

Project Title: eDNA Monitoring in the Upper Mississippi River

Geographic Location: Mississippi River (Pools 7, 8, 16), Turkey River, Wisconsin River, Upper Iowa River, St. Croix River, Minnesota River

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Statement of Need: In the surveillance and detection of a species in areas where it is rare, using multiple detection methods provides a balanced and a more complete monitoring program. Most efforts to monitor and remove Silver and Bighead Carp from the Upper Mississippi River (UMR) occur below Lock and Dam 15. Using eDNA upstream of this area as a long-term monitoring tool could provide early evidence of changes in the presence of invasive carps in pools and tributaries where traditional capture gears are not heavily utilized, which could inform future redirection of effort. Recommendations from the latest research aimed at refining eDNA use for Bighead and Silver Carp DNA detection are being implemented in the UMR each year and annual eDNA results in the UMR contribute to better understanding and utilization of eDNA technology for this purpose. The eDNA program is intended to be adaptive and to look at trends of positive detections over time. Each year of collection may make these data more meaningful.

Project Objectives:

- 1) Continue long-term multi-year eDNA monitoring in Mississippi River pools above the Intensive Management Zone (IMZ) and select tributaries of the UMR to provide data to infer trends or changes in invasive carp presence.
- 2) Continue work to refine optimal sampling design, sampling methods, and eDNA data interpretation

Project Highlights:

- USFWS collected 1,426 eDNA water samples across three Mississippi River pools and five tributaries
- Efforts in Pools 16 were conducted where a real-time telemetry receiver exists in order to compare eDNA detections to the presence of telemetered invasive carps
- The Wisconsin River yielded a high rate of positive detections during both spring and fall sampling
- Pool 7 was added in replacement of Pool 5 in the fall due to accessibility issues at the Pool 5 site

Methods:

USFWS staff from the La Crosse FWCO conducted spring sampling in Pools 8 and 16. Work that had been planned in Pools 5 and 5a was cancelled due to high water. As part of Objective 1, four backwater sites in Pool 8 were targeted with 100 samples and 10 field blanks each, and an additional off-channel area near the French Island powerplant as targeted with 50 samples and 5

field blanks. Credit Island backwater in Pool 16 was sampled for Invasive Carp DNA, as part of Objective 2, to add points of comparison between eDNA and telemetry detection data.

In late spring, five tributaries were sampled for Invasive Carp DNA including the Turkey and Upper Iowa Rivers in Iowa, the Wisconsin River in Wisconsin, the Minnesota River in Minnesota, and the St. Croix River bordering Wisconsin and Minnesota. In the Wisconsin, Turkey, Upper Iowa, and Minnesota rivers, sampling focused on the portion of each tributary downstream of the first barrier. The St. Croix River was also sampled; however sampling was focused on two backwater sites near Stillwater, MN. Sample sizes in tributary sites ranged from 44 to 110 samples, including field blanks.

Fall samples were collected from one site (Bluff Slough) in Pool 8 and two sites in Pool 7. Pool 7 was sampled in replacement of Pool 5 where fall waterfowl closures restricted access to desired sites. With advisement from MN DNR, samples intended for Pool 5 were reallocated to two sites in Pool 7. In both pools 7 and 8, 100 samples and 10 field blanks were collected. Credit Island backwater in Pool 16 was intended to be sampled in the fall also as an additional opportunity to compare telemetry and eDNA detections, however low water in that pool interfered with the utility of the real-time receiver, so sampling was cancelled.

All sample collection and processing procedures followed the 2023 Quality Assurance Project Plan (USFWS 2023). Field blanks were taken in addition to regular monitoring samples. Field blanks are a quality control measure and are not included in reported results. All samples are analyzed for the presence of carp eDNA with three marker sets: Silver Carp only, Bighead Carp only, and non-specific invasive carp. The non-specific invasive carp marker set can detect either Bighead Carp or Silver Carp but is not specific enough to say which species of the two. This is reported as a non-specific "Invasive Carp" detection. If both species-specific markers are detected in a water sample, it is reported under the "Bighead AND Silver" category.

Results and Discussion:

In Pool 8, the rate of positive eDNA detection was 2.7% across all sites and ranged from 0-5% at individual sites (Silver only and non-specific Invasive Carp marker types detected) in the spring (Figure 1). The total rate is higher than the spring of 2022 (<1%), but lower than the spring of 2021 (4%). In the fall in Pool 8, the rate of positive detection was 10% at the single site sampled (Silver only and non-specific Invasive Carp marker types detected; Figure 2). The fall detection rate at this location was higher than the the previous two years (5% in 2021 and 0% in 2022). In Pool 7 in the fall, the total rate of positive eDNA detection was 4% across two sites and ranged from 0-5.3% at individual sites (Silver only, Bighead only, and non-specific Invasive Carp marker types detected; Figure 2).

For tributaries, the Turkey and Minnesota Rivers had zero positive eDNA detections (Figures 3-4). The Upper Iowa River had a 2% positive detection rate (Silver only marker type detected;

Figure 5). These three tributaries were all new sites, so there are no past data for comparison. The St. Croix River had a total positive detection rate of 3.5%, compared to 6% the previous spring, with a range of 0-7% at individual sites (Bighead only and non-specific Invasive Carp marker types detected; Figure 6). The Andersen Bay site on the St. Croix River, near Bayport, MN, had a similar detection rate in 2023 (7%) compared to the previous spring (8%), and in both years the detections only consisted of Bighead and non-specific Invasive Carp marker types detected. This is unique to all other eDNA sampling locations in the UMR where detections are overwhelmingly Silver carp DNA. Telemetry data has shown a resident, tagged bighead that frequents this site and may be contributing to the build up of Bighead carp DNA. In the spring, the Wisconsin River had a positive eDNA detection rate of 24% and 48% in the fall (all marker types detected; Figure 7). These rates are both higher than the previous spring and fall which had 20% and 2% positive detection rates, respectively.

At Credit Island backwater in Pool 16, where samples are collected in order to compare with telemetry detections, the positive eDNA detection rate was just over 51%, which was higher than the previous two springs — 45% in 2021 and 25% in 2022 (Figure 8). There were 15 individual Invasive Carp detected in the backwater the day before sampling including 14 Silver carp and one Silver and Bighead carp hybrid, compared to two tagged Silver carp and one hybrid present in the days leading up to sampling in 2022.

In the spring of 2023, prolonged flooding on the Mississippi River caused an extended period of open river conditions on all lock and dams above Lock and Dam 19. This occurred when water temperatures were warm enough to trigger upstream movements of a large number of Invasive Carp (Mark Fritts, USFWS, personal communication). This mass movement was observed not only in an increase in the number of sightings and captures of Invasive Carp in various pools between above Lock and Dam 5 and 15, but also in the detections of acoustically tagged invasive carp. Many of these individuals made their way to Pool 5a and then either remained in that pool or retreated one or more pools downstream as river conditions returned to normal. This influx of individuals likely caused an increase in positive detection rates in both pool 8 and the Wisconsin River between the spring and fall, which is opposite of previous years, as carp potentially took up residence in these areas after their initial arrival. Particularly, the doubling of the detection rate in the Wisconsin River between spring and fall sampling events may suggest that some of these new fish chose to reside and overwinter in that area rather than simply utilizing it for spring spawning runs. This is also supported by the huge increase in detection rate in the fall of 2023 compared to the previous fall.

The detection rates in the St. Croix River were consistent with past years potentially indicating that the influx of Invasive Carp from the IMZ did not make it up that far in the system, or at least had not prior to the time of eDNA sample collection. New sampling areas like the Minnesota River, Turkey, and Upper Iowa Rivers saw low to no eDNA detection. The detection in the

lowest portion of the Upper Iowa River may also be tied to the upstream movement of Invasive Carp from the IMZ.

Tables and Figures:

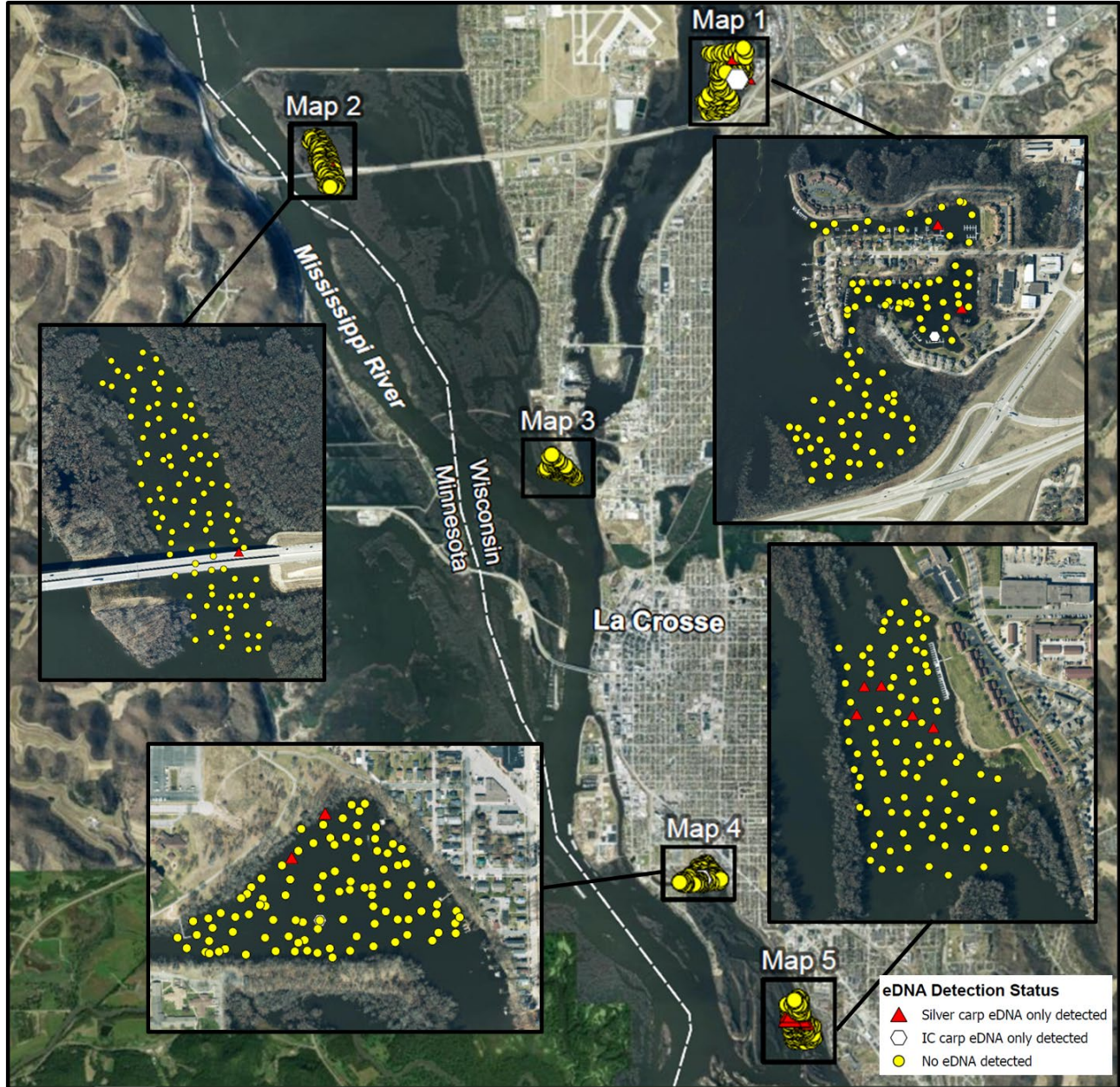


Figure 1. Detection results for Invasive carp eDNA sampling in Pool 8 of the Upper Mississippi River in spring 2023.

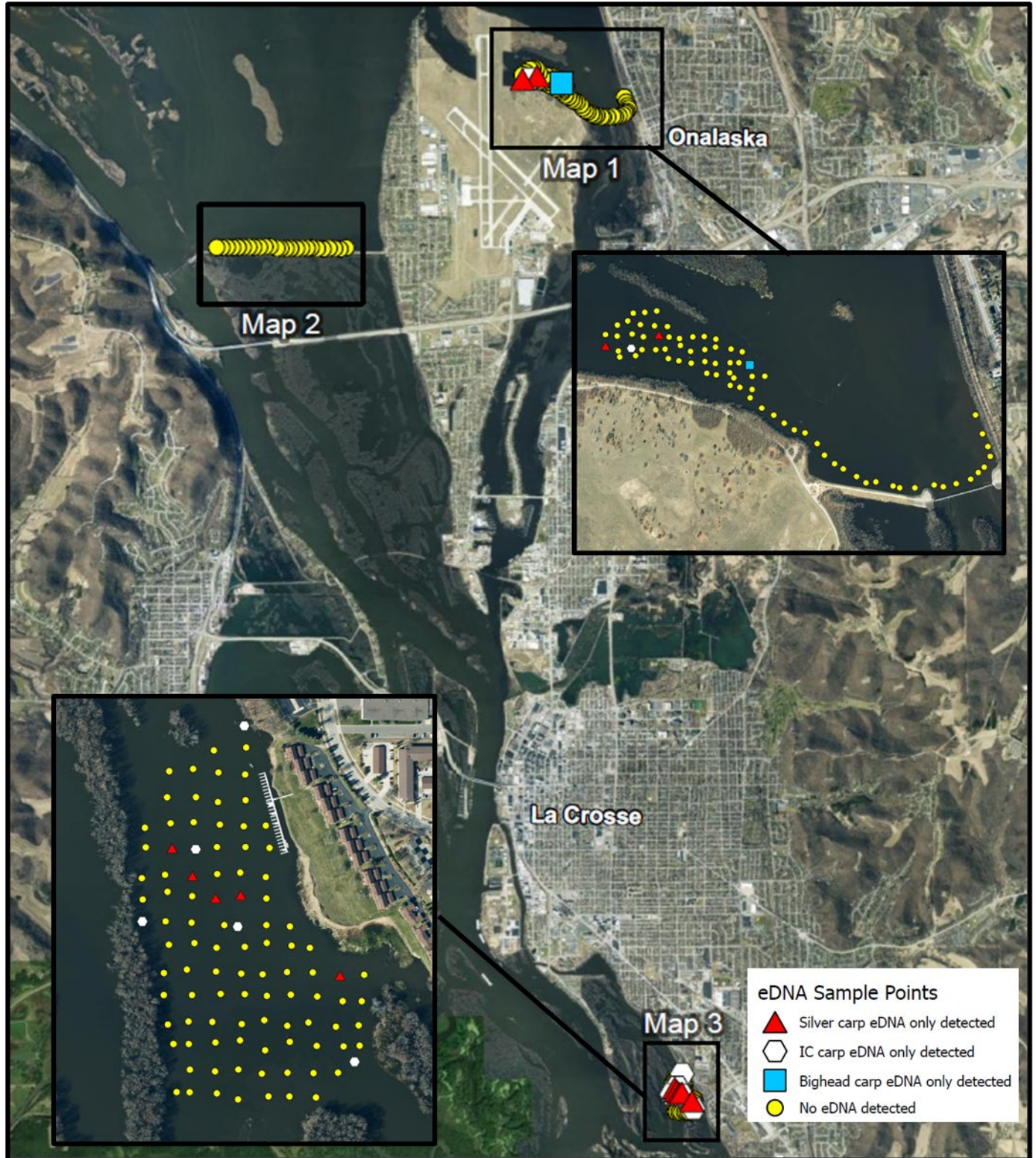


Figure 2. Detection results for Invasive carp eDNA sampling in Pool 7 and 8 of the Upper Mississippi River in fall 2023.

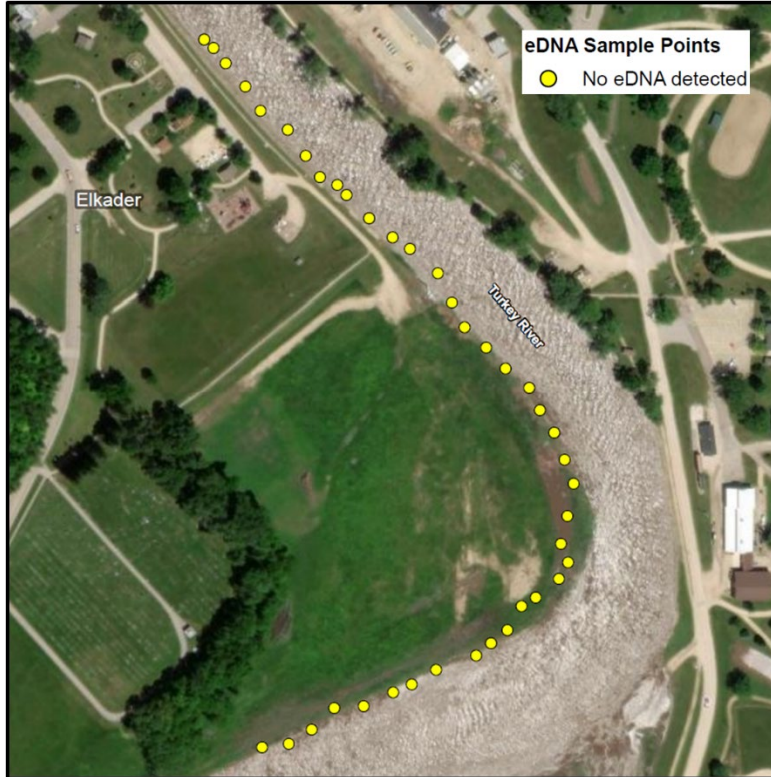


Figure 3. Detection results for Invasive carp eDNA sampling in the Turkey River near Elkader, Iowa in spring 2023.

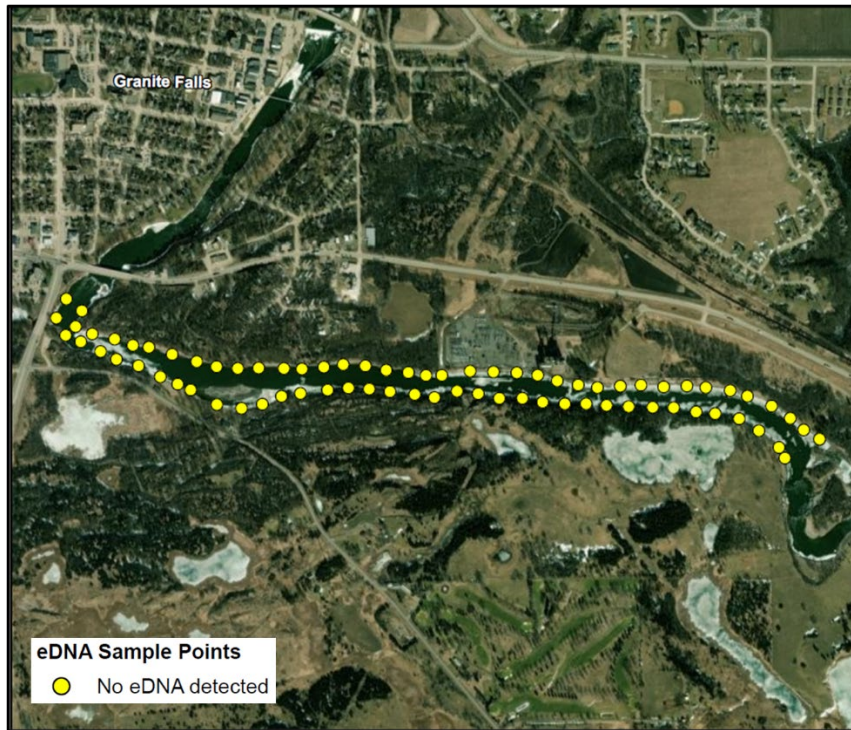


Figure 4. Detection results for Invasive carp eDNA sampling in the Minnesota River below the Granite Falls Dam in spring 2023.

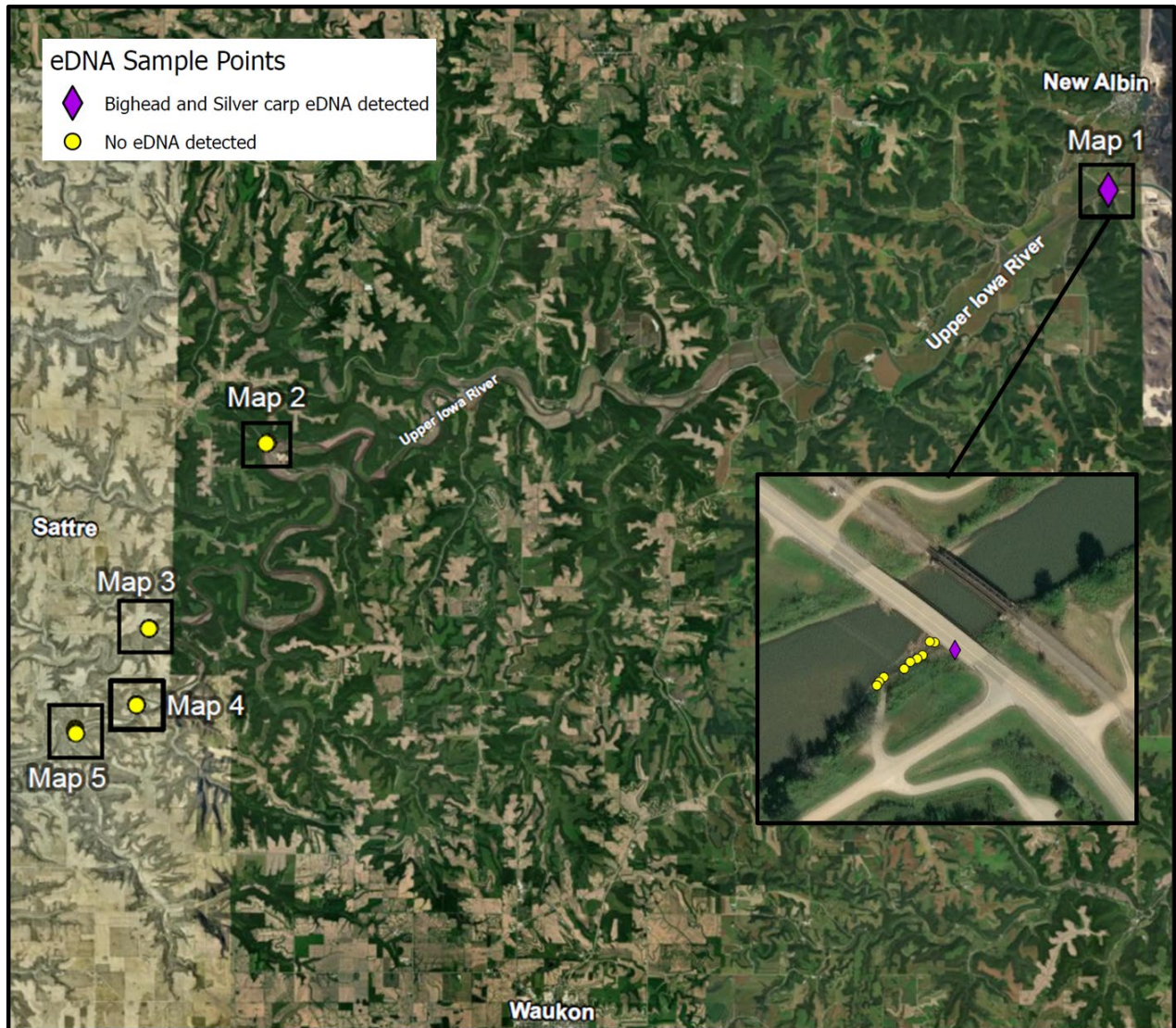


Figure 5. Detection results for Invasive carp eDNA sampling in the Upper Iowa River in Iowa in spring 2023.

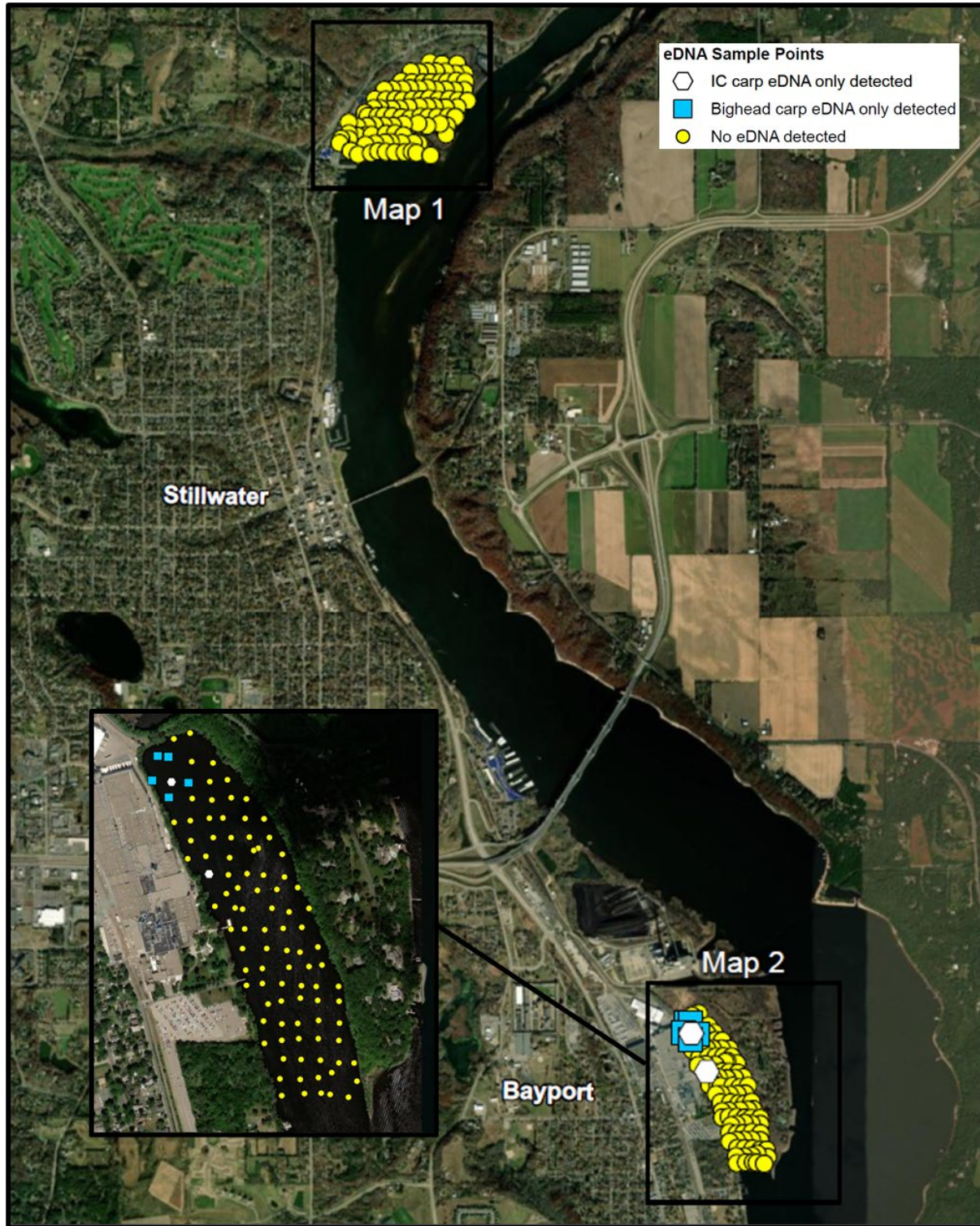


Figure 6. Detection results for Invasive carp eDNA sampling in the St. Croix River near Stillwater, MN in spring 2023.

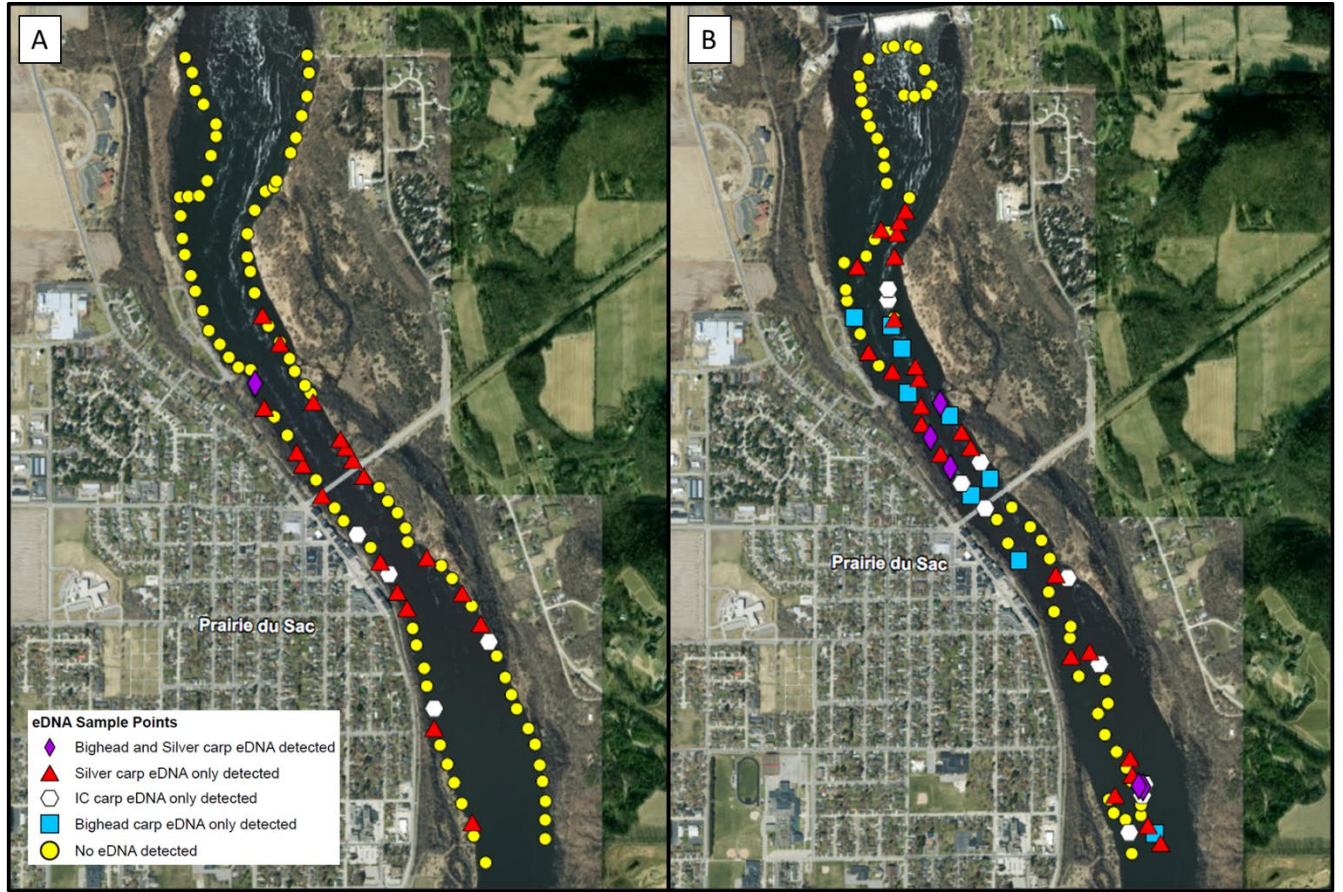


Figure 7. Detection results for Invasive carp eDNA sampling in the Wisconsin River below the Prairie Du Sac Dam in spring (A) and fall (B) 2023.

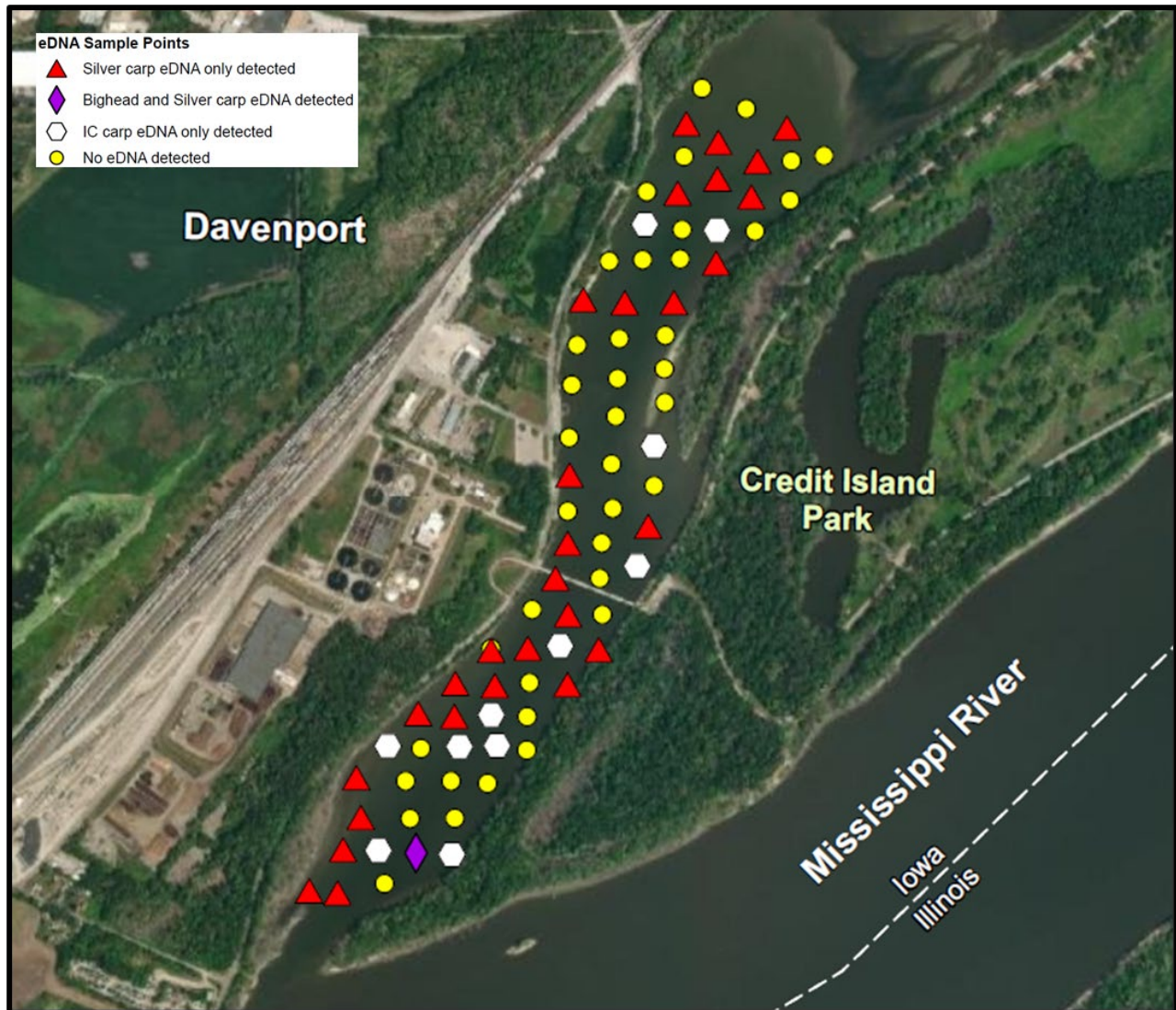


Figure 8. Detection results for Invasive carp eDNA sampling in Credit Island backwater in Pool 16 of the Upper Mississippi River in spring 2023.

Recommendation:

Given the movement and apparent new residency of so many Invasive Carp in 2023 to pools just below Lock and Dam 5, the utility and locations of use of eDNA monitoring should be reconsidered for 2024. eDNA has the greatest utility in areas where little is known about the invasive carp population and is used to give evidence of changing presence where other gears or efforts are lacking. Given this influx of Invasive Carp to the La Crosse region in 2023, and the telemetry and physical netting surveillance now occurring, locations below Lock and Dam 5 are no longer considered the invasion front and therefore the application of eDNA sampling is best utilized further upstream. La Crosse FWCO proposes that, going forward, eDNA be used in pools and tributaries above Lock and Dam 5 to help locate new areas of congregation and use by Invasive Carp that may have passed this dam in 2023 and remained upstream.

References:

US Fish and Wildlife Service (USFWS). 2023. Quality assurance project plan eDNA monitoring of bighead and silver carps. Midwest Region, Bloomington, Minnesota. Available: https://www.fws.gov/sites/default/files/documents/2023_QAPP_508_0.pdf