

# PRELIMINARY CHARACTERIZATION OF THE NATURAL FLOW REGIME IN THE BLUE RIVER OF SOUTH-CENTRAL OKLAHOMA

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**BACKGROUND:** The Blue River watershed is 670 square miles and provides water directly for 30,000 people as well as livestock and aquatic life in a rural area of South-central Oklahoma. In 2012, The Nature Conservancy (TNC) purchased a 490-acre tract of land with 0.9 miles of the Blue River. Since 2013, this section of the river has been monitored for hydrology, biology, water quality and geomorphology. The Blue River is sustained by the Arbuckle Simpson Aquifer which is a 500 square mile sole-source aquifer that provides water to over 150,000 people. The Blue River is sustained by a sole source aquifer that has state protections in place limiting the Maximum Annual Yield to 0.2 acre-feet per day (0.10 cubic feet per second per day). This aquifer provides numerous upwelling zones from the Arbuckle Simpson that sustain populations of aquatic life throughout the Blue River watershed. The Oka'Yahnali Preserve provides headwater protection on the Blue River for downstream users of the water such as the city of Durant. Historically, this river has 25 fish species and 21 mussel species.

**METHODS:** Fish abundance and diversity were sampled using backpack shockers and seines. Macroinvertebrates were sampled using D-frame dip-nets for abundance and diversity. An Index of Biotic Integrity (IBI) approach was used to sample riffles, runs and pools for fish until no new species was collected for three sampling events per macrohabitat for at least 1000 meters. Fish were identified to species and returned to the river downstream of sampling sites. Macroinvertebrates were sampled in riffles, runs and pools in 100 meter transects. Macroinvertebrates were identified to species when possible. Discharge was measured at cross sections established in 2013 using a Sontek Flowtracker where a minimum of 20 measurements of depth and velocity were taken at each cross section. Water quality was measured using a D55 Sonde at riffles, pools and runs. The suite of parameters measured included dissolved oxygen, water temperature, pH and conductivity. A self-leveling laser level was used to measure cross sections and longitudinal profiles to obtain wetted perimeter, bankfull, and slope changes between riffles, pools and runs. A minimum of 100 substrate measurements were taken using the Wentworth Modified Scale. Restoration of the riparian buffer is ongoing along one mile of the Blue River using native bottomland hardwood species.

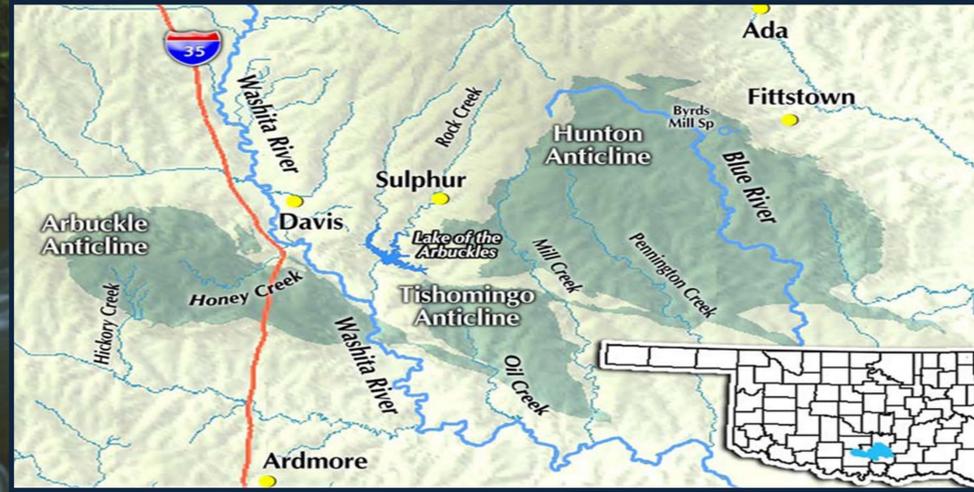


Figure 1. Blue River watershed in South-central Oklahoma

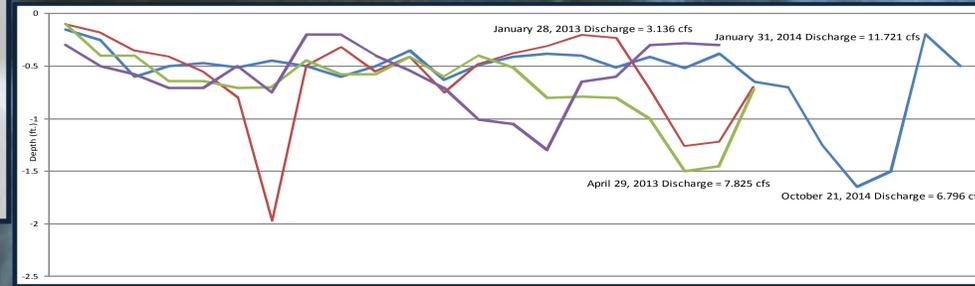


Figure 2. Discharge cross sections on the Blue River at Oka'Yahnali Preserve



## Results

Table 1. 1976-2014 fish species in the Blue River

Common Name	Scientific Name
Bigeye Shiner	<i>Notropis boops</i>
Blacktail Shiner	<i>Cyprinella venusta</i>
Black Crappie	<i>Pomoxis nigromaculatus</i>
Bluegill	<i>Lepomis macrochirus</i>
Bluntnose Minnow	<i>Pimephales notatus</i>
Central Stonewort	<i>Camptostoma anomalum</i>
Channel Darter	<i>Percina copelandi</i>
Dusky Darter	<i>Percina sciera</i>
Emerald Shiner	<i>Notropis atherinoides</i>
Fathead minnow	<i>Pimephales promelas</i>
Freckled Madtom	<i>Noturus nocturnus</i>
Green Sunfish	<i>Lepomis cyanellus</i>
Golden Redhorse	<i>Moxostoma erythrurum</i>
Golden Shiner	<i>Notemigonus crysoleucas</i>
Leach Darter	<i>Etheostoma microperca</i>
Logperch	<i>Percina caprodes</i>
Longear Sunfish	<i>Lepomis megalotis</i>
Mimic Shiner	<i>Notropis volucellus</i>
Mosquitofish	<i>Gambusia affinis</i>
Orangebelly Darter	<i>Etheostoma radiosum</i>
Orangespotted Sunfish	<i>Lepomis humilis</i>
Orangethroat Darter	<i>Etheostoma spectabile</i>
Redear Sunfish	<i>Lepomis microlophus</i>
Redfin Shiner	<i>Lythrurus umbratilis</i>
Redspot Chub	<i>Nocomis asper</i>
Rocky Shiner	<i>Notropis suttlesi</i>
Sand Shiner	<i>Notropis strimlingi</i>
Slough Darter	<i>Etheostoma gracile</i>
Smallmouth Bass	<i>Micropterus dolomieu</i>
Southern Redbelly Dace	<i>Phoxinus erythrogaster</i>
Spotted Bass	<i>Micropterus punctulatus</i>
Spotted Sucker	<i>Minnytrema melanops</i>
Striped Shiner	<i>Luxilus chrysocephalus</i>
White Crappie	<i>Pomoxis annularis</i>
Yellow Bullhead	<i>Ameiurus natalis</i>

Table 2. 2014 macroinvertebrate taxa on the Blue River

Order	Family	Genus
Mollusca	Corbiculidae	Corbicula
Decapoda	Cambarinae	Orconectes
Mollusca	Sphaeriidae	Sphaerus
Gastropoda	Hydrobiidae	Tryonia
Annelida	Oligochaeta	
Ephemeroptera	Heptageniidae	Stenacron
Trichoptera	Leptoceridae	Oecetis
Ephemeroptera	Baetiscidae	Baetisca
Diptera	Empididae	
Diptera	Cyclorrhaphases	
Diptera	Canacidae	
Trichoptera	Hydropsychidae	Parapsyche
Gastropoda	Viviparidae	Viviparous
Plecoptera	Perlidae	Perlesta
Coleoptera	Dytiscidae	
Odonata	Libellulidae	Libellula
Odonata	Gomphidae	Progomphus

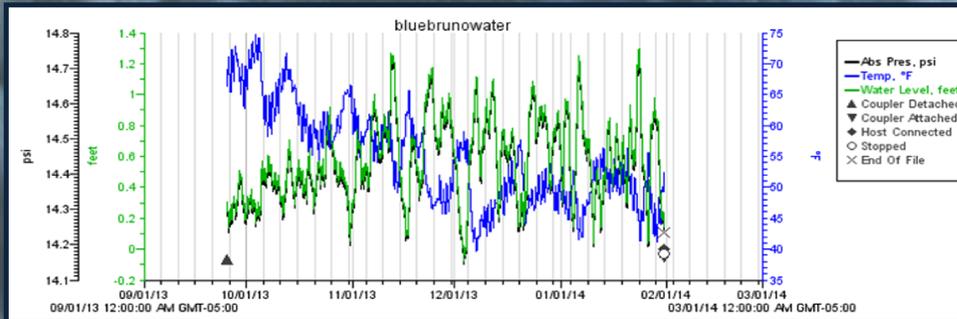


Figure 3. September 25, 2013 to January 31, 2014 water level and water temperature of the Blue River at Oka'Yahnali Preserve

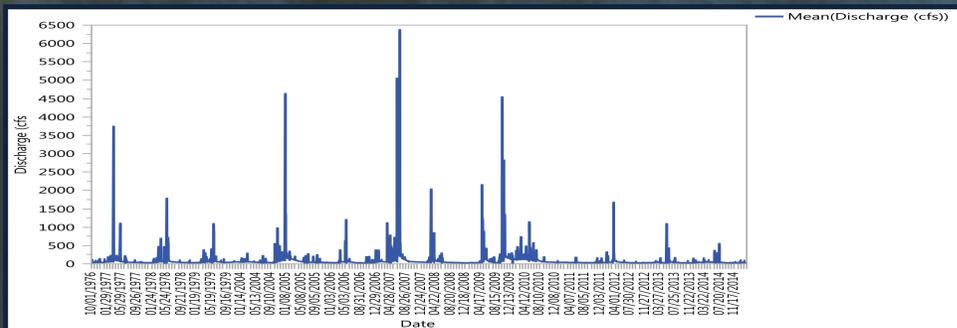


Figure 4. Mean daily discharge on the Blue River at Connerville located downstream of the Oka'Yahnali Preserve

Table 3. 2013-2014 water quality on the Blue River

Date	LDO (mg/L)	DO (% Sat)	Conductivity (ms/cm)	pH	Water Temp. °C
1/10/2013 AM	9.62	90	0.6	8.08	12.74
4/29/2013 PM	10.2	136.2	0.5706	8.14	20.55
9/25/2013 late AM	9.7	104.4	0.6253	5.49	18.87
1/3/2014 late AM	11.34	128.5	0.5831	7.92	12.91
4/29/2014 PM	11.12	119.8	0.6766	9.72	18.82

Table 4. Fish Index of Biotic Integrity (IBI) metrics, values and scoring for watershed health

Metric	Score of 5	Score of 3	Score of 1
Total # of species		16	
# of species comprising >75% of sample		4	
Shannon's Diversity based on #	3.05		
# of sunfish			1
# of intolerant sp.	10		
% of tolerant sp.	24%		
% of lithophils	44%		
% of DELT anomalies	0%		
Fish # (total individuals)	291		
<b>Total Score</b>			<b>36</b>

Table 5. Macroinvertebrate IBI scoring criteria and IBI score for watershed health

Metric	5	3	1
Total Taxa		17	
# EPT Taxa		5	
% EPT- % Hydropsychidae			1.2%
% Scrapers			1.2%
% Clingers		48%	
% Diptera		13%	
% Chironomidae	0%		
% Isopoda	0%		
% Tolerant Organisms			45%
HBI			5.62
% Intolerant Organisms	55%		
<b>Total IBI Score</b>			<b>31</b>

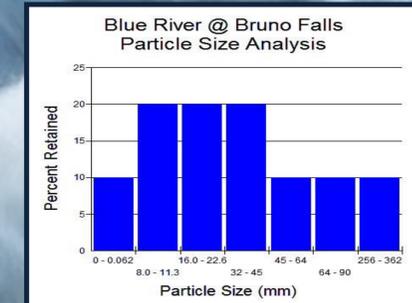


Figure 5. Particle size analysis of the Blue River at Bruno Falls

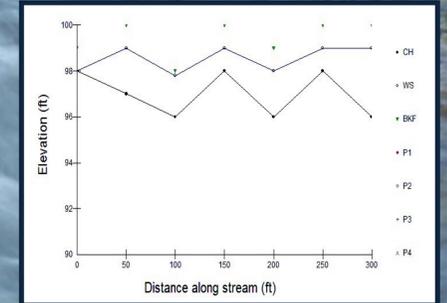


Figure 6. Longitudinal profile of the Blue River

**CONCLUSIONS:** Overall, the Blue River has sustained baseflows throughout the summer due to groundwater input in this section of the Blue River. The fishery is good based on an IBI score of 36 with a fair macroinvertebrate taxa score of 31. Some pollution tolerant macroinvertebrate taxa were found in the river, and this could be attributed to increased sedimentation and nitrogen and phosphorus in the river. Anthropogenic changes have occurred throughout the watershed due to land use changes and clearing of riparian areas. TNC will continue to manage this preserve for aquatic species and restoration of riparian corridors as well as streambank restoration. Future research needs include monitoring for nitrogen, phosphorus and sediment levels.

**FUTURE IMPLICATIONS:** The Oklahoma TNC chapter will continue to work with the Oklahoma Small Business Development Center (OSBDC) to promote economic growth and water conservation in the Blue River watershed. TNC and OSBDC will work together to promote collaboration and partnerships that promote sustainable business growth while ensuring Oklahoma's natural resources are conserved for future generations.

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