on 21 October 2024 to evaluate plant growth through the end of the growing season (Figure 7).

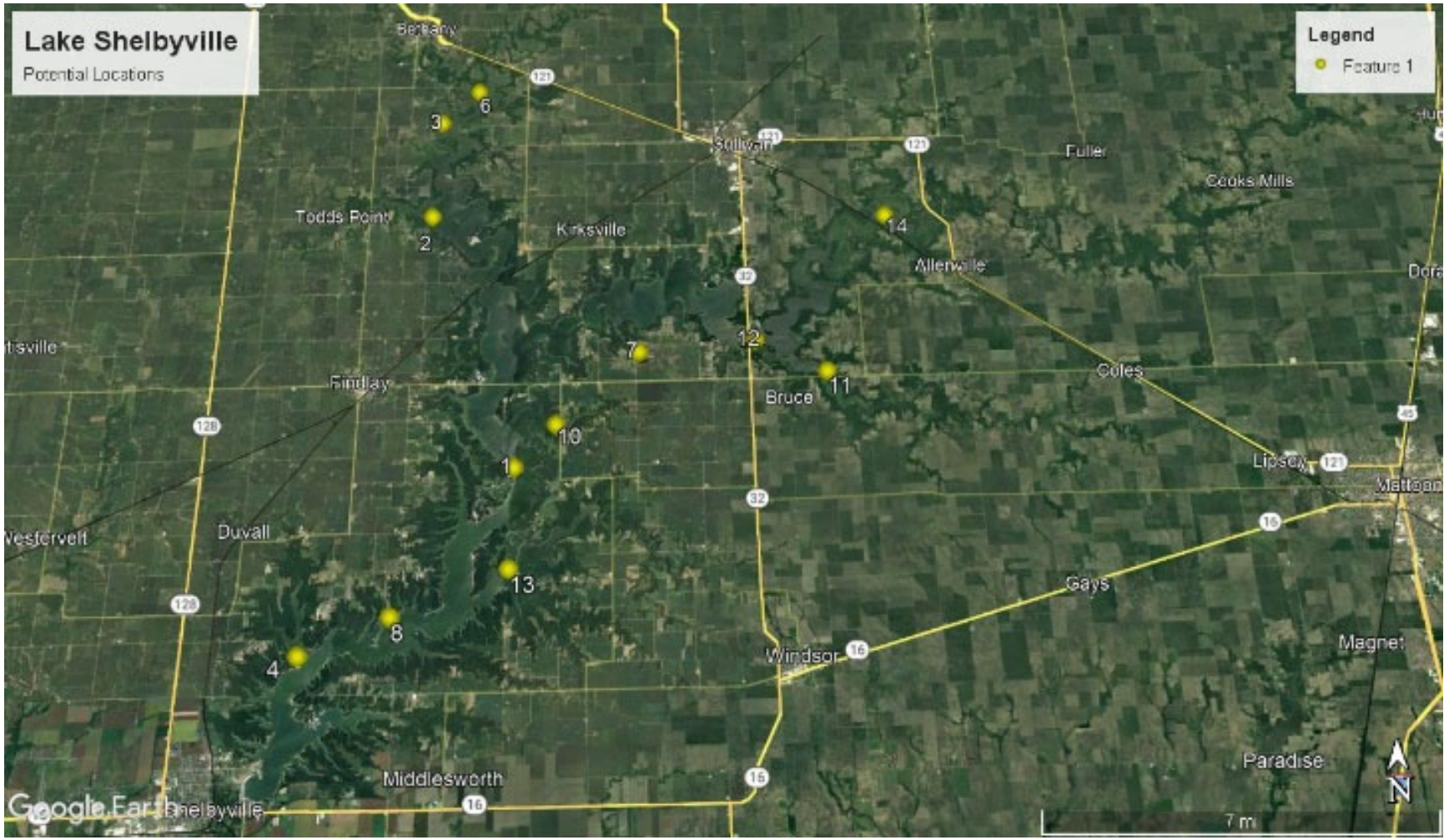

Figure 6. 2024 sample sites visited at Lake Shelbyville with potential for supporting emergent vegetation. Sites 7 and 12 were not sampled (Site 7 was hydraulically disconnected from the pool; Site 12 was influenced by a water control structure that created a sub impoundment in the pool.

Figure 7. 2024 sample sites at Carlyle Lake with potential for supporting emergent vegetation. Site names include Hazlet State Park (1), Allen Branch Area (2), Muskrat Flats (3), and Tamalco Area (4).

2.2 Integrated Waterbird Management and Monitoring Vegetation Surveys

2.2.1 Methods

A total of 6 sites were surveyed to assess individual emergent plant species cover at the Lower Lake Shelbyville (2 sites; sites 10 and 11) and Carlyle Lake (4 sites; sites 1-4), as described in Section 2.1. Lake Shelbyville and Carlyle Lake vegetation was sampled twice due to an armyworm infestation that defoliated most grasses and sedges in September (Figure 8). The second sampling date occurred on 21 October as plant growth was slowing towards the end of the growing season. Additional species established between the two sampling dates so data from both periods are provided. The Integrated Waterbird Management and Monitoring (IWMM) protocol was utilized to assess species abundance and percent cover (USFWS 2021). Only emergent vegetation from the current growing season was assessed. To complete the vegetation surveys while adhering to the protocol, two assessments were completed: 1) percent cover of emergent vegetation within the survey unit and 2) species inventory and species-specific percent cover within the areas of emergent vegetation.

To complete the first assessment, locations of all emergent vegetation areas throughout each survey unit were identified visually. After areas of emergent vegetation were identified, an estimate of the percent cover of the survey unit by emergent vegetation was completed. Percent cover is defined as the percentage of the survey unit covered by vertical projections from the outermost perimeter of the plants' foliage (Anderson 1986).

To complete the second assessment, a list of all common emergent vegetation species was compiled, and an estimate of each species' percent cover was completed. For this estimate, percent cover is defined as above except that it is estimated as a percentage of emergent vegetation area, not as a percentage of the total survey unit area. For example, a survey unit might contain a single emergent vegetation species that covers 50% of the total survey unit area and 100% of the emergent vegetation area within the survey unit. Therefore, 100% would be recorded for this assessment. Total cover across species can exceed 100% due to stratification of plant species with varying heights and growth habits.

2.2.2 Results

Results of the IWMM surveys are provided in Table 1 and Figures 9 to 16.

Figure 8. Example of defoliation by armyworms that occurred at Carlyle Lake and Lake Shelbyville. Most aboveground foliage on grasses and sedges in the drawdown zone were defoliated by 11 September 2024 at Carlyle Lake. Activity had just recently started at Lake Shelbyville on 15 September 2024 (USACE photo).

Table 1. Species encountered at Lake Shelbyville and Carlyle Lake sampling sites, 11 September, 15 September, 21 October 2024.

Species Code	Common Name	Scientific Name	Carlyle Lake	Lake Shelbyville
AMSP	amaranth species	Amaranthus sp.	X	X
AMTU	water hemp	Amaranthus tuberculatus	X	X
AMCO	purple ammania	Ammania coccinea	X	X
BICE	nodding marigold	Bidens cernua		X
BICO	purplestem beggarticks	Bidens connata	X	
BISP	beggarticks species	Bidens sp.	X	X
BOAS	false aster	Boltonia asteroides	X	
CASP	sedge species	Carex sp.	X	
CYSP	flatsedge species	Cyperus sp.	X	X
ECSP	millet species	Echinochloa sp.	X	
ECPR	yerba de tajo	Eclipta prostrata	X	X
ELSP	spikerush	Eleocharis sp.	X	X
ERHY	teal lovegrass	Eragrostis hypnoides	X	X
EUSE	late-flowering thoroughwort	Eupatorium serotinum	X	X
HILA	rose mallow	Hibiscus lasiocarpos	X	
IPSP	bindweed species	Ipomoea sp.	X	
JUSP	rush species	Juncus sp.	X	X
LEMI	duckweed	Lemna minor	X	
LEPA	Amazone sprangletop	Leptochloa panicoides	X	
LEMU	Obe-Wan-Conobea	Leucospora multifida	X	
LIDU	false pimpernel	Linderna dubia	X	X
PADI	fall panicgrass	Panicum dichotifolium	X	X
PESE	ditch stonecrop	Penthorum sedoides	X	
POLA	nodding smartweed	Polygonum lapathifolium	X	
POPE	Pennsylvania smartweed	Polygonum pennsylvanicum	X	X
POSP	smartweed species	Polygonum sp.	X	X
RASC	cursed crowfoot	Ranunculus sceleratus	X	X
RINA	fringed heartwort	Ricciocarpos natans	X	
ROSE	sessile-flowered yellowcress	Rorippa sessiliflora	X	X
RUSP	dock species	Rumex sp.	X	X
SALA	arrowhead	Saggitaria latifolia	X	
SASP	willow species	Salix sp.	X	X
SYLA	calico aster	Symphyotrichum latifolium		X
SYSP	aster species	Symphyotrichum sp.	X	
XAST	cocklebur	Xanthium strumarium	X	X

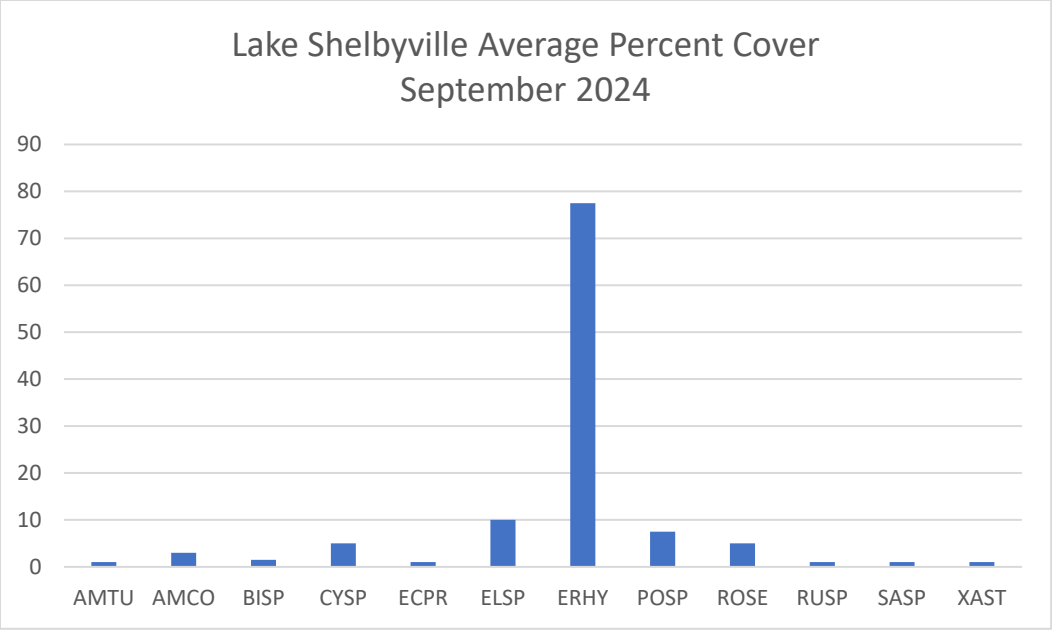

Figure 9. Average percent plant cover by species, per two samples, Lake Shelbyville sites (IWMM), sampled 15 September 2024.

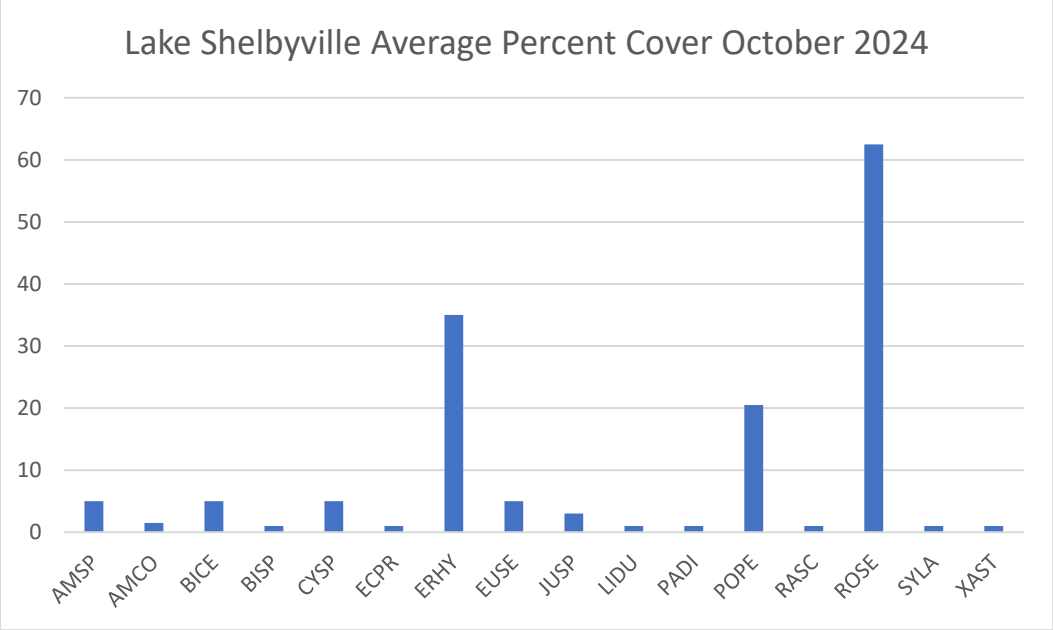

Figure 10. Average percent cover by species, per two samples, Lake Shelbyville sites (IWMM), sampled 21 October 2024.

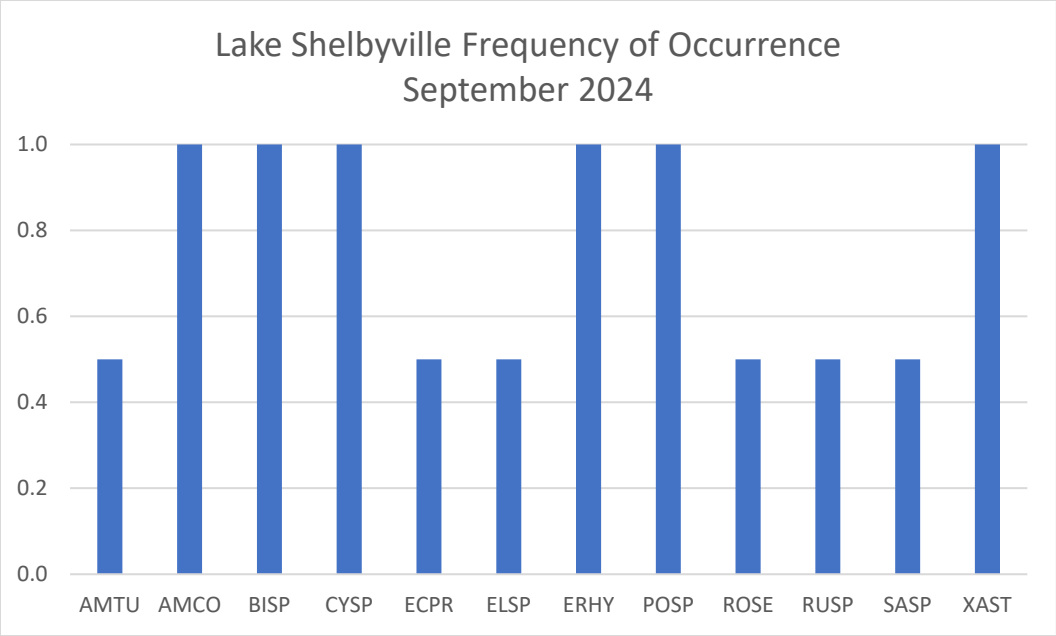

Figure 11. Frequency of occurrence by species, per two samples, Lake Shelbyville sites (IWMM), sampled 15 September 2024.

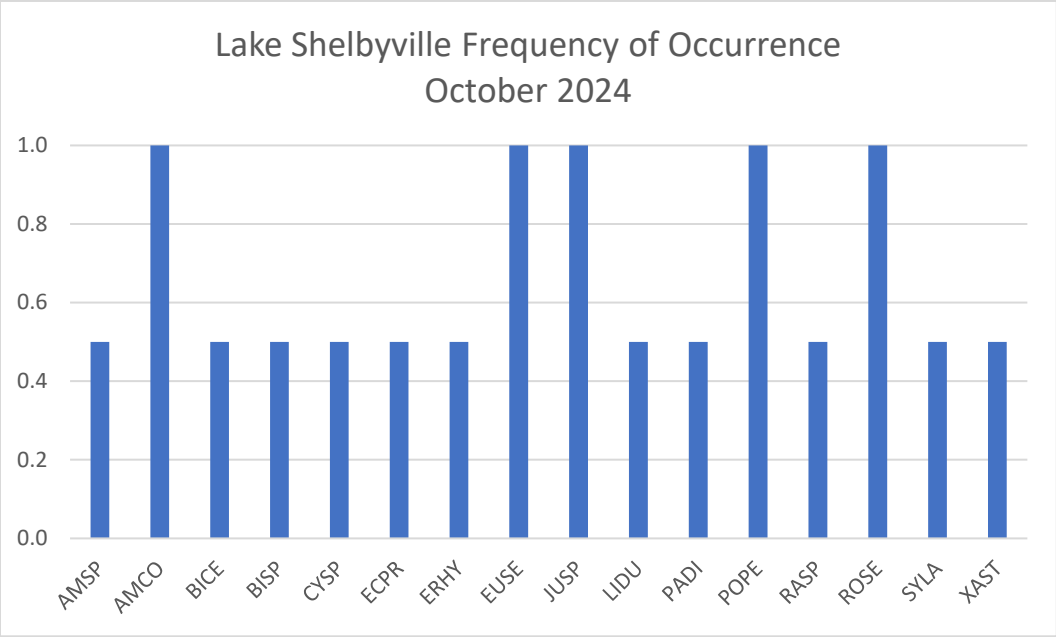

Figure 12. Frequency of occurrence by species, per two samples, Lake Shelbyville sites (IWMM), sampled 21 October 2024.

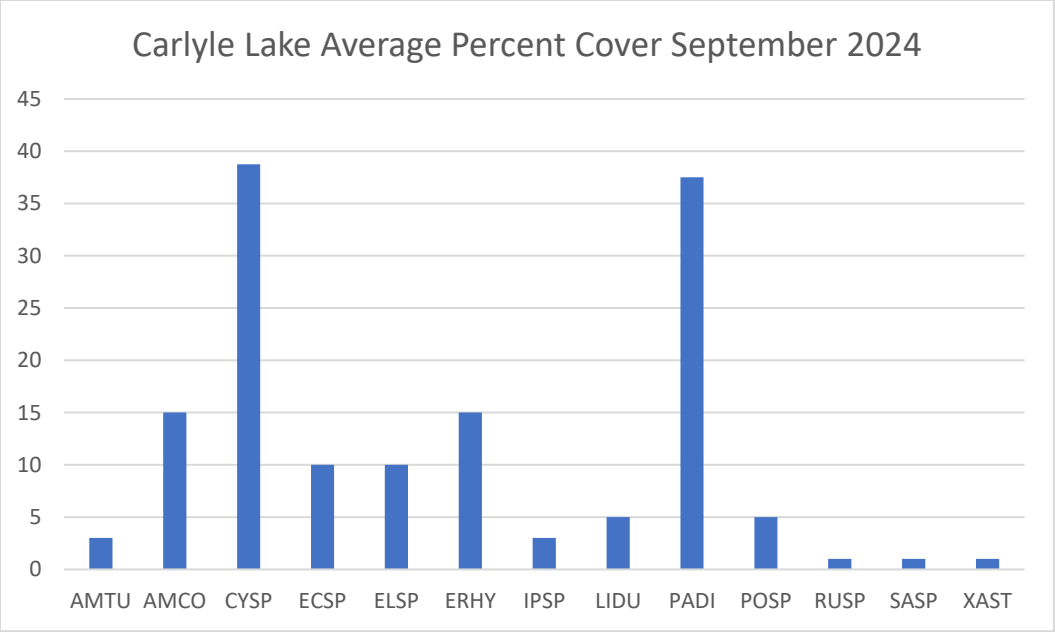

Figure 13. Average percent plant cover by species, per four samples, Carlyle Lake sites (IWMM), sampled 11 September 2024.

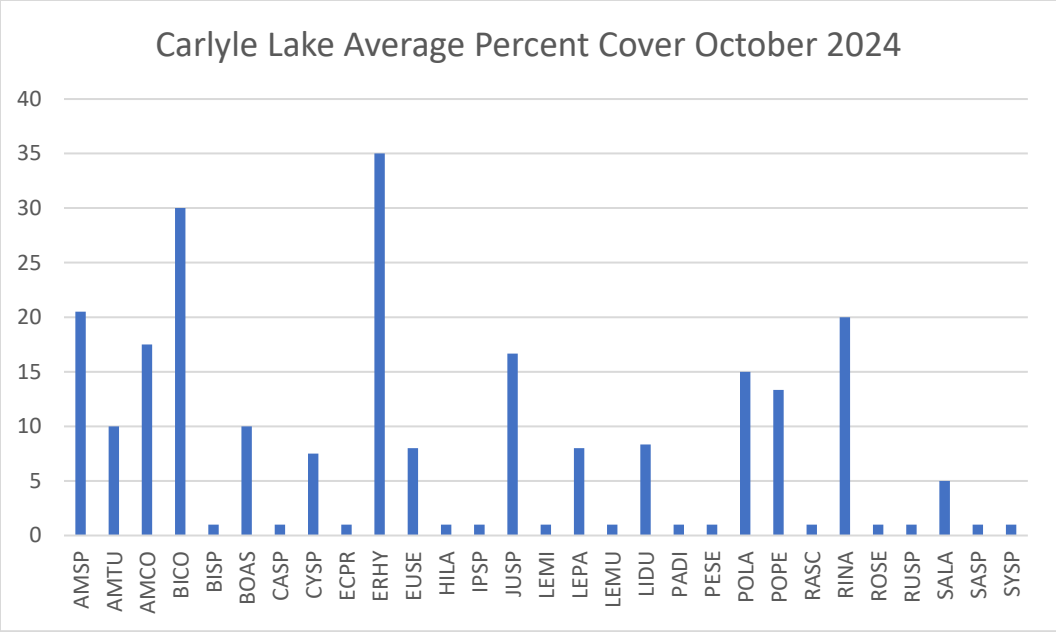

Figure 14. Average percent plant cover by species, per three samples, Carlyle Lake Sites (IWMM), samples 21 October 2024.

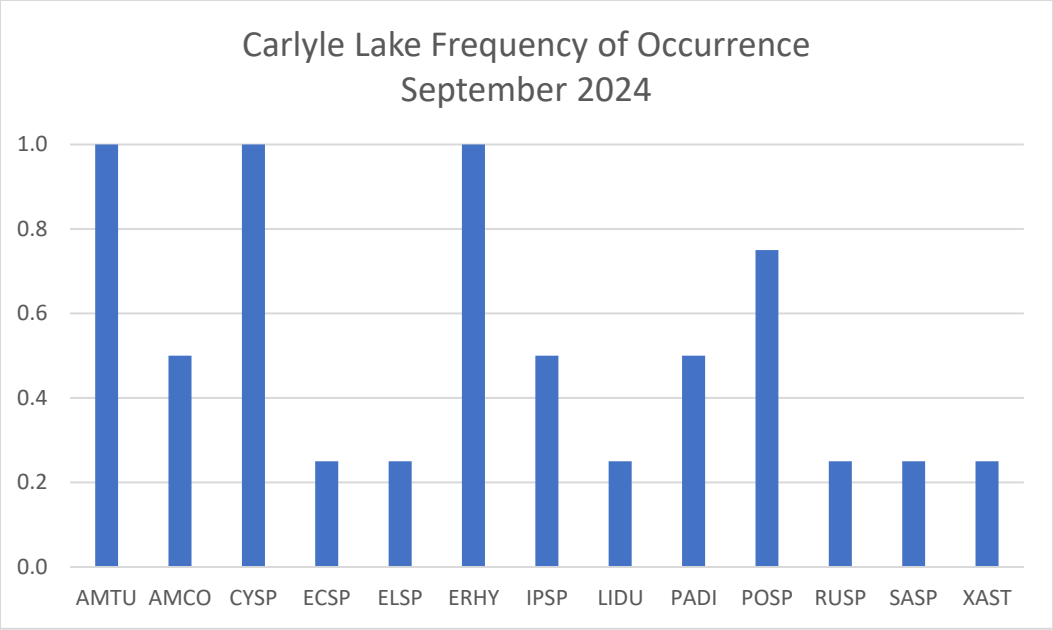

Figure 15. Frequency of occurrence by species, per four samples, Carlyle Lake sites (IWMM), sampled 11 September 2024.

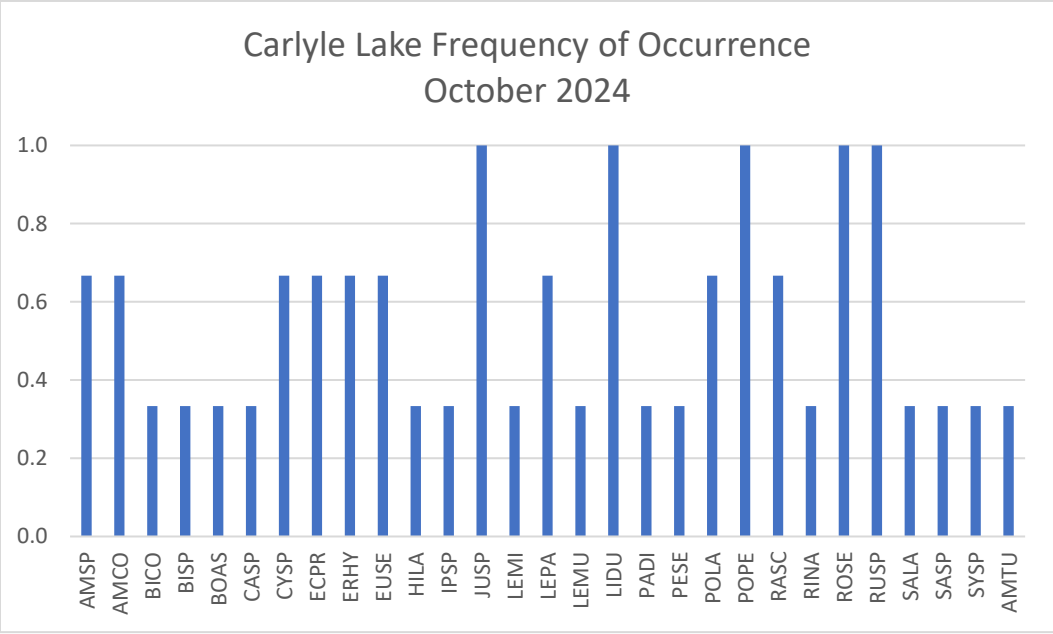

Figure 16. Frequency of occurrence by species, per three samples, Carlyle Lake sites (IWMM), samples 21 October 2024.

2.2.3 Discussion

On the 15 September sampling date at Lake Shelbyville 12 species were recorded in areas exposed by the drawdown (Figure 9). At that time an armyworm infestation had just recently started to defoliate grasses and sedges. This reduction in aboveground grass and sedge foliage allowed additional species to establish over the next month. On the 21 October sampling date, 16 species were record at the two sampling sites (Figure 10). Overall, teal lovegrass (*Eragrostis hypnoides*) percent cover was halved and *Cyperus* sp. cover remained low and constant compared to the typical drawdown response. Sessile-flowered yellowcress (*Rorippa sessiliflora*) became the dominant species by the October sampling date, accounting for over 60% of the plant cover on average. This species is a winter or summer annual plant that is typically found in disturbed wetland areas. Approximately half of recorded species occurred at both locations in September (Figure 11) and one third of recorded species occurred at both locations in October (Figure 12).

An armyworm infestation was widespread at Carlyle Lake during the 11 September sampling date where 13 species were recorded at four sampling sites (Figure 12). The reduction in aboveground grass and sedge foliage allowed additional species to establish over the next month. On the 21 October sampling date, 29 species were recorded at three sampling sites. Most grasses had large reductions in percent cover at sites, including *Cyperus* sp., *Echinochloa* sp., and fall panicgrass (*Panicum dichotifolium*) (Figures 13 and 14). One notable exception included teal lovegrass which increased from 15% cover on 11 September to 35% on 21 October. This species appeared to resprout or germinate after the armyworm infestation and produce a small amount of seed by 21 October. Other species that increased between the two sampling dates, included *Amaranthus* sp., smartweeds (*Polygonum lapathifolium* and *Polygonum pennsylvanicum*), *Bidens* sp., and fringed heartwort (*Ricciocarpos natans*). Fringed heartwort is a liverwort species that occurs in a range of wetland habitats, including sandy silt or sandy soils with decaying organic matter along shorelines, mudflats, swamps, wet willow thickets, lakes, banks of rivers, limestone sinkholes, and floodplain woodlands (Figures 13 and 14). Approximately half of recorded species occurred in at least half of sampled sites on both dates (Figures 15 and 16).

2.3 Transect Surveys

2.3.1 Method

Following the Illinois Natural History Survey, Critical Trends Assessment Protocol for Wetland sites (INHS 2002), a transect is placed perpendicular to the long axis of the wetland. A random distance along the transect is then selected to establish a baseline. When lying the transect, the tape measure is pulled taut, but laid on the ground at all points along its length. Herbaceous vegetation is sampled in ¼ m^2 quadrats at an interval of every 2 m along the transect, starting 2 m from the baseline (Figure 17).

Figure 17. Quadrat layout along transect.

A total of 20 quadrats are sampled per site. Quadrats are placed 1 m from the transect on alternate sides, starting on the left at the 2 m point (e.g. the first quadrat covers the area from 2-2.5 m along the transect, at a distance covering 1-1.5 m left of the transect). At each quadrat, all species present were identified and assigned a percent cover rating between 1 and 7. The cover rating related to species percent cover is as follows: 1) <1%, 2) 1-5%, 3) 6-25%, 4) 26-50%, 5) 51-75%, 6) 76-95%, and 7) 96-100%. Average species percent cover and frequency of occurrence by plot were calculated. Data were collected at one transect (site 4, Tamalco) on 21 October 2024 for Lake Shelbyville and one transect (site 10) on 21 October 2024 for Carlyle Lake.

2.3.2 Results

A list of all species recorded during transect surveys at Lake Shelbyville and Carlyle Lake on 11 September, 15 September, and 21 October 2024 is provided in Table 2. Results of the transect surveys at Lake Shelbyville and Carlyle Lake sampling sites, 21 October 2024 are provided in Figures 18 to 21.

Table 2. Species recorded at Kaskaskia River and Lake Shelbyville sampling sites, 11 September, 15 September, and/or 21 October 2024.

Species Code	Common Name	Scientific Name	Carlyle Lake	Lake Shelbyville
AMSP	ameranthus species	Amaranthus sp.	X	X
AMCO	purple ammania	Ammania coccinea	X	X
BISP	beggarticks species	Bidens sp.	X	X
BICO	purplestem beggarticks	Bidens connata	X	
CHFA	partridge pea	Chamaecrista fasciculata	X	
CYSP	flatsedge species	Cyperus sp.	X	X
ECPR	yerba de tajo	Eclipta prostrata	X	X
ELSP	spikerush species	Eleocharis sp.	X	X
ELNY	aunt lucy	Ellisia nyctelea	X	
ERHY	teal lovegrass	Eragrostis hypnoides	X	X
IPSP	bindweed species	Ipomoea sp.	X	
JUSP	rush species	Juncus sp.	X	X
LEMU	Obe-Wan-Conobea	Leucospora multifida		X
LIDU	false pimpernel	Linderna dubia	X	X
PASP	panicgrass species	Panicum	X	X
PADI	fall panicgrass	Panicum dichotifolium	X	
POSP	smartweed species	Polygonum sp.	X	X
POLA	nodding smartweed	Polygonum lapathifolium	X	X
POPE	Pennsylvania species	Polygonum pensylvanicum		X
RASC	cursed crowfoot	Ranunculus sceleratus		X
RINA	fringed heartwort	Ricciocarpos natans	X	
ROSE	marsh yellowcress	Rorippa palustris var fernaldiana	X	X
RUSP	dock species	Rumex sp.	X	X
EUNU	nodding spurge	Euphorbia nutans	X	
XAST	cocklebur	Xanthium strumarium	X	X

Figure 18. Average plant cover class by species, site 11, Lake Shelbyville, sampled 21 October 2024.

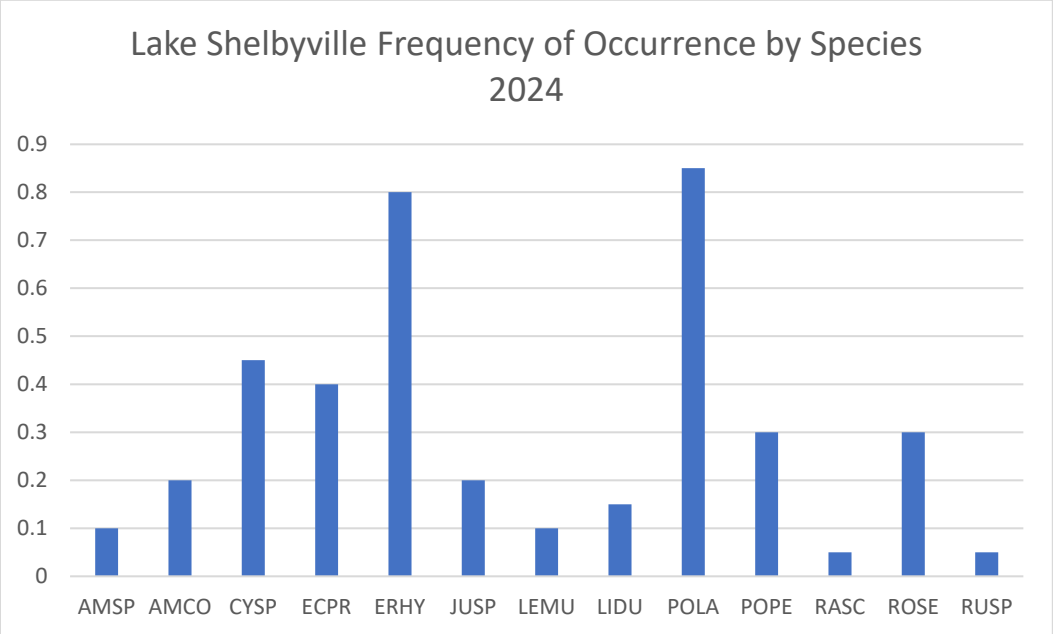

Figure 19. Frequency of occurrence by species, site 11, Lake Shelbyville, sampled 21 October 2024.

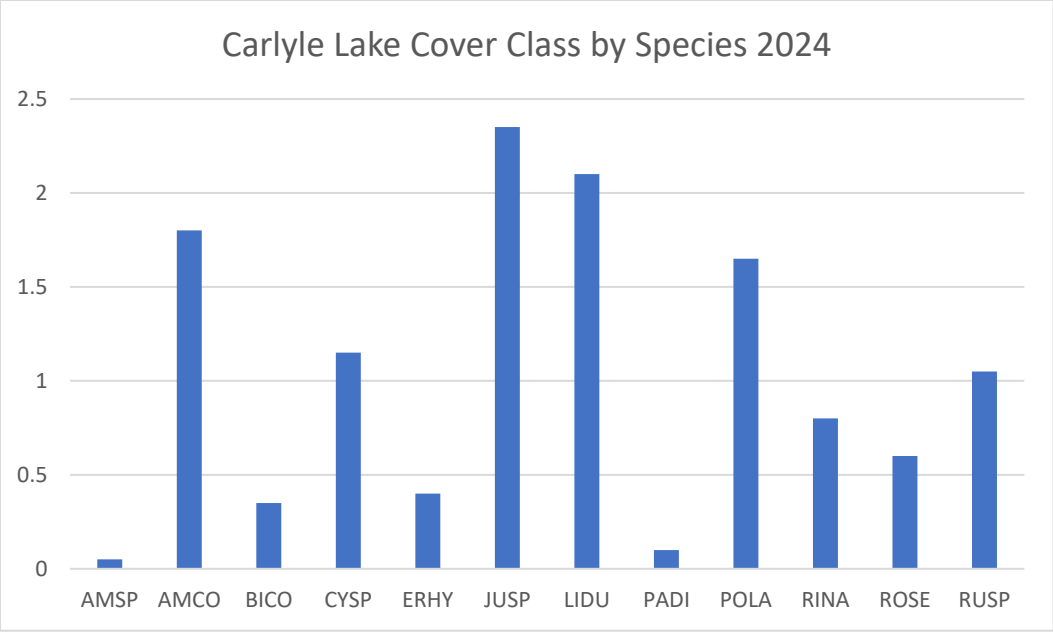

Figure 20. Average percent cover class by species, Tamalco site, Carlyle Lake, sampled 21 October 2024.

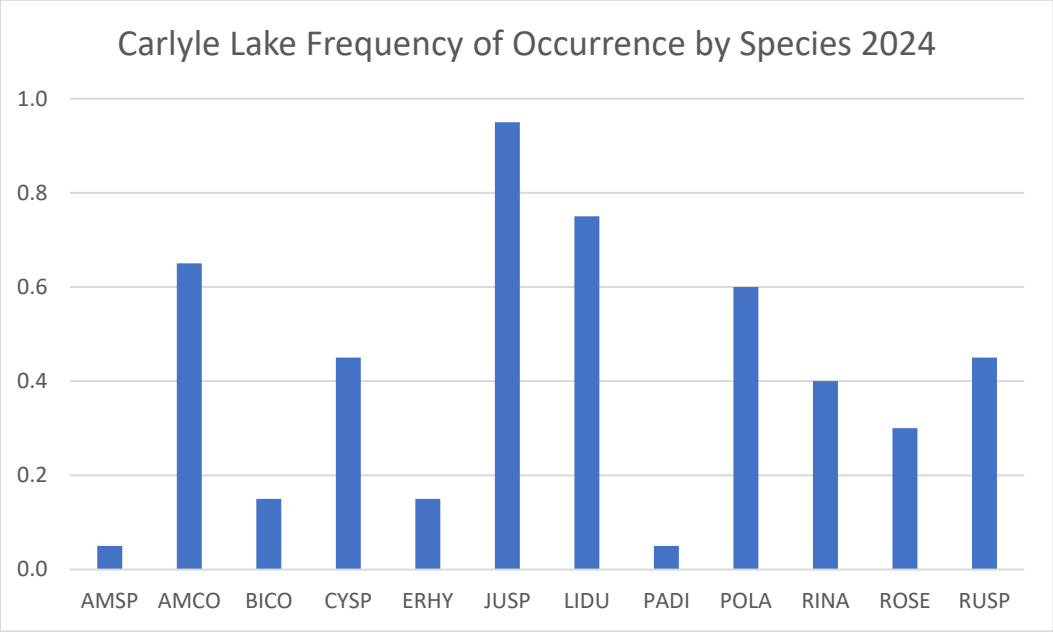

Figure 21. Frequency of occurrence by species, Tamalco site, Carlyle Lake, sampled 21 October 2024.

2.3.3 Discussion

At Lake Shelbyville, 13 species were recorded at the site 11 transect (Figure 18). The two species with the greatest overall percent cover across plots (nodding smartweed and millet) are valuable for waterfowl. Only 2 of the 13 species recorded occurred at more than half of plots.

At Carlyle Lake, the four species with the greatest percent cover included Juncus sp., false pimpernel (*Linderna dubia*), purple ammania (*Ammania coccinea*), and nodding smartweed. These four species were not disturbed by the armyworm infestation and may have been able to increase in extent due to lower competition from flatsedges and grasses. Only 4 of 12 species recorded at Tamalco access on 21 October occurred at more than half of sample plots (Figure 21).

2.4 Seedhead Analysis

Lake Shelbyville and Carlyle Lake were evaluated on dates in September and October 2024 in an attempt to gather seedhead samples for a seed production analysis. However, major seed producing species (grasses and flatsedges) were heavily grazed by an armyworm infestation in September which setback plant development to soil level for these species (Figure 8). A return visit in October did not result in enough plant development to allow a seedhead analysis to be conducted.

2.5 Conclusion

Drawdowns at Lake Shelbyville and Carlyle Lake occurred later in the season than desired. Additionally, an armyworm infestation at both sites altered plant community development towards forbs throughout many of the sites sampled. Most of these species did not produce seed this year or did so at low levels compared to typical conditions. As a result, seedhead analysis could not be conducted this year. The armyworm infestation did provide an opportunity to see how other species develop with less competition from the annual emergent wetland grasses that typically comprise a large component of the overall percent cover at sites affected by summer drawdowns. We saw increases in a number of forbs that are typically present at lower levels. The team plans to attempt drawdowns at all three sites again next year in an attempt to get seed production estimates at Carlyle Lake and Lake Shelbyville. This report continues a series of documentation about EPM activities and benefits for the Kaskaskia River (USACE 2023; USACE 2024).

3 Public Meetings and Outreach

We held two public meetings in 2024 for the Kaskaskia project. The first occurred at Carlyle Lake on 2 December 2024 and consisted of 3 individuals representing businesses, outreach groups, and adjacent landowners. The second occurred in Shelbyville, IL, on 17 December 2024 to discuss the drawdown at Lake Shelbyville as well as a dam safety summary and other mission updates for USACE authorizations at the reservoir. The second meeting consisted of approximately 4 individuals representing businesses and interested public at Lake Shelbyville.

At the Carlyle meeting, Water Control provided an update on lake management. One business owner voiced concerns on impacts to his marina during certain periods of time, specifically using this year's environmental pool drawdown period as an example. This was followed by a discussion to better understand the conditions that occur at these times each year that impact water management decisions.

At the Shelbyville meeting, Water Control provided an update on lake management during the previous year as well as anticipated management during the winter. This was followed with a summary of benefits that could result from drawdowns, a discussion of the plant response this year, and images of vegetation production from sites we've previously implemented environmental pool management. No concerns were brought up during the meeting related to environmental pool management. Several questions were asked related to water quality concerns at the lake and Water Control provided resources for attendees to better track water levels at the lake throughout the year.

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