Options for carp management in Hess Lake
2-10-2023
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Background

In 2022, Carp Solutions carried out a pilot carp management project on Hess Lake to estimate the carp population and biomass density and test box netting as a removal method. The carp population was estimated to be around 32,000 with a biomass density of about 250 kg/ha, well above the management threshold of 100 kg/ha. While difficulties were encountered for box netting, it did prove to be a viable option that when scaled up significantly could bring the population below the management threshold. However, smaller carp were found in the lake, indicating reproduction within the system. Before large scale removals, the reproduction should be studied and prevented in order to ensure that the population does not continue to grow. This proposal lays out the timing and cost of the various activities both for the summer of 2023 (Task 1 and 2) as well as options for future removal contingent on the results of reproduction surveys in 2023.

Task 1: Tracking of spring migrations with PIT antennas systems

To make sure that removals of carp have a long term impact, it is critical that reproduction of carp in a system is understood and controlled so that the carp are not able to replace those removed. In lakes such as Hess Lake, carp reproduction typically occurs in peripheral/attached shallow water bodies that frequently winterkill and lack bluegills and other micropredators (Bajer and Sorensen 2010). Carp tend to migrate to these water bodies in large numbers in the spring, often through small streams connecting them to the main lake. Carp reproduction in the main lakes is often very sporadic because of native micropredators. In the Hess Lake system, the most likely areas that carp would attempt to migrate to spawn in are the Wheeler Drain and Brooks Lake. These migrations can be tracked by the use of PIT antenna systems, just like those used in the box nets in 2022. An antenna that picks up PIT tags implanted in carp would be stretched across a suitable section of the inlet or outlet stream. This antenna would detect any PIT tagged carp migrating to Wheeler Drain or Brooks Lake. Information on the number of carp detected and the timing of these detections can be used to inform the future use of barriers to block these migrations and provide an opportunity for removal of the migrating carp. Although having more PIT tags implanted in carp is always better, the 129 PIT tags implanted in 2022 should be sufficient to show patterns of migration out of the lake in the spring of 2023. To cover all bases and ensure that carp are not using the other five smaller inlets to Hess Lake, we recommend the use of remote access security cameras checked remotely every day at these inlets during the same period as the PIT antennas. While they are cheaper than the PIT antennas, they do not provide the same level of detail as regards the number of carp migrating and the time of these movements. It can be merely seen if carp aggregate at the inlet streams or culverts, some idea of what time of year and day they

aggregate, and a rough idea of how many carp are present. If these antennas are used in the spring of 2023 and reveal significant migratory patterns, a barrier to block carp migration could be designed and built before the migration in the spring of 2024. In order to capture the whole migration, we propose the installation of these PIT antenna systems in mid-late March and keeping them running until at least mid-June. Additionally, we will need PAE to coordinate with land owners on the placement of these antenna systems. Just like the systems used in box nets in 2022, these systems would have remote online access for us to monitor whether they are working and monitor the carp migration live. In the case of issues with the system, we budgeted for two additional maintenance trips if required to ensure that the PIT systems remain operational all spring.

Cost for PIT antennas: $31,422

Figure 1: A PIT antenna system in a stream in Minnesota for tracking the spring migration of PIT tagged common carp.

Task 2: Aging

In order to provide information on the reproduction of the carp in Hess Lake, carp should be aged using their otoliths. A sample of 50 carp would be caught by boat electrofishing so that their otoliths could be removed for aging. The otoliths would be removed onsite, and the length and weight of the carp they were removed from measured. This would take place over a two day period in the mid-late June and would be performed on the same trip that the PIT systems are uninstalled. In the winter of 2023-2024, Carp Solutions would embed the otoliths in epoxy and section them to obtain their age from the annuli of the otolith as seen in the example in Figure 2. This age data will show the history of carp in the system and specifically their pattern of reproduction. If reproduction occurs in pulses, especially corresponding to harsher winters, this generally indicates that carp are primarily reproducing in peripheral waterbodies that winterkill frequently (Bajer et al. 2015). On the other hand, if carp reproduction is consistent, this indicates that micropredators in the system are incapable of controlling the in lake reproduction of carp. Along with the PIT antenna data, this will shed light on the patterns of reproduction in the Hess Lake system so that we can develop a strategy to deal with it. Disposal of carp carcasses will be needed either through the use of an onsite dumpster or with the partnership of a local farmer for burial in a field.

Cost for aging: $7,556

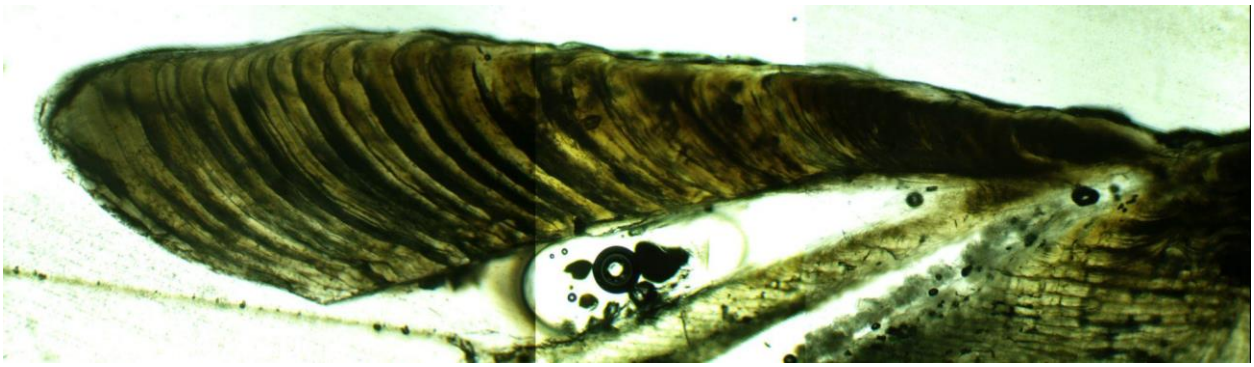

Figure 2: A section of an otolith from a carp from a lake in Minnesota.

After the locations and patterns of reproduction have been investigated in 2023, removal should be conducted starting in 2024 to reduce the carp populations below the 100 kg/ha management threshold. There are three main options for removal: spring spawning migration, box netting, and cold water seining. If there is a significant spring spawning migration observed by the PIT antennas, that migration should be blocked with a physical or electric barrier to prevent reproduction in the system. The migrating carp can be targeted for removal at the barrier. Spring removals are often the most efficient and effective means of removal when a large portion of the adult carp in the lake migrate out of the lake. If there is not a significant spawning migration, in lake removals will be required. Larger scale box netting than occurred in 2022 as regards both the number of nets and the number of times the nets are pulled would be required over multiple years. This netting would need to be preceded by annually implanting carp with more PIT tags. PIT antennas around the bait would be used to fine tune the baiting amounts and timing along with guiding the tripping times for the nets. Another alternative removal method is coldwater seining. Common carp tend to aggregate in large groups as water temperatures fall below 5℃ (41℉) (Bajer et al. 2011). These aggregations can be targeted by open water seines in the late fall or early spring or if ice conditions allow, late winter. This method utilizes the “Judas fish” technique, where some carp (~ 20 in lake the size of Hess Lake) are implanted with a radiotelemetry tag. These carp can then be tracked to observe their behavior, especially when they aggregate heavily.The aggregations located in this way can then be netted with a seine net. However, seining may be of limited use if obstacles (large rocks, trees, etc.) are present in areas where carp aggregate as these obstacles can snag the net. Before employing this technique, it would be necessary to implant radio tags in at least 20 carp in Hess Lake in the fall and track them monthly to see if they form large aggregations in suitable areas to seine.

Report

At the conclusion of the carp reproduction surveys, we will provide a written report with management recommendations. The report will be submitted by January 31, 2024.

Report Cost: $1,000

Detailed budget for tasks 1&2 below

Literature cited

Bajer, P. G., & Sorensen, P. W. (2010). Recruitment and abundance of an invasive fish, the common carp, is driven by its propensity to invade and reproduce in basins that experience winter-time hypoxia in interconnected lakes. Biological Invasions, 12(5), 1101-1112.

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Bajer, P.G., Beck, M.W., Cross, T.K., Koch, J.D., Bartodziej, W.M. and Sorensen, P.W., 2016. Biological invasion by a benthivorous fish reduced the cover and species richness of aquatic plants in most lakes of a large North American ecoregion. Global Change Biology, 22(12), pp.3937-3947.

Hundt, P.J., White, L.A., Craft, M.E. and Bajer, P.G., 2022. Social associations in common carp (Cyprinus carpio): Insights from induced feeding aggregations for targeted management strategies. Ecology and evolution, 12(3), p.e8666.

		Hours/Days /Months	People/ units	Rate per person/ unit	Hourly /Daily rate	$	$ Totals
Task 1: Migration Tracking							
PIT and Data Collection							
	System Preparation	8	2	100	800	1600	
	Install PIT antennas	12	2	100	200	2400	
	Uninstall PIT antennas	10	2	100	200	2000	
	PIT system operation, monitoring, and weekly reports	3	2	1000	2000	6000	
	Cloud data fees for remote PIT system operation	3	2	200	400	1200	
	Remote camera at the other 5 inlets	5	3	200	1000	3000	
	PIT system subtotal						**16200**
Travel Costs							
	Install						
	Mileage from MN to Hess Lake (install)		1226	0.625		766	
	Time for travel round trip from MN to Hess Lake	22	2	100	200	4400	
	Per Diem	4	2	64	128	512	
	Housing	3	2	150	300	900	
	Potential maintenance trips (two trips budgeted)						
	Mileage round trip from Chicago to Hess	2	430	0.625	269	538	
	Time for travel round trip from Chicago to Hess Lake	14	1	100	100	1400	

	Housing	2	1	150	150	300	
	Per Diem	4	1	64	64	256	
	Uninstall						
	Mileage from MN to Hess (uninstall)		1226	0.625		766	
	Time for travel round trip from MN to Hess Lake	22	2	100	200	4400	
	Housing	2	2	150	300	600	
	Per Diem	3	2	64	128	384	
	Travel Costs						**15222**
Task 1 Total:							**31422**
Task 2: Aging Carp							
Electrofishing							
	2 half days of boat electrofishing	8	2	100	200	1600	**1600**
Carp Aging							
	2 half days of otolith removal (50 Otoliths)	8	2	100	200	1600	
	Embedding, sectioning, and slide interpretation (~20 min/ fish)	16.5	1	100	200	3300	
	Materials					200	
	Aging costs						**5100**
Travel Costs							
	Aging Housing	2	2	150	300	600	
	Per Diem	2	2	64	128	256	
	Travel costs						**856**
Task 2 Total:							**7556**

	Report and analysis						**1000**
TOTAL							**39978**