

Inventory of Fishes in Kings Mountain National Military Park



Submitted by

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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 Kings Mountain National Military Park (KIMO).

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.

Kings Mountain is a rocky spur of the Blue Ridge Mountains that rises 46m above the surrounding area. In 1780, British Major Patrick Ferguson and his loyalist militia were severely defeated by a small band of patriot forces, turning the tide of England's attempt to conquer the South. Congress established this 3,945 acre site to become a National Military Park in 1931. The park is located in the Blacksburg, South Carolina (Piedmont Region), 2.5 miles south of I-85 and 25 miles west of Gastonia, NC. The Northern

boundary of the park is located approximately 1 mile south of the North Carolina/ South Carolina state line. KIMO's water resources are part of the Broad River drainage (Santee River system). There are numerous small streams on the property that drain to Kings Creek and Long Branch.

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 stream systems. No impounded waters or substantial springs capable of supporting fishes were identified. Recommendations of National Park Service personnel were also considered in selecting sampling locations. In determining where to sample stream systems, I weighted effort toward larger streams and downstream reaches because it is known that fish diversity increases with stream size, and given that a primary goal of the inventory is to collect a large percentage of species present on the park unit. 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 (decimal degrees using datum NAD83) to selected sampling sites.

Fishes in KIMO were sampled in May and June of 2006. Fish sampling was conducted using a backpack electrofishing technique in the wadeable streams. Sampled stream lengths varied among sites, and were equivalent to at least 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. All fish collected were identified to species, counted and released.

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 system.

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 included average wetted width (m, taken from water edge to water edge) of the 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 streams (all tributaries of Kings Creek and Long Branch) in Kings Mountain National Military Park during summer of 2006 (Figure 1). For the purposes of this study, the sites were labeled as followed: KIMO1 - Kings Creek, KIMO2 - Long Branch, KIMO3 - Garner Br., KIMO4 - Stonehouse Br., KIMO5 - Dellingham Br., KIMO6 – tributary to Long Br., KIMO7 - trib to Long Br., and KIMO8 - trib to Kings Cr.. 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 all stream sites, but some suspicious readings from the water quality meter occurred on 6/5/06. The meter subsequently had to be repaired so I have low confidence in the readings taken that day.

I collected a total of 19 species from 5 families (Table 2), six species of which are listed in South Carolina's Comprehensive Wildlife Conservation Strategy as priority conservation species (SCDNR 2005). Highback chub, greenfin shiner, and flat bullhead are moderate priority species; seagreen darter and Carolina fantail darter are high conservation priority; Carolina darter is considered highest conservation priority. One

species I collected was exotic to the Broad River drainage: smallmouth bass (Warren et al. 2000). All other species are considered native. 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 <http://www.natureserve.org/explorer/> could be searched by typing species names (common or scientific) into the search field.

The site with greatest species richness was KIMO1 Kings Creek with 16 species (Table 3), which was not surprising given that it was the largest stream I sampled. KIMO2 Long Branch was the second richest with 10 species. KIMO3 Garner Branch was remarkable with 8 species occurring in such a small stream. Perhaps even more remarkable, KIMO6 was smaller and had 6 species. Two sites (KIMO7 and KIMO8) were lowest in richness with two species in common, creek chub and rosyside dace (Table 3).

A total of 1,329 individuals were collected during the inventory, the highest number of the Cumberland-Piedmont Network Parks I inventoried (Table 4). The site with the greatest number of fish was KIMO2 Long Branch (459 individuals), followed by the tiny KIMO6 (229) and Kings Creek (227). The density of fish in the headwater stream KIMO6 calculates to nearly 16 fish per square meter, more than an order of magnitude higher than KIMO2 and one of the highest densities I have ever encountered.

Relative abundance (defined as abundance by species divided by total catch) gives a measure of fish assemblage structure. Overall in the park, the most common species collected were rosyside dace and bluehead chub (Table 5). Creek chub and yellowfin

shiner were also abundant. Creek chubs were the only fish to occur at all sampling sites. They are considered 'pioneering' species due to their ability to migrate into headwater streams, so would be expected in these headwater streams. Creek chubs made up only two percent of the catch in the larger KIMO1 Kings Cr., but 98% of the catch in the smallest stream KIMO7. The least abundant species were Carolina darter, flat bullhead, and the introduced smallmouth bass, each represented by only a single individual.

The occurrence of several species of state conservation concern in the park is noteworthy. Although these species made up only 7.8% of the park's fish fauna, they made up 21% of the assemblage in KIMO6. Highback chub, greenfin shiner, Carolina darter, seagreen darter, and Carolina fantail darter are all endemic to the southern Atlantic Slope. All of these species face similar threats across their range: impacts from land development, deforestation, loss of riparian cover, siltation, and hydrologic alterations (channelization and impoundment construction). Flat bullheads are more widespread and common in the state, but face threats in South Carolina from the introduced piscivore, flathead catfish *Pylodictis olivaris* (SCDNR 2005).

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 (19) was 92% of the computed expected richness value, and 56% 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 the park.

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

A list of digital photos taken at the KIMO 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 Kings Mountain National Military Park was found to contain several headwater and tributary streams of Kings Creek and Long Branch, all part of the Broad River basin. The fish inventory of these aquatic habitats produced 1,329 individuals of 19 species. The assemblages were characterized by classic stream-dwelling species along with six species of conservation concern to the South Carolina Department of Natural Resources. The overall composition of the fish fauna suggests that these aquatic systems are among the highest quality in the state, reflecting the fact that the park protects the headwaters of these streams (except Kings Creek, which originates off-site and drains private lands). The fisheries section of SCDNR has an interest in monitoring “reference” stream conditions throughout the state, and several KIMO sites are certainly candidates.

The fact that the fish assemblage inhabiting the park includes six of South Carolina's priority conservation species, making up of about 8% of the park's fish fauna, is an excellent indicator of the ecological integrity of aquatic systems on KIMO. 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 headwater streams is highly valuable and plays an important part in the future persistence of our native fishes in South Carolina.

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Table 1. Date of sampling, site coordinates in decimal degrees (datum NAD83), 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 ($\mu\text{S}/\text{cm}$), TURB – turbidity (nephelometric turbidity units), TEMP – temperature ($^{\circ}\text{C}$).

KIMO SITE ID	FISH DATE	LATTITUDE	LONGITUDE	LENGTH	AVG WIDTH	DO	PH	CONDUC	TURB	TEMP
KIMO1 – Kings Creek	5/31/2006	35.14471	81.41354	168	5.6	7.42	7.58	151	6.36	20.64
KIMO2 - Long Branch	6/1/2006	35.13700	81.35900	112	4.1	7.19	7.21	54	3.2	18.4
KIMO3 - Garner Br.	6/1/2006	35.11890	81.40930	45	1.5	7.36	7.29	54	1.66	19.8
KIMO4 - Stonehouse Br.	6/5/2006	35.14280	81.41300	50	1.7	8.77	5.98*	259*	1.59	16.54
KIMO5 - Dellingham Br.	6/5/2006	35.13640	81.41440	50	1.8	7.3	5.54*	212*	5.02	16.25
KIMO6 - trib to Long Br.	6/5/2006	35.12801	81.38473	21	0.7	8.25	6.69*	142*	3.07	17.89
KIMO7 - trib to Long Br.	6/5/2006	35.12665	81.38717	20	0.5	-	-	-	-	-
KIMO8 - trib to Kings Cr.	6/5/2006	35.15540	81.39320	60	2	8.6	6.05*	118*	0.96	16.59

* On 6/5/06 water quality meter began giving suspicious readings for pH and conductivity; meter was subsequently sent in for repairs.

Table 2. Fish species collected from Kings Mountain National Military Park , including their conservation and range status. Native refers to a species being indigenous to the 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
northern hogsucker	<i>Hypentelium nigricans</i>	Catostomidae		Native	One preserved specimen
white sucker	<i>Catostomus commersoni</i>	Catostomidae		Native	photo P5310106.jpg
striped jumprock	<i>Scartomyzon rupiscartes</i>	Catostomidae		Native	photo P5310133.jpg
rosyside dace	<i>Clinostomus funduloides</i>	Cyprinidae		Native	photo P5310145.jpg
sandbar shiner	<i>Notropis scepticus</i>	Cyprinidae		Native	One preserved specimen
yellowfin shiner	<i>Notropis lutipinnis</i>	Cyprinidae		Native	11 preserved specimens
greenfin shiner	<i>Cyprinella chloristia</i>	Cyprinidae	Moderate Priority	Native	2 preserved specimens
creek chub	<i>Semotilus atromaculatus</i>	Cyprinidae		Native	photo P5310113.jpg
bluehead chub	<i>Nocomis leptocephalus</i>	Cyprinidae		Native	4 preserved specimens
highback chub	<i>Hybopsis hypsinotus</i>	Cyprinidae	Moderate Priority	Native	3 preserved specimens
redbreast sunfish	<i>Lepomis auritus</i>	Centrarchidae		Native	photo P5310105.jpg
Bluegill	<i>Lepomis macrochirus</i>	Centrarchidae		Native	-
smallmouth bass	<i>Micropterus dolomieu</i>	Centrarchidae		Introduced	photo P5310114.jpg
marginated madtom	<i>Noturus insignis</i>	Ictaluridae		Native	photo P5310122.jpg
flat bullhead	<i>Ameiurus platycephalus</i>	Ictaluridae	Moderate Priority	Native	photo P5310125.jpg
Carolina darter	<i>Etheostoma collis</i>	Percidae	Highest Priority	Native	photos P6010147 - 151
tessellated darter	<i>Etheostoma olmstedii</i>	Percidae		Native	One preserved specimen
Carolina fantail darter	<i>Etheostoma flabellare</i> complex	Percidae	High Priority	Native	photos P5310115-116
seagreen darter	<i>Etheostoma thalassinum</i>	Percidae	High Priority	Native	2 preserved specimens

Table 3. Species distributions among sites. Total number of fish species collected in the park was nineteen (19).

Common Name	Occurrence of Fish Species by Site							
	KIMO 1	KIMO 2	KIMO 3	KIMO 4	KIMO 5	KIMO 6	KIMO 7	KIMO 8
northern hogsucker	X							
sandbar shiner	X							
yellowfin shiner	X	X	X	X				
greenfin shiner	X							
redbreast sunfish	X	X	X			X		
white sucker	X							
bluegill	X							
bluehead chub	X	X	X	X	X	X		
tessellated darter	X	X						
Carolina fantail darter	X		X	X		X		
creek chub	X	X	X	X	X	X	X	X
seagreen darter	X							
Carolina darter		X						
marginated madtom	X	X						
highback chub	X	X	X			X		
smallmouth bass	X							
striped jumprock		X	X					
rosyside dace		X	X	X	X	X	X	X
flat bullhead	X							
Number of Species	16	10	8	5	3	6	2	2

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

Common Name	Number of Individuals by Species								Park Total
	KIMO 1	KIMO 2	KIMO 3	KIMO 4	KIMO 5	KIMO 6	KIMO 7	KIMO 8	
northern hogsucker	17	0	0	0	0	0	0	0	17
sandbar shiner	21	0	0	0	0	0	0	0	21
yellowfin shiner	20	94	9	35	0	0	0	0	198
greenfin shiner	4	0	0	0	0	0	0	0	4
redbreast sunfish	34	23	1	0	0	6	0	0	64
white sucker	5	0	0	0	0	0	0	0	5
bluegill	2	0	0	0	0	0	0	0	2
bluehead chub	82	128	12	43	1	30	0	0	296
tessellated darter	12	14	0	0	0	0	0	0	26
Carolina fantail darter	5	0	1	4	0	1	0	0	11
creek chub	5	40	26	8	43	56	45	34	257
seagreen darter	7	0	0	0	0	0	0	0	7
Carolina darter	0	1	0	0	0	0	0	0	1
marginated madtom	7	4	0	0	0	0	0	0	11
highback chub	4	27	1	0	0	47	0	0	79
smallmouth bass	1	0	0	0	0	0	0	0	1
striped jumprock	0	5	4	0	0	0	0	0	9
rosyside dace	0	123	55	8	36	89	1	47	359
flat bullhead	1	0	0	0	0	0	0	0	1
Number Individuals	227	459	109	98	80	229	46	81	1329

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 (%)								
	KIMO 1	KIMO 2	KIMO 3	KIMO 4	KIMO 5	KIMO 6	KIMO 7	KIMO 8	Park Overall
northern hogsucker	7%	0%	0%	0%	0%	0%	0%	0%	1.3%
sandbar shiner	9%	0%	0%	0%	0%	0%	0%	0%	1.6%
yellowfin shiner	9%	20%	8%	36%	0%	0%	0%	0%	11.9%
greenfin shiner	2%	0%	0%	0%	0%	0%	0%	0%	0.3%
redbreast sunfish	15%	5%	1%	0%	0%	3%	0%	0%	4.8%
White sucker	2%	0%	0%	0%	0%	0%	0%	0%	0.4%
bluegill	1%	0%	0%	0%	0%	0%	0%	0%	0.2%
bluehead chub	36%	28%	11%	44%	1%	13%	0%	0%	22.3%
tessellated darter	5%	3%	0%	0%	0%	0%	0%	0%	2.0%
Carolina fantail darter	2%	0%	1%	4%	0%	0%	0%	0%	0.8%
creek chub	2%	9%	24%	8%	54%	24%	98%	42%	19.3%
seagreen darter	3%	0%	0%	0%	0%	0%	0%	0%	0.5%
Carolina darter	0%	0%	0%	0%	0%	0%	0%	0%	<0.1%
marginated madtom	3%	1%	0%	0%	0%	0%	0%	0%	0.8%
highback chub	2%	6%	1%	0%	0%	21%	0%	0%	5.9%
smallmouth bass	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
striped jumprock	0%	1%	4%	0%	0%	0%	0%	0%	0.7%
rosyside dace	0%	27%	50%	8%	45%	39%	2%	58%	27.0%
flat bullhead	0%	0%	0%	0%	0%	0%	0%	0%	0.1%

Table 6. Observed fish species richness within KIMO, 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	19	%Observed vs. Estimated Richness
Chao1 Expected Richness	20.5	92.7%
Chao1 lower 95% CL	19.2	99.2%
Chao1 upper 95% CL	33.6	56.5%

Table 7. A partial list of other fish species that were not collected within the park during this inventory, but which are native to streams of the outer piedmont ecoregion of the Broad River basin.

Scientific Name	Common Name
<i>Scartomyzon</i> sp. cf. <i>rupiscartes</i>	brassy jumprock
<i>Notemigonus crysoleucas</i>	golden shiner
<i>Hybognathus regius</i>	eastern silvery minnow
<i>Cyprinella nivea</i>	whitefin shiner
<i>Cyprinella pyrrhomelas</i>	fieryblack shiner
<i>Notropis hudsonius</i>	spottail shiner
<i>Moxostoma collapsum</i>	V-lip redhorse
<i>Ameiurus brunneus</i>	snail bullhead
<i>Ameiurus catus</i>	white catfish
<i>Ameiurus natalis</i>	yellow bullhead
<i>Ameiurus nebulosus</i>	brown bullhead
<i>Gambusia holbrooki</i>	eastern mosquitofish
<i>Lepomis gulosus</i>	warmouth
<i>Lepomis gibbosus</i>	pumpkinseed
<i>Micropterus salmoides</i>	largemouth bass
<i>Pomoxis nigromaculatus</i>	black crappie

Scientific Name	Common Name
<i>Percina crassa</i>	piedmont darter
<i>Esox niger</i>	chain pickerel
<i>Cyprinella labrosa</i>	thicklip chub
<i>Cyprinella zanema</i>	Santee chub
<i>Moxostoma pappilosum</i>	slender redhorse

Table 8. List of digital photographs taken at KIMO 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.

<i>Image file name</i>	<i>Description of image</i>
P5310105.JPG	Identification voucher photo – redbreast sunfish
P5310106.JPG	Identification voucher photo – white sucker
P5310113.JPG	Identification voucher photo – creek chub
P5310114.JPG	Identification voucher photo – smallmouth bass
P5310115 - 116	Identification voucher photo – Carolina fantail darter
P5310117.JPG	greenfin shiner
P5310122.JPG	Identification voucher photo – margined madtom
P5310123.JPG	highback chub
P5310124.JPG	KIMO1 Kings Cr. – processing the fish collection
P5310125.JPG	Identification voucher photo – flat bullhead
P5310130.JPG	sandbar shiner
P5310133.JPG	Identification voucher photo – striped jumprock
P6010136.JPG	KIMO2 Long Branch
P6010138.JPG	KIMO2 Long Branch – backpack electrofishing
P6010139.JPG	Crayfish carrying ova in KIMO2
P6010144.JPG	KIMO2 Long Branch
P5310145.JPG	Identification voucher photo – rosyside dace
P6010147 through 151	Identification voucher photos – Carolina darter
P5310156.JPG	KIMO3 Garner Branch – underwater habitat, yellowfin shiners
P5310157.JPG	KIMO3 Garner Br. – underwater habitat, yellowfin, crayfish
P5310159 - 160	KIMO3 Garner Br. – underwater habitat, yellowfin shiners
P5310161 - 164	KIMO3 Garner Br. – backpack electrofishing

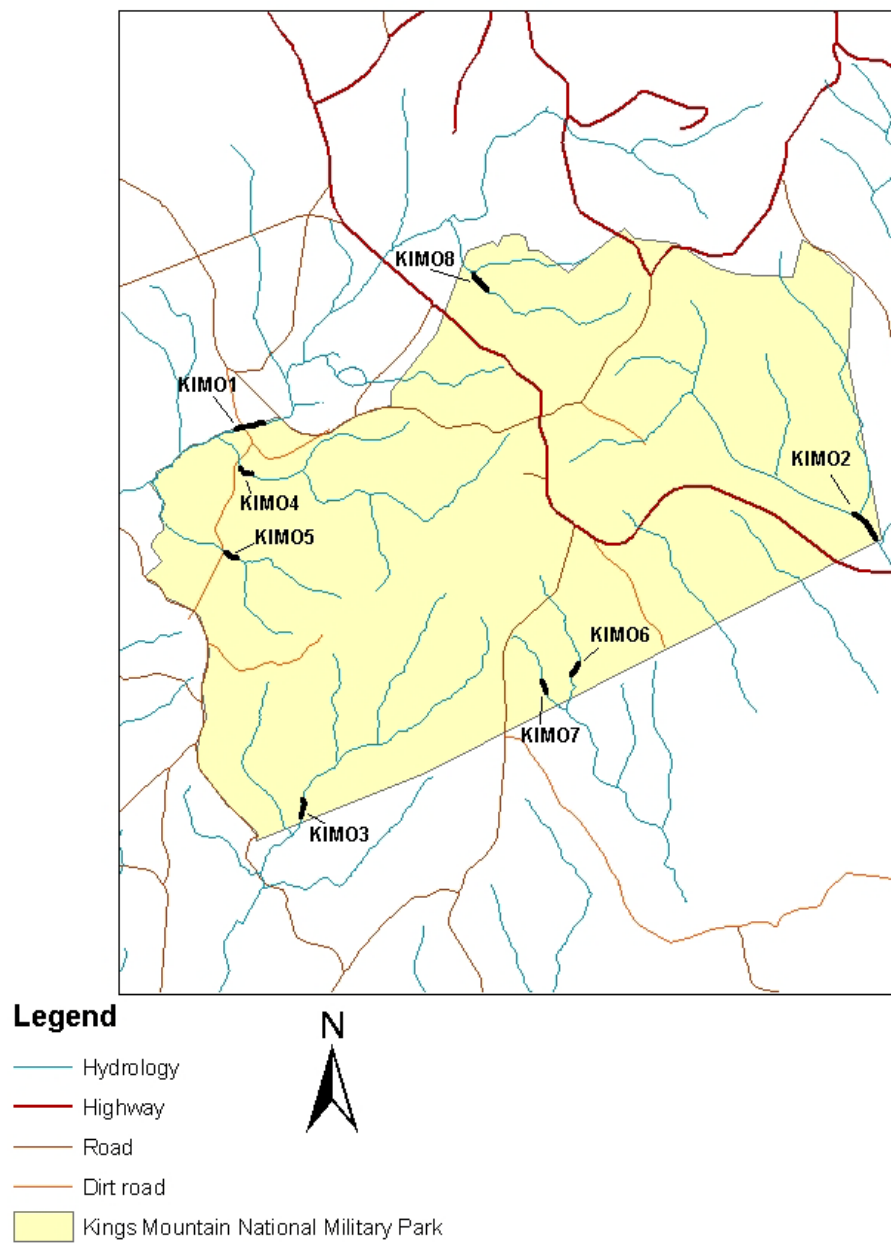


Figure 1. Map of Kings Mountain National Military Park, hydrological features, road network, and locations of fish collections on eight streams.