

Telemetry of Asian Carp in the Ohio River

Authors: Jeff Stewart, Neal Jackson, Chris Hickey, Katherine Zipfel, Jeremy Pritt

Participating Agencies: US Fish and Wildlife Service (USFWS), Kentucky Department of Fish and Wildlife Resources (KDFWR), Ohio Division of Wildlife (ODNR DOW), West Virginia Division of Natural Resources (WVDNR), Indiana Department of Natural Resources (INDNR)

Introduction:

The bigheaded carps, herein referred to as Asian carp, include the Silver Carp (*Hypophthalmichthys molitrix*) and Bighead Carp (*H. nobilis*) as well as hybrids between these species. Populations of these two introduced aquatic nuisance species (ANS) are spreading throughout the Mississippi River Basin (Conover et al. 2007; Chapman and Hoff 2011; O'Connell et al. 2011). Kolar et al. (2007) rated the probability of Silver and Bighead Carp spreading to previously uncolonized areas as "high" and assigned this rating a "very certain" degree of certainty. Asian carp are highly invasive fishes that have been expanding their range in the U.S. since the early 1980's when they first began to appear in public waters (Freeze and Henderson 1982; Burr et al 1996). Populations of Asian carp have grown exponentially because of their rapid growth rates, short generation times, and dispersal capabilities (DeGrandchamp 2003; Peters et al. 2006; DeGrandchamp et al. 2008). Asian carp have been shown to exhibit very high reproductive potentials with high fecundity and the potential for a protracted spawning period (Garvey et al. 2006). Garvey et al. (2006) stated that high reproductive capacity of both species, in particular Silver Carp ensure that attempts to exclude or remove individuals will require a massive undertaking that targets juveniles as well as adults. These fishes have invaded the Ohio River system and are spreading up the river and many tributaries. Populations of Asian carp have become well established in the lower and middle reaches of the Ohio River and successful reproduction is suspected as far upstream as the Falls of the Ohio at Louisville, Kentucky. The upper reaches of the Ohio River as well as many upper basin tributary streams may not currently be inhabited by Asian carp. The need exists to prevent the establishment of these species into the upper portions of the Ohio basin. Any information that we can learn about Asian carp distribution, abundance, and/or biology that could help managers to limit or stop their spread would be important to a wide variety of ecosystems.

The Great Lakes and Mississippi River Interbasin Study (GLMRIS) identified six different possible routes for ANS to access the Great Lakes Basin through tributaries of the Ohio River. Because of these potential connections between Ohio River tributaries and Lake Erie, natural resource managers are concerned about the potential for the invasion of Asian carps into the Great Lakes Basin through the upper Ohio River watershed. If Asian carp gain entry into the Great Lakes they could pose a significant threat to established fisheries by competing with economically and recreationally important fishes for limited plankton resources (Sparks et al. 2011). They would also pose a very real danger to recreational boaters. Although predictions of the effects of Asian carp on the Great Lakes ecosystem vary widely, negative impacts on the fishery and recreational use of these resources are expected.

The overall goal of these efforts is to understand the distribution and movement patterns of Asian carp in the middle and upper Ohio River. Understanding these aspects of Asian carp biology in the Ohio River will assist efforts to minimize their further spread in the basin and reduce the size of existing populations.

Objectives:

1. Understand Asian carp use of tributaries with potential connections to the Great Lakes.
2. Delineate the upstream-most distribution of Asian carp and potential for further upstream movement. This will help with identification of barrier sites or other points where fish can be slowed or stopped.

3. Utilize mobile tracking data and Judas fish techniques to guide contract fishers and agency sampling efforts.
4. Identify habitat preferences of Asian carp within the middle and upper Ohio River including tributary use.

Methods:

Ultrasonic telemetry was used to track the movements of Asian carp and evaluate their ability to pass the lock and dam systems upstream of current known populations.

Ultrasonic Transmitter Tagging: Adult Bighead Carp and Silver Carp were surgically implanted with ultrasonic transmitters (Vemco, Model V16-6H; 69 kHz) which provide individual identification. The V16-6H coded transmitters are nominally programmed to transmit a signal every 40 seconds yielding a battery life of 1,825 days. Fish tagged were collected by Agency personnel from the McAlpine, Markland, and Meldahl pools. Following surgery, fish were measured for total length (in.) and weight (lb.), visually or manually sexed (if possible). Tagged fish were fitted with an external jaw tag applied around the dentary bone (lower jaw) (National Tag Co. #1242 F9). Gill nets and Direct Current (DC) boat electrofishing were used to capture Asian carp for tagging. Efforts were concentrated in areas that are attractive to Asian carp such as side channels, backwaters, and tributary creeks and rivers.

Ultrasonic receiver array: An array of VR2W receivers was redeployed in the river in summer 2015. Receivers were placed above and below lock and dams, in the lower portions of major tributary streams, and at regular intervals between lock and dams. Receiver data were downloaded monthly.

Mobile Tracking: Active tracing was used in concert with netting and electrofishing to help locate tagged fish and increase the likelihood of capturing new fish to tag. Fish were located with a portable hydrophone and receiver (Vemco Model VH110-10M and Vemco Model VR100, respectively).

Barge tow mounted receivers: In addition to data which we have gathered from stationary receivers we have received additional detection data from colleagues with the Large Rivers and Wetland Field Station of the Missouri Department of Conservation (MDC) and ODNR. MDC and ODNR have made arrangements with commercial barge tow operators to mount VR2W receivers on barge tows operating actively within the Mississippi and Ohio Rivers. We include results received from MDC and ODNR herein.

Results:

Receiver Array Placement - Due to spring and early summer flooding, installation of receivers was problematic. Mainstem and tributary VR2W receivers were installed from April through June as conditions allowed. Five VR2AR acoustic release receivers were deployed approximately one mile upstream of the Markland, Meldahl, Greenup, Byrd, and Belleville dams during July. Additional receivers were installed in the approach to each lock chamber on the downstream side of the lock and in each lock chamber (mounted behind recessed ladders) during September. These receivers are protected from damage due to ice and barges and will remain in the river throughout the year. Figure 1 illustrates the locations of VR2W receivers deployed in 2015. Receivers were deployed over a 442 river mile (RM) reach of the Ohio River from Louisville, KY upstream to Eureka, WV.

Receivers were especially concentrated within the Captain Anthony Meldahl pool during 2015 due to a concurrent catfish telemetry study being conducted by the Ohio Division of Wildlife within that pool. By using the same telemetry equipment both studies are able to share all of the fish detection data. Recorded detections were downloaded on a monthly schedule and data uploaded to an FTP site maintained by ODNR.

Fish Tagging Efforts– To date 192 Asian carp have been surgically implanted with acoustic transmitters from the McAlpine, Markland, and Meldahl pools of the Ohio River. Table 2 breaks out the numbers by species, year, and pool. During 2015 fish collection efforts included 230 minutes of DC boat electrofishing, 13,950 yards of gillnet (119 hours soak time), and 15.3 net nights hoop netting.

Fish Detections – Between 26 March 2015 and 7 January 2016 receivers recorded 1,578,888 individual Asian carp detections. Sixty seven of 124 receivers deployed recorded detections. The vast majority of detections were recorded in the Meldahl (58.2%) and McAlpine (40.7%) pools. Table 3 shows the distribution of Asian carp detections among Ohio River pools during 2015. Of ninety eight fish that were detected in 2015, 44% exhibited direct evidence of survival (moved upstream at some time during the year) and in 56% no upstream movements were recorded. All detections from the Greenup, R.C. Byrd, and Racine pools were from a single fish (Bighead Carp #28345).

Fish Movements – During 2015 the majority of tagged fish in this study remained in the pool in which they were initially tagged. Seven fish which made significant movements out of the pools where they were tagged will be discussed below.

McAlpine Pool fish movements – Of the fish tagged within the McAlpine pool (139 to date), thirty fish made significant movements within the pool. Detections within the McAlpine pool in 2015 were limited due to a relative paucity of receivers being installed that year. Despite the fact that we had only five VR2W receivers within the pool, 40.7 % of all detections, representing 69 individual fish were detected. Thirty of these fish were detected moving back and forth between receivers within the pool as indicated by the distribution of detections among all five receivers. One Silver Carp left the pool and was detected at RM 667 in the Cannelton pool. The fact that only 69 of a total of 139 tagged carp were detected within McAlpine suggests that some of the tagged fish may be remaining within tributaries throughout the year. Kentucky River, Little Kentucky River, and Indian Kentucky Creek all appear to be important tributaries for Asian carp use in this pool. The addition of more receivers within the mainstem as well as within tributaries of McAlpine pool should help to clarify the movements of these fish.

Markland Pool fish movements – Of 14 fish which have been tagged to date from the Markland Pool, only four fish were detected during 2015. These four fish (two Bighead Carp and Two Silver Carp) were detected making extensive movements in the Cincinnati area and upstream to the Meldahl dam. Detections within the Markland pool have been limited to the upper reaches of this pool due to a lack of receivers in the lower portions of the pool. Additional receivers in the lower half of Markland pool will most likely reveal more extensive movements by the fish within that pool. Four Silver Carp which were tagged within the Markland pool made extensive movements outside of the Markland pool and will be discussed separately below.

Meldahl Pool fish movements – Of 39 fish which have been tagged from the Meldahl pool 21 fish were detected in 2015 (5 Bighead Carp and 13 Silver Carp) making up 58.2% of all detections. Of these 21 fish, 18 made extensive movements within the pool which appear to be centered in the area of Brush Creek and Brush Creek Island. The receiver at Brush Creek Island recorded 23.5% of all detections during 2015. This area appears to be particularly attractive to both Silver and Bighead Carp. Additional study of Brush Creek and the surrounding area is warranted. The addition of another receiver within Brush Creek will provide data on movements into and out of this important tributary.

The Rogue Bighead Carp - Bighead Carp #28345 was captured in a 4” mesh gill net and was tagged on 11 June 2013 at the town of Wheelersburg, Ohio within the Meldahl pool. At the time of capture it was 43” total length and weighed 45lb. During summer 2013 it moved 60 RM downstream and took up residence in Ohio Brush Creek over the winter of 2013-2014. Then in April and May of 2014 it moved upstream passing the Greenup Dam and through the Greenup pool to just below the R.C. Byrd dam

(receivers were ca. 4 miles downstream of the dam). Between May and November the fish swam back and forth between the Byrd dam and Greenup dam and was resident above the Greenup dam as of November 2014. During 2013-2014 it moved at least 790 miles in total and 98 miles upstream and passed one lock and dam.

On 20-21 October 2015 this fish was detected in the Racine Pool at RM 214. Sometime between November 2014 and June 2015 it moved past the R.C. Byrd and Racine lock and dams, an additional 65 river miles upstream. The week of 26 October crews manually tracked the Racine pool and found fish #28345 in Mill Creek at the town of Millwood, West Virginia. An attempt was made to capture it with gill nets but we were unable to get the fish to move. On 5 November a biologist from WVDNR went back to Mill Creek and manually tracked the area and the fish was gone. She was unable to relocate the fish that day. Since it was tagged in 2013 this fish has moved upstream at least 174 river miles and has passed three lock and dam projects. We would expect the battery in this fish's acoustic tag to last until summer 2018.

Roaming Silver Carp – Based on data downloaded by MDC from receivers mounted on three different barge tows, six silver carp made extensive movements downstream during 2014. Four of these fish tagged on the same day, 9/24/2014 from two different areas in the Markland pool moved downstream past 8 lock and dams and then up the Mississippi River to the Harlow Island area over a four day period. This is a distance of over 600 river miles. Silver Carp #27405 was subsequently detected at RM602 at Louisville, KY above the Falls of the Ohio River during 2015. This represents a round trip of over 1,200 miles. Two other Silver Carp, one tagged in the Meldahl pool and one from the Markland pool moved down the Ohio River and up the Mississippi River to the St. Louis area. These two fish made this movement over a larger amount of time, three and five months respectively. Figure 2. Shows the locations of Silver Carp detections in the Middle Mississippi River during 2014. The fact that these six fish moved past numerous lock and dam projects on the Ohio River suggests that the dams present very little barrier to fish movements, especially in a downstream direction.

Recommendations: We recommend the continuation of this study with an expansion of receiver locations to fill in gaps that currently exist in the array. We recommend the addition of receivers to several important tributaries including the Kanawha and Big Sandy Rivers and Ohio Brush Creek. We also recommend installing additional receivers in the lower reaches of Markland pool as well as Cannelton and McAlpine pools. We recommend tagging of additional Asian carp in the Meldahl, Markland, McAlpine, and Cannelton pools in 2016.

Project Highlights:

An extensive array of stationary receivers was deployed during 2015 which recorded 1,578,888 detections of 98 Silver and Bighead Carp throughout three Ohio River pools.

Most of the fish tagged during 2014 and 2015 remain in the Ohio River pool where they were tagged. Only one fish tagged to date has moved upstream out of the pool in which it was tagged. That Bighead Carp has moved over 174 river miles, upstream from the point of capture, past three lock and dam projects.

Six Silver Carp left the Ohio River and ascended the Middle Mississippi River during 2014, at least one had returned to the McAlpine pool by July 2015.

Literature Cited:

- Burr, B.M., D.J. Eisenhour, K.M. Cook, C.A. Taylor, G.L. Seegert, R.W. Sauer, and E.R. Atwood. 1996. Nonnative fishes in Illinois waters: What do the records reveal? *Transactions of the Illinois State Academy of Science* 89(1/2):73-91.
- Chapman, D.C., and M.H. Hoff. 2011. Introduction *in* D.C. Chapman and M.H. Hoff, editors. *Invasive Asian Carps in North America*. American Fisheries Society, Symposium 74, Bethesda, Maryland.
- Conover, G., R. Simmonds, and M. Whalen., editors. 2007. Management and control plan for bighead, black, grass, and silver carps in the United States. Asian Carp Working Group, Aquatic Nuisance Species Task Force, Washington, D.C. 190 pp.
- DeGrandchamp, K. L. 2003. Habitat selection and movement of bighead carp and silver carp in the lower Illinois River. Master's Thesis. Southern Illinois University at Carbondale, Illinois. 47 pp.
- DeGrandchamp, K.L., J.E. Garvey, and R.E. Colombo. 2008. Movement and Habitat Selection by Invasive Asian Carps in a Large River. *Transactions of the American Fisheries Society* 137:45-56.
- Freeze, M. and S. Henderson. 1982. Distribution and status of the bighead carp and silver carp in Arkansas. *North American Journal of Fisheries Management* 2:197-200.
- Garvey, J.E., K.L. DeGrandchamp, and C.J. Williamson. 2006. Life History Attributes of Asian Carps in the Upper Mississippi River System. ERDC/TN ANSRP-06-__ November 2006.
- Kolar, C.S., D.C. Chapman, W.R. Courtenay, Jr., C.M. Housel, J.D. Williams, and D.P. Jennings. 2007. Bigheaded carps: a biological synopsis and environmental risk assessment. American Fisheries Society, Special Publication 33, Bethesda, Maryland.
- O'Connell, M.T., A.U. O'Connell, and V.A. Barko. 2011. Occurrence and Predicted Dispersal of bighead carp in the Mississippi River system: development of a heuristic tool. Pages 51-71 *in* D.C. Chapman and M.H. Hoff, editors. *Invasive Asian Carps in North America*. American Fisheries Society, Symposium 74, Bethesda, Maryland.
- Peters, L. M., M. A. Pegg, and U. G. Reinhardt. 2006. Movements of adult radio-tagged bighead carp in the Illinois River. *Transactions of the American Fisheries Society* 135:1205-1212.
- Sparks, R.E., T.L. Barkley, S.M. Creque, J.M. Dettmers, and K.M. Stainbrook. 2011. Occurrence and predicted dispersal of bighead carp on the Mississippi River system: development of a heuristic tool. Pages 51-71 *in* D.C. Chapman and M.H. Hoff, editors. *Invasive Asian Carps in North America*. American Fisheries Society, Symposium 74, Bethesda, Maryland.

Figures and Tables –

Table 1. Distribution of telemetry receivers in 2015 (Rec. = receivers, RM = river miles)

Ohio River Pool	# of Rec.	RM in Pool	Rec./RM	Rec. in Locks	Rec. in Tribs.
McAlpine	8	75	9.4	0	0
Markland	16	95	5.9	3	0
Capt. A. Meldahl	54	95	1.8	3	6
Greenup	14	62	4.4	3	2
R.C. Byrd	13	42	3.8	3	4
Racine	6	31	5.1	3	0
Belleville	12	42	3.5	3	1
Willow Island	1	35	n/a	3	0
Totals	123			21	13

Table 2. Bighead Carp and Silver Carp tagged from 2013 - 2015

	Pool			
	McAlpine	Markland	Meldahl	
2013				
Silver Carp			6	6
Bighead Carp			13	13
2014				
Silver Carp	112	6	10	128
Bighead Carp	4	4		8
2015				
Silver Carp	22	3	5	30
Bighead Carp	1	1	5	7
Totals	139	14	39	192

Table 3. Distribution of Asian carp detections in 2015 (Rec. = receivers, RM = river miles)

Ohio River Pool	# of Rec.	# of detections	% of detections	Rec. w/detections	# of AC detected
McAlpine	8	636,970	40.7	5	69
Markland	16	18,276	1.0	10	4
Capt. A. Meldahl	54	922,460	58.2	42	20
Greenup	14	30	<0.01	2	1*
R.C. Byrd	13	14	<0.01	4	1*
Racine	6	1,138	<0.07	3	1*
Belleville	12	0	0	0	0
Willow Island	1	0	0	0	0
Totals	123				

* Upstream of the Greenup Lock and Dam the only tagged fish detected was Bighead Carp #28345.

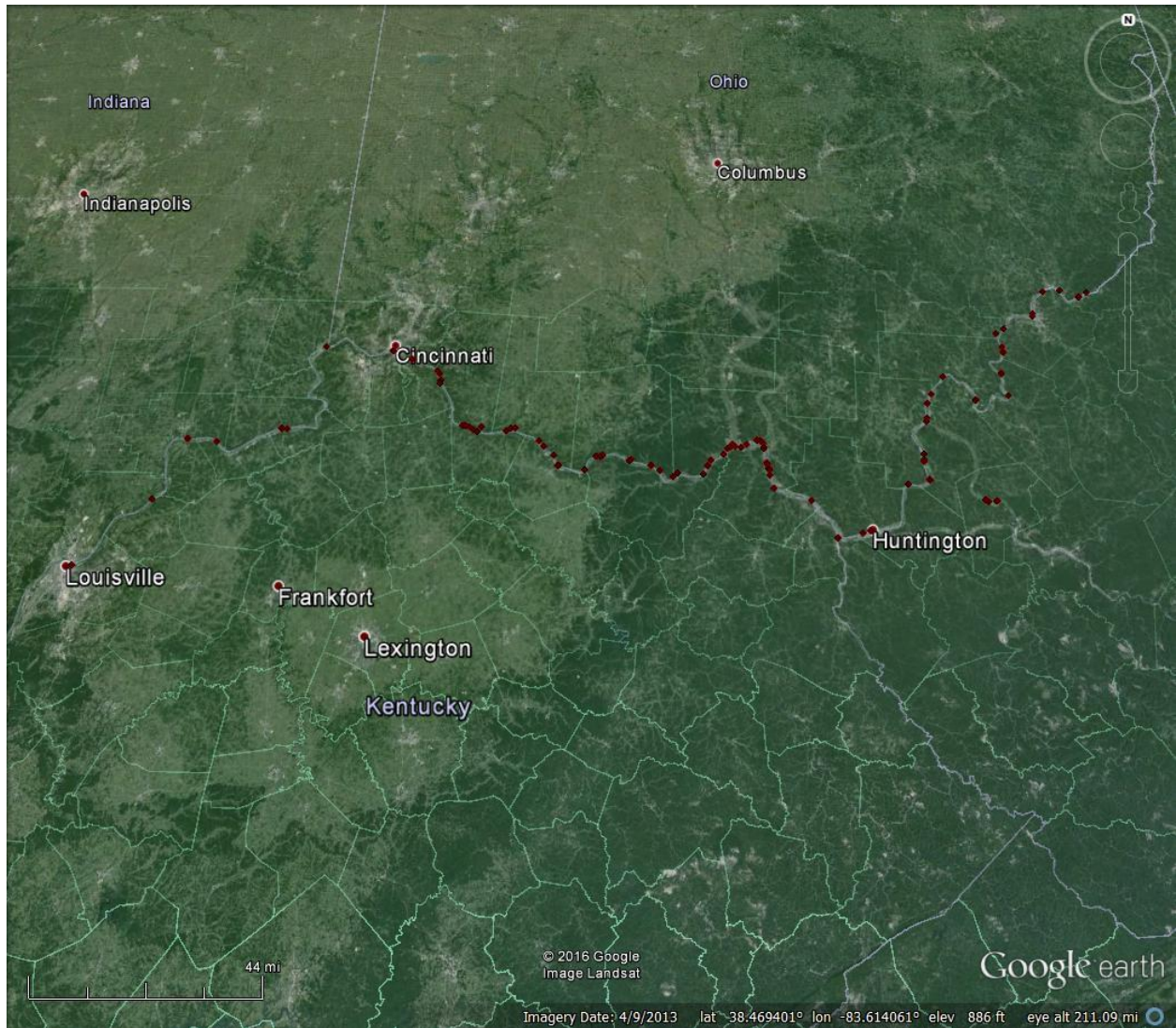


Figure 1. Locations of stationary VR2W receivers in 2015. Individual points may represent more than one receiver at this scale.

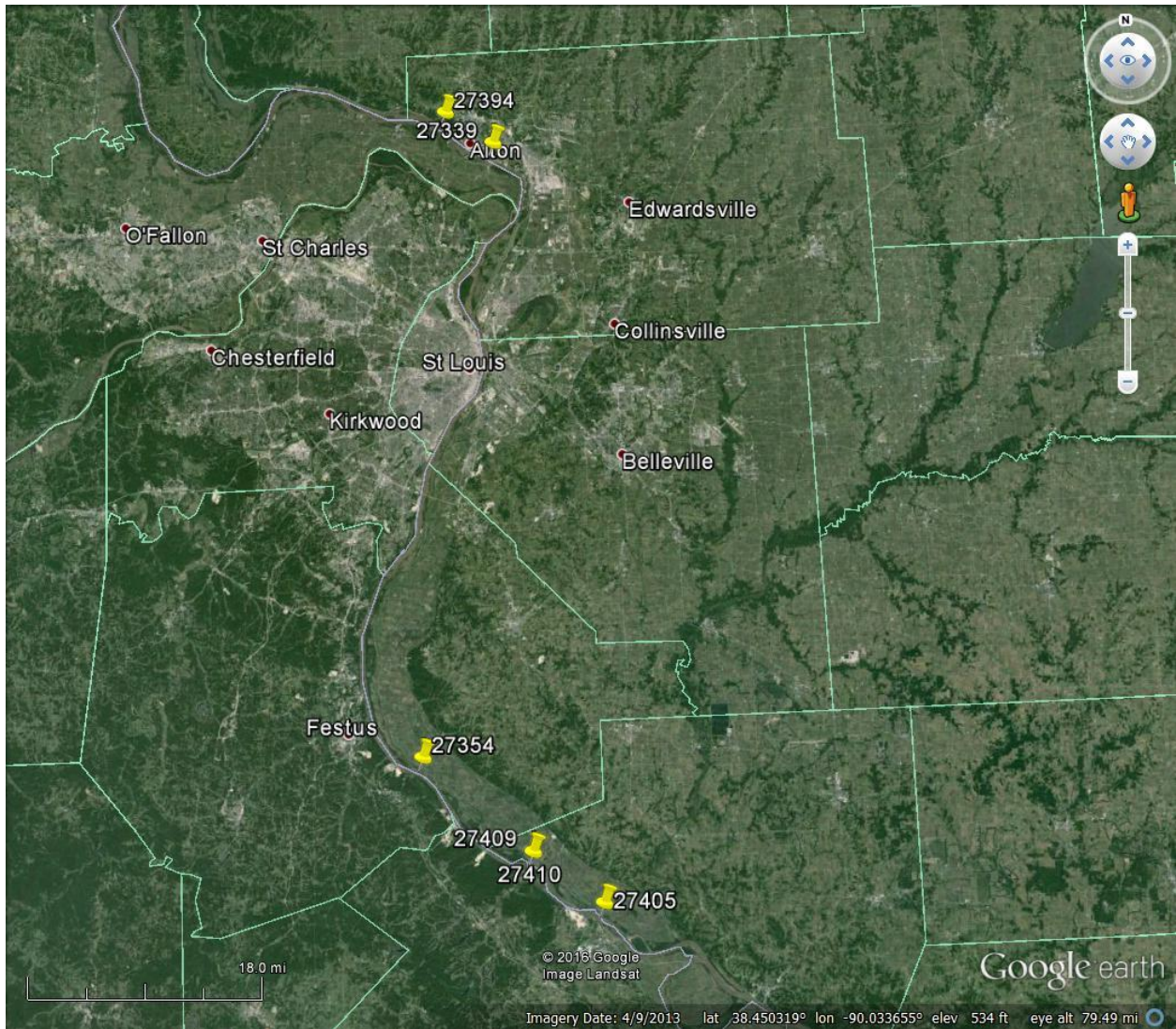


Figure 2. Locations of Ohio River tagged Silver Carp detections in the Middle Mississippi River during 2014.