Inventory of Fishes in Carl Sandburg Home National Historic Site



Submitted by

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November 30, 2006

Introduction

South Carolina Department of Natural Resources Freshwater Fisheries staff inventoried freshwater fishes during 2005-2006 for the National Park Service in four Cumberland Piedmont Network parks in South Carolina and North Carolina. This document reports the findings from inventory activities at Carl Sandburg Home National Historic Site (CARL). The inventory comprised a series of tasks that were addressed, as applicable:

(A) Identifying species richness (to a 90% level),
(B) Describing the distribution of each species within a park,
(C) Determining abundance (particularly of sensitive species),
(D) Collecting voucher specimens for those species where none exist or where species is not readily identifiable by photograph (no collecting of sensitive species),
(E) Recording habitat variables and mapping observation coordinates
(F) Collecting and organizing data to be compatible with existing databases,
(G) Conducting representative sampling of common habitats and comprehensive coverage of specialized habitats,
(H) Identifying fish species that are non-native to a park,
(I) Reviewing Existing NPS Database Records for accuracy.

The Carl Sandburg Home National Historic Site is located in western North Carolina near the town of Flatrock (Blue Ridge ecoregion). The park honors the poet Carl Sandburg, who moved his family to this farm, named Connemara, in 1945 and lived there 22 years. The park encompasses 264 acres, and its water resources are part of the French Broad River drainage (Tennessee River system). There are two impoundments, Front Lake and

Side Lake, several small ponds, a headwater spring, and a number of small streams on the property, all of which drain to Meminger Creek.

Methods

I obtained topographic maps and aerial photos from National Park Service staff to identify terrain features and hydrologic systems. Sites were initially selected using the maps and photos; actual sampling sites were then visited to determine accessibility and appropriate sampling methods. Freshwater habitats present were classified as reservoir, pond, spring, and stream systems. Recommendations of National Park Service personnel were also considered in selecting sampling locations. In determining where to sample stream systems, given that a primary goal of the inventory is to collect a large percentage of species present on the park unit, I weighted effort toward larger streams and downstream reaches because it is known that fish diversity increases with stream size. A Geographic Positioning System unit (Garmin model 76CS, error typically reported +/- 4 to 12 m depending on topography and canopy cover) was used to assign coordinates to selected sampling sites (decimal degrees using datum NAD83).

Fishes in CARL were sampled in August of 2005 and May of 2006. Fish sampling was conducted using three techniques: backpack electrofishing gear in wadeable stream and pond habitat, seine hauls in shallow pond habitat, and boat-mounted electrofishing gear in Front and Side Lakes. Sampled stream lengths varied among sites. I sampled Meminger Creek from the park boundary upstream to the Front Lake dam, approximately 75 meters. In the tributary to Meminger downstream of Side Lake dam, I sampled a length

equivalent to 30 times the average stream width because this effort has been shown to approach an asymptote of species richness for stream fishes (Angermeier & Smogor 1995). Each stream was sampled with one pass from downstream toward upstream, with thorough effort to collect all encountered fishes in all habitats. The ponds were either waded with a backpack electrofisher along shore and in open water areas (Trout Pond), or a seine net was used (Duck Pond). Both Front and Side Lakes were sampled with a complete shoreline circuit using boat electrofishing, in conjunction with a fish health investigation lead by Dr. Jim Long, southeast regional fishery biologist for the National Park Service. All fish collected were identified to species, counted and released with some exceptions. Specimens of some species in Front and Side Lake were retained by Jim Long for laboratory analysis as part of a fish health investigation. Voucher specimens of some species were retained and stored in a 70% ethanol solution with remaining vouchers comprising digital photos. No species listed as threatened or endangered by state or federal agencies were collected.

Number of individuals of each species collected was recorded for each sample location. Species relative abundance was calculated, determined by dividing the total number of fish of each species by the total number of fish collected at the site. Sites were pooled to give abundance and relative abundance by species for the entire park. I also report state conservation status of species as well as whether species were native or introduced to the hydrologic system draining the park.

To give some likelihood that my effort captured 90% of fish species present on the park, I calculated the Chao1 estimator of total species richness from the park-wide sample data. This nonparametric estimator is based on the concept that rare species carry the most information about the number of missing ones, and uses single- and double-occurring species to estimate the number of species missing (Chao 2004). The Chao1 estimates of expected richness with 95% confidence intervals were computed from my samples using the EstimateS software (Colwell 2005) and estimates were compared to the richness I observed during the inventory.

I collected habitat variables at each stream site at the time of sampling according to SCDNR standard protocols. Geomorphic variables of the stream reach included average depth (m) and average wetted width (m, taken from water edge to water edge), obtained by taking widths and depths at five cross-section transects along the length of the sample reach. Water quality measured at the time of fish collection included water temperature (°C), dissolved oxygen (mg/L), pH, conductivity (uS/cm), and turbidity (NTU).

Results

I sampled eight sites on CARL, all of which drained to Meminger Creek. Two streams (Meminger Creek and an unnamed tributary), two small ponds, and a small spring and its reservoir were sampled in the summer of 2005 (Figure 1). I sampled both Front and Side Lakes during spring 2006. For the purposes of this study, the sites were labeled as followed: CARL1 – Meminger Creek, CARL 2 – unnamed tributary of Meminger Cr.,

Spring and Reservoir, Duck Pond, Trout Pond, Front Lake and Side Lake (Figure 1). Dates of sampling, site coordinates, habitat and water quality measures taken at each site are presented in Table 1. Water quality was within normal limits at most sites, but dissolved oxygen and pH was low in the spring and reservoir.

I collected a total of 14 species from 5 families (Table 2). None of the species I collected are listed in North Carolina's Comprehensive Wildlife Conservation Plan as priority conservation species (NCWRC 2005), nor are any species listed as imperiled on federal or state agency lists. Two species I collected are not native to the French Broad River drainage and thus exotic to the park; redbreast sunfish and flat bullhead are both native to Atlantic Slope drainages (Warren et al. 2000). To obtain information on distribution, ecology, and conservation status of any of the species mentioned in this report (as of the date of this publication), NatureServe's website could be searched by typing species names (common or scientific) into the search field at http://www.natureserve.org/explorer/ .

The site with greatest species richness was Meminger Creek (CARL1) with 11 species, followed by CARL2 with 8 species (Table 3). Both of these streams harbored native species expected to be present in the upper French Broad drainage, such as river chub, warpaint shiner, creek chub, and central stoneroller (Rohde et al. 1996). There were as well non-native species, redbreast sunfish and flat bullhead. The standing-water habitats were less diverse than the running waters on the park. The headwater spring and its reservoir did not produce any fish, which is not surprising given the fact that the site is

upstream of a very high gradient section that likely acts as a barrier to colonization by fish. The Trout Pond also did not yield fish with my shoreline electrofishing, although it is much deeper and therefore more difficult to sample efficiently. As such, the possibility that some fish were in deeper refuges within the pond cannot be ruled out. Just downstream, the Duck Pond contained only a population of creek chub, a common headwater species. Creek chubs are considered 'pioneering' species due to their ability to migrate into headwater streams. The same assemblage of four species was found in Front and Side Lakes, consisting of several species of sunfish and bass in the family Centrarchidae. An additional species, grass carp, was not collected during sampling but was observed in Front Lake (at least two individuals). This herbivorous fish is native to eastern Asia and has been imported for control of aquatic vegetation. The state of North Carolina permits stocking this fish but requires that they be sterile triploid forms, therefore after a typical lifespan of 10 years the grass carp will be extirpated from the lake, barring additional stocking. I do not know when these particular fish were stocked. Overall, the assemblage in the lakes is typical of impoundments managed for recreational fishing. Although I have no evidence, I speculate that the redbreast sunfish may have been stocked into Front and/or Side Lakes, from which it colonized the streams.

A total of 566 individuals were collected in the park, with the most found at CARL2 (186 individuals; Table 4), followed by CARL1 (160) and Front Lake (132). However, far more collecting effort was expended during the shoreline electrofishing in the lakes compared to the stream sites, so fish densities were actually much lower in the lakes. Fifty-eight fish were collected in Side Lake, and 30 creek chubs in Duck Pond.

Relative abundance (defined as number of fish by species divided by total catch) gives a measure of fish assemblage structure. Overall in the park, the most common species collected were bluegill and river chub (Table 5), respectively making up 35% and 22% of my collection. River chub only occurred in the stream sites whereas bluegill were found in four of the five sites that had fish. Creek chub (15% relative abundance) occurred at both of the stream sites and also in the Duck Pond. Largemouth bass were major components of the lake assemblages, after bluegill, but were not present in the stream samples. Two native species found only in the stream samples are noteworthy in that their native ranges are restricted to the Appalachian highlands: warpaint shiner and smoky sculpin. The two species are a minor component of the park's fish fauna but are representative of a group of endemic Appalachian fishes that make the regional assemblage unique (Scott and Helfman 2001). This group of highland endemics appears to be sensitive to habitat alteration and water quality degradation.

I assessed my inventory effort within the park by comparing the inventoried species number, targeted at 90% of total species richness, to Chao1 estimates of total richness generated from my sampling data (Table 6). Observed richness within the park (14) was over 97% of the computed expected richness value, and 70% and 99% of the upper and lower confidence limits, respectively. Therefore I conclude that my effort was adequate to inventory the aquatic habitats supporting fishes on CARL.

Many other fish species that were not collected within the park occur in the upper French Broad River drainage. A partial list is presented in Table 7. Note that this list is generated from NatureServe data, and reflects collections taken from much larger streams and rivers at higher or lower elevations, so many of these species would not necessarily be expected to occur in CARL.

A list of digital photos taken at the CARL sites and their descriptions are included in Table 8. The images will be supplied separately from this report as digital files in JPG format.

Summary

The Carl Sandburg Home National Historic Site was drained by Meminger Creek, a tributary stream within the French Broad River system. The Meminger Creek drainage contained a headwater spring and its reservoir, Trout Pond, Duck Pond, Front Lake, and Side Lake. The fish inventory of these aquatic habitats produced 566 individuals of 14 species, and one other species (grass carp) was observed but not collected during the inventory. Common stream and reservoir species were encountered along with two introduced species.

The fact that the fish assemblage inhabiting the park includes two species endemic to the Appalachian highlands is a good indicator. Land management is critical to aquatic systems, particularly headwater streams, since ecosystem processes such as hydrologic regime, carbon inputs and processing, and nutrient dynamics are highly influenced by the

terrestrial drainage. Management to conserve aquatic ecosystem integrity includes restrictions on land development, maintenance of forested riparian zones to the maximum extent practical in keeping with cultural values of the park, and maintenance of natural hydrology and water quality. The role of the National Park System as good steward of these aquatic resources is valuable and plays an important part in the future persistence of our native fishes.

Acknowledgements

Thanks to Irene VanHoff and "Frenchie" of the NPS CARL staff, and SCDNR staff Kevin Kubach, Cathy Marion, Troy Cribb, and Melissa Littleton for assisting with data collection and entry.

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Table 1. Date of sampling, site coordinates in decimal degrees (datum NAD83), stream channel dimensions (meters), and water quality measures associated with each fish collection. Column abbreviations and measurement units are as follows: DO – dissolved oxygen (mg/L), CONDUC – conductivity (μS/cm), TURB – turbidity (nephelometric turbidity units), TEMP – temperature (°C).

CARL SITE ID	FISH DATE	LATTITUDE	LONGITUDE	LENGTH	AVG WIDTH	AVG DEPTH	DO	PH	CONDUC	TURB	TEMP
CARL1 Meminger Cr.	8/10/2005	35.27409	82.44598	75	3.5	0.2	6.55	6.57	42	2.15	24.5
CARL2 Unnamed Trib	8/10/2005	35.27420	82.44619	87	2.9	0.2	7.17	5.78	38	-	23.19
Spring & Reservoir	8/10/2005	35.26565	82.45102	na	na	0.5	3.69	4.47	15	1.08	18.96
Trout pond	8/10/2005	35.26900	82.44927	na	na	-	6.37	5.11	14	-	18.56
Duck pond	8/10/2005	35.27127	82.45036	na	na	0.5	14.07	5.93	21	-	22.13
Side Lake	5/17/2006	35.27370	82.44830	na	na	-	9.13	6.2	34.5	2.74	18.5
Front Lake	5/17/2006	35.27330	82.44580	na	na	-	7.24	6.45	47.5	5.04	17.5

Table 2. Fish species collected or observed in Carl Sandburg Home National Historic Site, including their conservation and range status. Native refers to a species being indigenous to the French Broad River drainage. Any of the species mentioned in this report could be searched via NatureServe's website http://www.natureserve.org/explorer/ as of the date of this publication. Species names (common or scientific) can be typed into the search field to obtain information on distribution, ecology, and conservation status.

Common Name	Scientific Name	Family	State Conservation Status	Native/Introduced	Voucher status
white sucker	*Catostomus commersoni*	Catostomidae	None of the species on North Carolina's priority conservation list	Native	photo CARLCcommersoni.jpg
black crappie	*Pomoxis nigromaculatus*	Centrarchidae		Native	photo DSCN1133.jpg
bluegill	*Lepomis macrochirus*	Centrarchidae		Native	photo DSCN1126.jpg
redbreast sunfish	*Lepomis auritus*	Centrarchidae		Introduced	One preserved specimen
warmouth	*Lepomis gulosus*	Centrarchidae		Native	photo CARLLgulosus.jpg
redear sunfish	*Lepomis microlophus*	Centrarchidae		Native	photo DSC06214.jpg
largemouth bass	*Micropterus salmoides*	Centrarchidae		Native	photos DSC06213 & DSC06214
smoky sculpin	*Cottus* sp. cf. *bairdii*	Cottidae		Native	One preserved specimen
central stoneroller	*Campostoma anomalum*	Cyprinidae		Native	photo DSCN1129.jpg
creek chub	*Semotilus atromaculatus*	Cyprinidae		Native	photo CARLSatromaculatus.jpg
golden shiner	*Notemigonus crysoleucas*	Cyprinidae		Native	photo DSCN1130.jpg
river chub	*Nocomis micropogon*	Cyprinidae		Native	One preserved specimen
warpaint shiner	*Luxilus coccogenis*	Cyprinidae		Native	6 preserved specimens
grass carp	*Ctenopharyngodon idella*	Cyprinidae		Introduced	Visual observation only
flat bullhead	*Amerius platycephalus*	Ictaluridae		Introduced	5 preserved specimens

Table 3. Species distributions among sites. Total number of fish species collected in the park was fourteen (14), plus observation was made of grass carp *Ctenopharyngodon idella* in Front Lake.

	Occurrence of Fish Species by Site						
Common Name	CARL 1	CARL 2	Spring& Reservoir	Trout Pond	Duck Pond	Side Lake	Front Lake
river chub	X	X					
smoky sculpin	X						
bluegill	X	X				X	X
flat bullhead	X	X					
central stoneroller	X	X					
creek chub	X	X			X		
warpaint shiner	X	X					
warmouth	X						
black crappie	X						
redbreast sunfish	X	X				X	X
golden shiner	X						
grass carp							X
largemouth bass						X	X
redear sunfish						X	X
white sucker		X					
Number of Species	11	8	0	0	1	4	4

Table 4. Abundance of each fish species by site and totals within the park.

Common Name	Number of Individuals							
	CARL 1	CARL 2	Spring& Reservoir	Trout Pond	Duck Pond	Side Lake	Front Lake	Park Total
river chub	51	74	0	0	0	0	0	125
smoky sculpin	1	0	0	0	0	0	0	1
bluegill	69	19	0	0	0	40	71	199
flat bullhead	10	14	0	0	0	0	0	24
central stoneroller	11	1	0	0	0	0	0	12
creek chub	1	55	0	0	30	0	0	86
warpaint shiner	6	2	0	0	0	0	0	8
warmouth	2	0	0	0	0	0	0	2
black crappie	3	0	0	0	0	0	0	3
redbreast sunfish	4	20	0	0	0	1	23	48
golden shiner	2	0	0	0	0	0	0	2
largemouth bass	0	0	0	0	0	16	26	42
redear sunfish	0	0	0	0	0	1	12	13
white sucker	0	1	0	0	0	0	0	1
Total Individuals	160	186	0	0	30	58	132	566

Table 5. Relative abundance of each fish species by site and overall within the park. Totals may not add up to 100% due to rounding.

Common Name	Relative Abundance (%)							
	CARL 1	CARL 2	Spring& Reservoir	Trout Pond	Duck Pond	Side Lake	Front Lake	Park Total
river chub	32%	40%	0%	0%	0%	0%	0%	22.1%
smoky sculpin	1%	0%	0%	0%	0%	0%	0%	0.2%
bluegill	44%	10%	0%	0%	0%	69%	53%	35.2%
flat bullhead	6%	8%	0%	0%	0%	0%	0%	4.2%
central stoneroller	7%	1%	0%	0%	0%	0%	0%	2.1%
creek chub	1%	30%	0%	0%	100%	0%	0%	15.2%
warpaint shiner	3%	1%	0%	0%	0%	0%	0%	1.4%
warmouth	1%	0%	0%	0%	0%	0%	0%	0.4%
black crappie	2%	0%	0%	0%	0%	0%	0%	0.5%
redbreast sunfish	3%	11%	0%	0%	0%	2%	17%	8.5%
golden shiner	1%	0%	0%	0%	0%	0%	0%	0.4%
largemouth bass	0%	0%	0%	0%	0%	28%	20%	7.4%
redear sunfish	0%	0%	0%	0%	0%	2%	9%	2.3%
white sucker	0%	1%	0%	0%	0%	0%	0%	0.2%

Table 6. Observed fish species richness within CARL, computed Chao1 estimate of species richness with 95% confidence limits, and percentage of observed richness versus the estimates. Goal of the inventory effort was to document 90% of species expected within the park.

Observed Species Richness	**14**	% Observed vs.Estimated Richness
Chao1 Expected Richness	14.3	97.7%
Chao1 lower 95% CL	14.1	99.9%
Chao1 upper 95% CL	19.9	70.3%

Table 7. A partial list of other fish species that were not collected within the park during this inventory, but which are recorded in the upper French Broad River basin.

Scientific Name	Common Name
Lampetra appendix	American brook lamprey
Dorosoma cepedianum	gizzard shad
Hybopsis amblops	bigeye chub
Luxilus chrysocephalus	striped shiner
Notropis leuciodus	Tennessee shiner
Notropis photogenis	silver shiner
Notropis rubellus	rosyface shiner
Notropis rubricroceus	saffron shiner
Notropis spectrunculus	mirror shiner
Notropis telescopus	telescope shiner
Notropis volucellus	mimic shiner
Pimephales vigilax	bullhead minnow
Rhinichthys atratulus	blacknose dace
Rhinichthys cataractae	longnose dace
Hypentelium nigricans	northern hog sucker
Moxostoma anisurum	silver redhorse
Moxostoma carinatum	river redhorse
Moxostoma duquesnei	black redhorse
Moxostoma erythrurum	golden redhorse
Moxostoma macrolepidotum	shorthead redhorse
Ameiurus natalis	yellow bullhead
Ictalurus punctatus	channel catfish
Noturus eleutherus	mountain madtom
Pylodictis olivaris	flathead catfish
Salvelinus fontinalis	brook trout

Scientific Name	Common Name
Cottus carolinae	banded sculpin
Ambloplites rupestris	rock bass
Lepomis megalotis	longear sunfish
Micropterus dolomieu	smallmouth bass
Micropterus punctulatus	spotted bass
Pomoxis annularis	white crappie
Etheostoma blennioides	greenside darter
Etheostoma chlorobranchium	greenfin darter
Etheostoma flabellare	fantail darter
Etheostoma rufilineatum	redline darter
Etheostoma swannanoa	Swannanoa darter
Etheostoma zonale	banded darter
Cyprinella galactura	whitetail shiner
Pimephales promelas	fathead minnow
Moxostoma collapsum	V-lip redhorse
Ameiurus platycephalus	flat bullhead
Ameiurus nebulosus	brown bullhead
Percina evides	gilt darter
Phenacobius crassilabrum	fatlips minnow
Ichthyomyzon greeleyi	mountain brook lamprey
Erimystax insignis	blotched chub
Percina aurantiaca	tangerine darter
Etheostoma vulneratum	wounded darter
Percina squamata	olive darter

Table 8. List of digital photographs taken at CARL with their descriptions. Site names are referenced in Table 1, and species information is found in Tables 2 through 5. The images will be supplied as digital files (JPG format) separate from this report.

Digital image file name	*Description of image*
CARL1 01.JPG	Meminger Cr. (CARL1) looking upstream
CARL2 01.JPG	CARL2 – water quality measurement
CARL2 02.JPG	CARL2 – electrofishing
CARL DuckPond02.JPG	Duck Pond - seining
CARL TroutPond.JPG	Trout Pond
CARL SpringReservoir.JPG	Reservoir of the spring at Meminger Creek headwater
CARL SpringCreek.JPG	Stream just below spring reservoir
CARLCcommersoni.JPG	Identification voucher photo – white sucker
CARLLgulosus.JPG	Identification voucher photo – warmouth
CARLSatromaculatus.JPG	Identification voucher photo – creek chub
DSC06207.JPG	Preparing to electrofish Front Lake
DSC06208.JPG	Electrofishing Front Lake
DSC06209.JPG	Front Lake - water quality measurement
DSC06213.JPG	Specimens for fish health analysis – note largemouth bass
DSC06214.JPG	Specimens for fish health analysis – note redear sunfish
DSCN1126.JPG	Identification voucher photo – bluegill
DSCN1128.JPG	smoky sculpin
DSCN1129.JPG	Identification voucher photo – central stoneroller
DSCN1130.JPG	Identification voucher photo – golden shiner
DSCN1132.JPG	river chub
DSCN1133.JPG	Identification voucher photo – black crappie

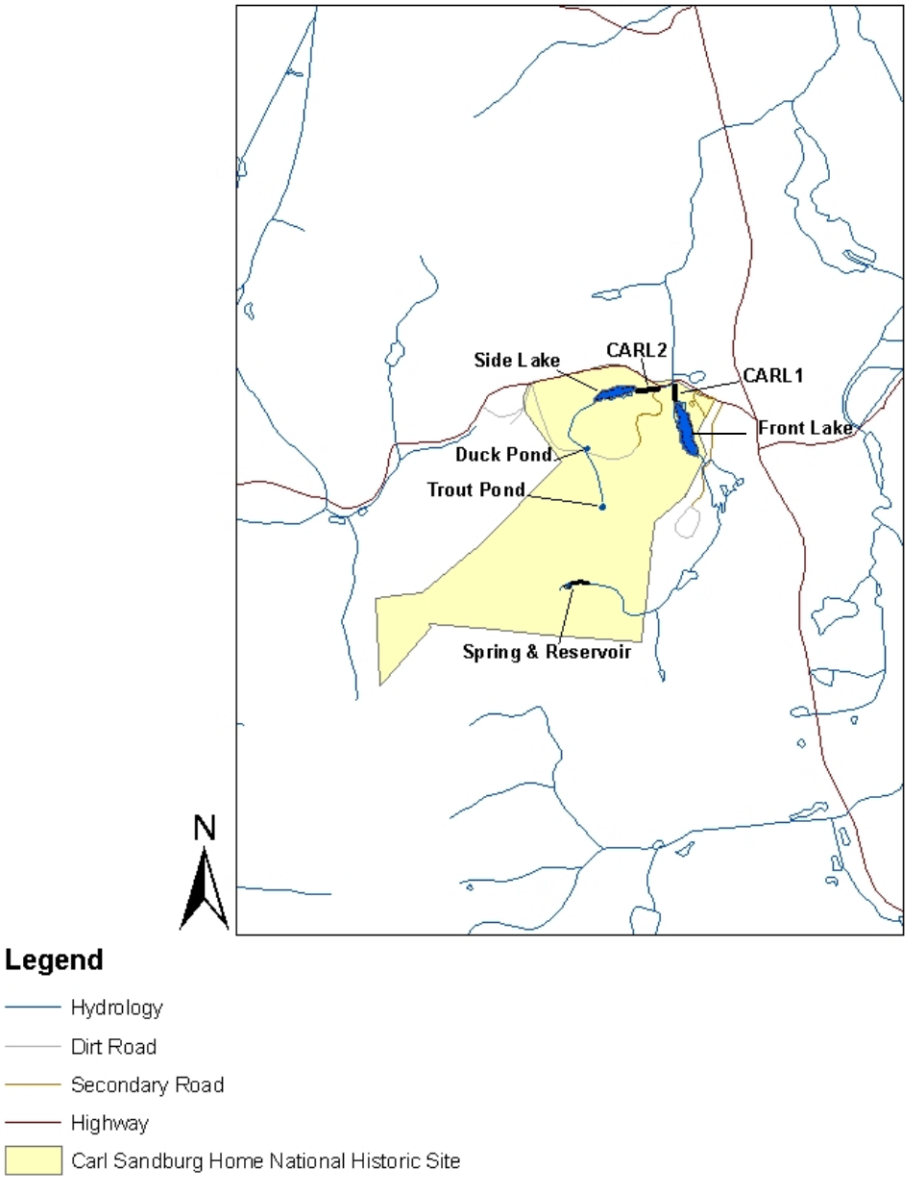


Figure 1. Map of Carl Sandburg Home National Historic Site, hydrological features, road network, and locations of fish collections on two streams (CARL1 – Meminger Creek, CARL2 – unnamed tributary of Meminger Cr.), one small spring and reservoir at the headwater of Meminger Cr., two ponds (Trout and Duck), and two impoundments (Front and Side Lake).