Rehabilitation of Indian Lake, Dane County Wisconsin

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Executive Summary

The Dane County Land and Water Resources Department (LWRD), Wisconsin Department of Natural Resources (DNR) and the Friends of Indian Lake have been collectively working to rehabilitate Indian Lake since 2013. Indian Lake has experienced a decline in water quality and fisheries since a winterkill event during 2008-2009. This resulted in a fish kill which impacted the bass and bluegill. Common carp which are tolerant of low dissolved oxygen survived and became the dominant fish. Without a predator base their numbers exploded and carp biomass surpassed over 600 lbs./acre. Literature suggest carp biomass over 100 lbs./acre are detrimental to water quality.

A number of remediation techniques were evaluated and in some instances used over the last six years. This included mechanical removal and the use of a fish pesticide called Rotenone. The seining consisted of two lake-wide pulls yielding 2,000 carp. Rotenone was determined to be more effective and while the initial treatment in 2015 was compromised by weather, the 2018 was implemented in the fall after the lake was drawn down.

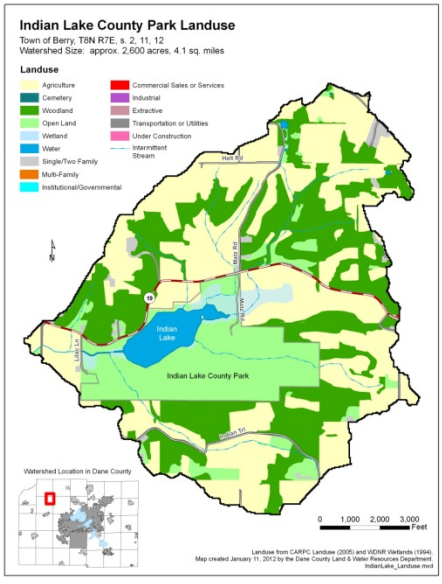
The 2018 treatment appeared to meet the desired results of eradicating common carp and lessening the black bullhead population. The Dane County LWRD and the DNR will continue to monitor the fishery in the coming years and will assess the efficacy of the treatment during the 2019 field season. Stocking plans call for bluegill, largemouth bass, yellow perch and channel catfish. With the addition of the new restrooms and shelter, kids climbing wall, the ADA fishing pier and ever popular dog park, the future of Indian Lake is positive.

Introduction

Ecological regime shifts are large, sudden changes in ecosystems that last substantial periods of time. Regime shifts entail changes in the internal dynamics and feedbacks of an ecosystem that often limit it from returning to a previous regime, even when the driver that precipitated the shift is reduced or removed. Regime shifts typically result from a combination of gradual changes in an underlying driving variable (or set of variables), combined with an external shock, such as a storm, fire, or fish kill.

Shallow lakes exhibit these regime shifts: The preferred clear-water regime is typified by seasonal periods of clear water state stable where algae are grazed to low levels, rooted aquatic plants dominate, and gamefish like bluegill, pumpkinseed, northern pike, and bass are dominant. The alternative turbid stable state regime is typified by high phosphorus levels, turbid water, dominance of algae, absence of rooted aquatic plants, and benthivorous fish (bottom feeding fish like shad, bullhead, and carp) dominate. Human perturbations, primarily, non-point and point source nutrient loading, introduction of exotic species, and water-level manipulations have caused regime shifts in shallow lakes.

Shallow lakes in the turbid water condition suffer from persistent algal blooms and tend to be resistant to recovery. In these systems, reducing external nutrient loading alone is often insufficient to restoring clear water conditions and aquatic habitat. Fish play an important role in maintaining the stable condition, whether it is turbid or clear. Common carp are often a major driver of turbid water in shallow lakes. Their feeding uproots aquatic vegetation and re-suspends sediments, leading to increased turbidity that prevents the regrowth of plants. Wetlands with high carp populations have noticeably less diverse and abundant aquatic plants, invertebrates, fish, and wildlife populations than those without carp. Furthermore, carp transport nutrients from benthic to pelagic habitats which provides a source of “new” nutrients that are fundamentally different from recycled nutrients because nutrients released by benthic-feeding fishes can increase the total nutrient content of pelagic waters. Thus, they are best compared with external nutrient loading or other net sources of nutrients (anoxic sediment transport and phosphorus from sediments during low D.O. periods).



Setting

Indian Lake is a 66-acre shallow kettle lake located in northwest Dane County, Wisconsin. To improve the water quality of Indian Lake and provide a multi-use recreational park, Dane County has purchased more than 690 acres of property around the lake since 1974. Today the entire lake is surrounded by the popular Indian Lake County Park with recreational uses that include fishing, bird watching,

picnicking, cross country skiing, dog walking, hiking with link to Ice Age Trail, canoeing and small watercraft boating.

Indian Lake is a classic example of a regime shift in a shallow lake. Historically, Indian lake supported dense aquatic plants, clear water, and a bass/bluegill fishery. Unfortunately, in 2008 Indian Lake's ecological regime shifted to the described degraded turbid condition. A partial fish winterkill in 2008 reduced the abundance of bluegill and largemouth bass. Reduced centrarchid abundance the following summer released the 2009 young-of-year common carp (Cyprinus carpio) from predation and allowed this year class to recruit in abundance. Abundant carp recruitment eliminated dense aquatic plant beds resulting in a shift to a Cyanobacteria bloom dominated ecosystem. Water quality has declined significantly and heavy Cyanobacteria blooms and their toxins pose threats to humans, dogs and wildlife. Except for few scattered submersed plants, the previous dense beds of coontail, Eurasian water milfoil have disappeared. At this stage, reducing external nutrient loading alone is often not sufficient to restore clear water conditions, aquatic plants and a centrarchid fishery.

Phase I Management and Results

Prior to the funding of this project, Dane County, Wisconsin DNR, and Friends of Indian Lake collectively planned to rehabilitate the lake by chemically treating the abundant carp and bullhead fish community with rotenone and restocking the lake with gamefish. This proven shallow lake restoration technique would have allowed a shift of the lake from its current algae dominant condition to the clear-water state with a desirable bass-panfish community.

Indian Lake was treated in late winter of 2015 with Rotenone as a method to remove an expanding common carp problem. Dane County in partnership with WDNR Fisheries and the Friends of Indian Lake worked for over a year to plan the treatment. While the treatment resulted in a high percentage of carp mortality, an unforeseen extreme warm weather event in the week following the treatment caused snow melt runoff from the watershed and early lake ice melting which severely diluted the product. Bioassays showed longer survival of test species and live fish were observed under the ice. Spring

clean-up of fish carcasses showed an overwhelming amount of dead carp along with lesser amounts of bass and bluegills.

It was not immediately known how effective the treatment was although no carp were observed in the spring of 2015. Typically shallow water thrashing during spawning provides visual evidence of adults although none was detected. DNR and Dane County subsequently began stocking of forage, bluegills, bass, walleye and northern pike. Dane County was made aware of the existence of young of the year carp by the University of Wisconsin Stevens Point fisheries students doing long-term data collection. Subsequent seining, gill netting and electrofishing conducted by WDNR in the fall of 2015 captured adult carp, however young-of-year (age-0) carp were estimated between 5,000 and 14,000 individuals based on the Sorenson P.E. Model.

As a result of the survival and recruitment of carp, Dane County LWRD applied for and received a Rapid Response Grant which was used to implement Phase II and Phase III. The grant identified seining for carp removal and water quality monitoring for and sonar plant mapping for documenting results and response to carp removal.

Young of year carp collected by UWSP in August 2015.

Phase II Management and Results

Since Indian Lake was stocked heavily stocked with game and forage in spring of 2015 and showed outstanding growth rates, it was the consensus of DNR Fisheries and Dane County that the only reasonable method to remove this cohort of carp was through seining. This would eliminate bycatch mortality and offer additional information on existing population estimates.

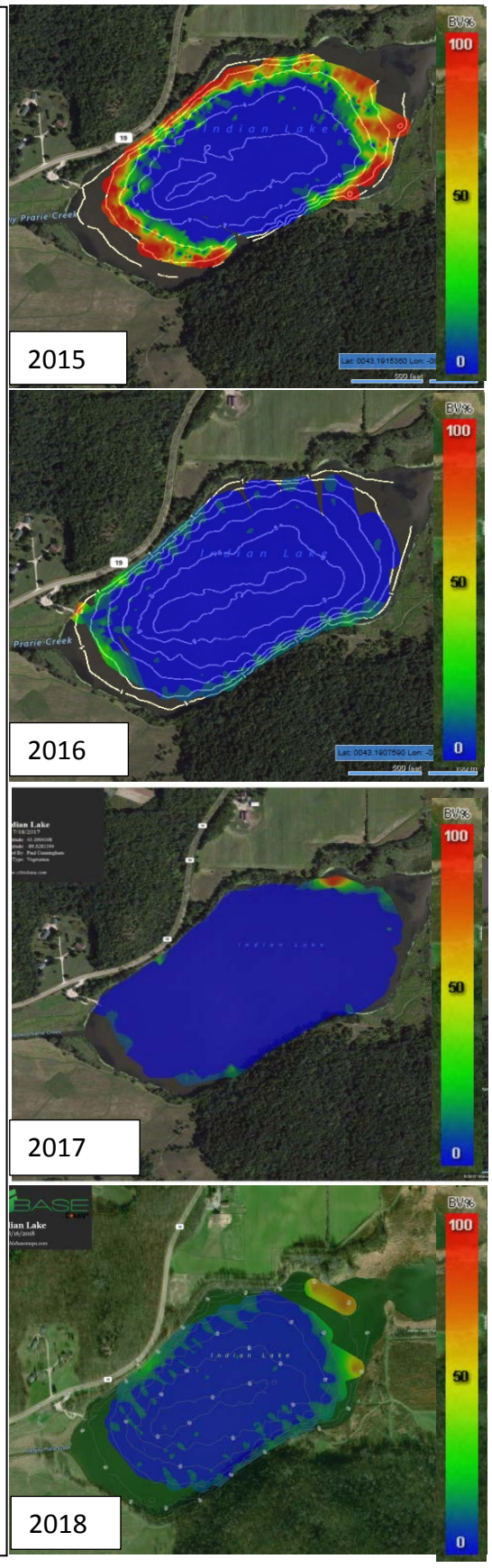
Seining of Indian Lake took place in the spring and fall of 2016. Dane County along with oversight and approval from WDNR Fisheries hired a commercial fisherman to conduct both pulls. In total, only 2,000 carp were removed during both efforts.

Removal of 1- year old carp in fall 2016. Fish showed high growth rates and averaged 11-14" in length.

Staff conducted aquatic plant sonar surveys on consecutive years during the last week of July to coincide with maximum plant densities. Sonar surveys were conducted by boating 25-meter transects and recording sonar signals and processing data using Biobase softward (https://www.biobasemaps.com/). BioBase is a cloud-based platform that automates processing and map creation of spatial data. Currently, BioBase EcoSound processes sonar log files from off-the-shelf Lowrance™sonar to create detailed bathymetric, submerged aquatic vegetation, and bottom hardness maps. All data collected is maintained in the DNR fisheries database and is not available on SWIMS.

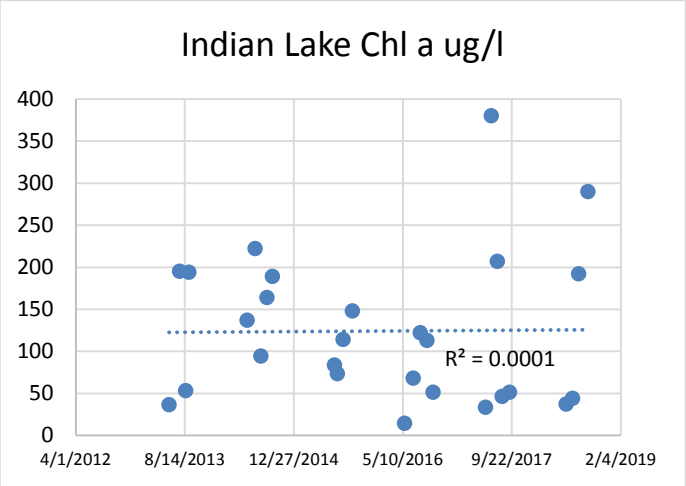
Indian Lake has lost an estimated 95% of its' rooted aquatic plant community since 2008. Aquatic plant densities shown from years 2015-2018 are at the right. Note the lack of plants which is a direct result of bioturbation by carp. 2015 densities were greater as the lake remained in a clear water phase until that year class of carp became benthivorous.

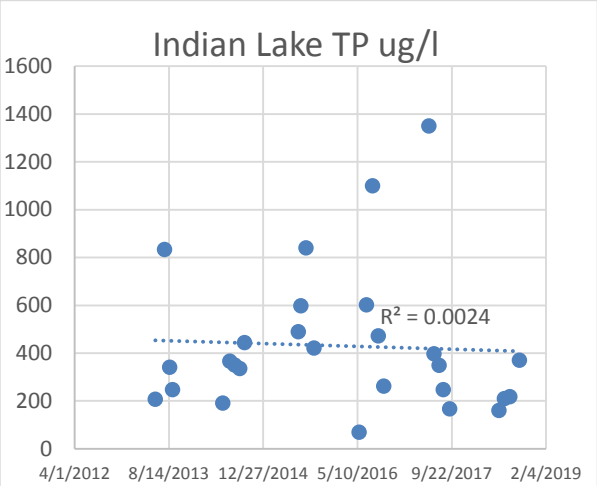
With the decline of aquatic plants due to carp and bullhead rooting in the sediments, average clarity in the lake is less than 18" during the summer months. Turbid conditions decrease the photic zone and make it difficult for plants to grow and mature in such conditions. Nutrient loading from outside sources is limited however internal loadings and resulting blue green algae blooms occur. Removal of carp and bullhead biomass should result in clear water conditions allowing plants to thrive and use bioavailable nutrients limiting blue green algal blooms. Water quality monitoring and sonar surveys were conducted from 2015-2018. Dane County staff and the Friends of Indian Lake have been conducting monthly water quality testing since 2014.
No discernable differences were noted in either Chlorophyll a or phosphorus concentrations in the trend data below. Dane County will continue



Submerged aquatic vegetation density heat maps for 2015-2018. Color ranges show % plant biovolume where red depicts 100% and blue depicts 0 % biovolume. Plant biovolume refers to the percentage of the water column taken up by vegetation.

water quality monitoring for the foreseeable which will provide further clarification on trends. All water quality results can be seen in SWIMS.





Trophic State Indicators showing little to no change. Indian Lake remains Eutrophic.

Continued monitoring of Indian Lake in 2017 and 2018 showed the predator base improving. The initial stocking of bluegills had successfully recruited and the northern pike densities and growth were high.

On July 4th 2017 the lake experienced a heavy blue green algae bloom which resulted in a severe fish kill. Agency response early on July 5th showed oxygen levels below 1.5ppm and moribund fish of all species throughout the lake.

In September 2017 DNR Fisheries and Dane County Staff electro-fished Indian Lake. Staff determined that a healthy mature population of carp still existed and a majority of predator fish were lost during the July 4th fish kill. 2015, '16 and '17 year classes of carp were present and the 2+ year olds were deemed sexually mature.

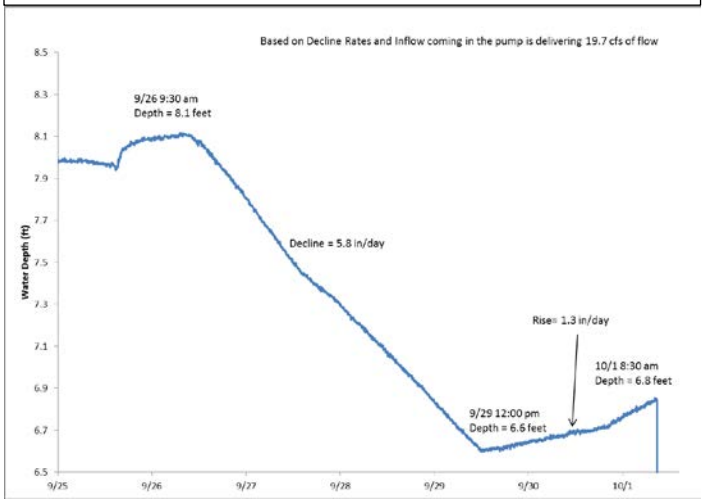
Phase III Management

Dane County and DNR launched another rotenone treatment planning process in spring 2018. As with the first objective, rotenone was deemed as the best option with a target date of fall 2018. The updated project plan involved drawing the lake down to a manageable size for an effective rotenone application to eradicate common carp, followed by native fish restocking and establishing desirable submersed, floating-leafed, and emergent aquatic plants. Fisheries objectives include: 200 bluegill per mile catch per unit effort, 20-50 largemouth bass per mile catch per unit effort and less than 5 carp per mile catch per unit effort.

The project team was able to secure a 24" pump and retrofitted agricultural tile lines to allow discharge of lake water to downstream Halfway Prairie Creek.

Dewatering included placing the pump near the public boat landing and connecting 400' of 24" drain tile to convey discharge to downstream Halfway Prairie Creek. Pump is capable of 40 cfs or 15,000 gpm. After connecting the tile, Dane County staff secured joints with stone to prevent water pressure from moving or breeching the connections. The tile lines will be repurposed on the County's trail systems as culvert replacements.

Pumping rates out of Indian Lake averaged 5.3 inches per day while recharge rates were 1.3. Getting lake levels down 3' allowed adequate time for the rotenone to detoxify before discharge to Halfway Prairie. Less water volume resulted in over an $8,000 savings in product.



Dane County calculated flow outputs and worked with DNR permitting to evaluate any potential downstream impacts. Unknown was the rate of recharge of Indian Lake. Best estimates indicated refill rates at 1-3 weeks. Improved rotenone efficacy would be maximized with at least a week while also negating having to use potassium permanganate to neutralize any potential outflow to downstream Halfway Prairie Creek. In order to more accurately predict recharge, a test pump was conducted in September to draw the lake down 2.5'. Staff deployed barometric sensors and the lake was allowed to fill. Changes noted in pressure were then converted to water levels giving the project team accurate refill rates and confirming the pumping as a viable option for the treatment. An additional benefit from the drawdown was that less product was used resulting in a significant product cost savings.

Treatment

WDNR contracted the rotenone treatment via an aerial application. All logistical measures including permitting, determining flight path and concentration was the responsibility of the WDNR's Rotenone Action Team (R.A.T.) The project team set a application window based on precipitation, wind and temperature. Treatment occurred on October 18, 2018 and took roughly 3 hours to complete.

Contract applicators load the helicopter in-between spraying flights. 10 flights were made following transects located on the helicopter's gps unit. The sprayer was calibrated to dose the lake at 3ppm of rotenone. 270 gallons of rotenone were used in total for the treatment of the lake and both the upstream inlet and downstream portion of Halfway Prairie to HWY 19.

RAT members also treated the small inlet upstream of Indian Lake and the outlet including Halfway Prairie Creek down to HWY 19. This particular area did contain large numbers of young of the year carp determined by electrofishing.

Young of the year carp collected from Halfway Prairie Creek 100 meters downstream of Indian Lake. Upper reaches of the stream held significant numbers of carp that would have eventually made it back into the lake without being treated.

Post treatment bioassays indicated lethality until approximately 1 week after treatment. The use of fathead minnow (tolerant) and white sucker (intolerant) were placed in small cages and monitored daily until survival of white sucker reached three consecutive days.

Rotenone does break down rather quickly in open water via photodegredation. Post treatment surveys in lake were not conducted although visual observations indicated a thorough kill. Hundreds of massing gulls were also present at the lake in weeks after.

Future Management Actions

Dane County and WDNR will conduct early spring electrofishing to determine what if any survival has occurred. There was a small restocking effort made in November of 2018 which was limited due to early ice formation and failed seining attempts for bluegills. However, 2,500 largemouth bass fingerlings were introduced.

Spring of 2019 will include the stocking of at least 500 adult bluegills which should allow for recruitment. Additionally, Dane County and the Friends of Indian Lake will stock yellow perch, forage, and channel catfish with more largemouth bass committed for the fall of 2019. There is also the possibility of stocking northern pike depending on hatchery availability. Further evaluations of the game fish will occur in future years to determine how the lake has recovered.

Success of the project will also be determined by annual monitoring of the plant community and water quality. DNR and Dane County will continue to partner on annual sonar plant survey and mapping. By combining both field observations and the sonar mapping, a clear understanding of the plant response with a target goal of 60-80% aerial coverage will be an excellent indicator on the success of the project. Dane County will also continue water chemistry analysis for nutrients and chlorophyll a along with Secchi and oxygen profiling.

Long-term management includes the replacement of a new aerator motor and blower in 2019. The aeration line itself was replaced in 2017 and has demonstrated to be very effective while maintenance free. As part of the pumping, Dane County dredged and repaired the existing boat landing which will improve access. Parks operations will also be moving the ADA fishing pier near the landing which will create further opportunities to partake in the improved fishery.

Culvert located at Lilac Lane just downstream of Indian Lake on Halfway Prairie Creek. The culvert was retrofitted with a steel barrier to prevent upstream carp migration to Indian Lake. During high flow events the barrier will allow water to flow through.