DRAFT **Upland Streams & Rivers**

From the Executive Summary of the 2016 State of the GCPO

GCPO
Gulf Coastal Plains & Ozarks
Landscape Conservation Cooperative

DRAFT SUMMARY

PHOTOS, CITATION, ACKNOWLEDGEMENTS

All Figures created by Yvonne Allen

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The desired ecological state for priority habitat systems should characterize the least impacted condition – systems in this condition should be targets for maintenance/protection and the goal of restoration activities in degraded systems. In the GCPO LCC Integrated Science Agenda (ISA), a general description of the desired ecological state for high gradient streams and rivers of the Ozark Highlands is: “Small springs, runs, and headwaters characterized by clear, clean, and relatively cold water in largely undisturbed forest settings.”

To identify high gradient streams, a threshold of 2% slope was originally chosen to align with categories of “high” and “very high” established by the Southeast Aquatic Resources Partnership (SARP), which in turn were based on fish distribution patterns across the Southeast. However, the natural flow regimes for these Ozark streams were overwhelmingly classified as “intermittent,” so a modified definition of “upland streams and rivers” based on elevation greater than 130m was adopted for the current assessment. This elevation threshold was suggested by the GCPO SARP project to refine the ISA for aquatic systems. As a result, the revised definition of this broadly defined habitat includes rivers and streams having a wide range of slope/gradient classes.

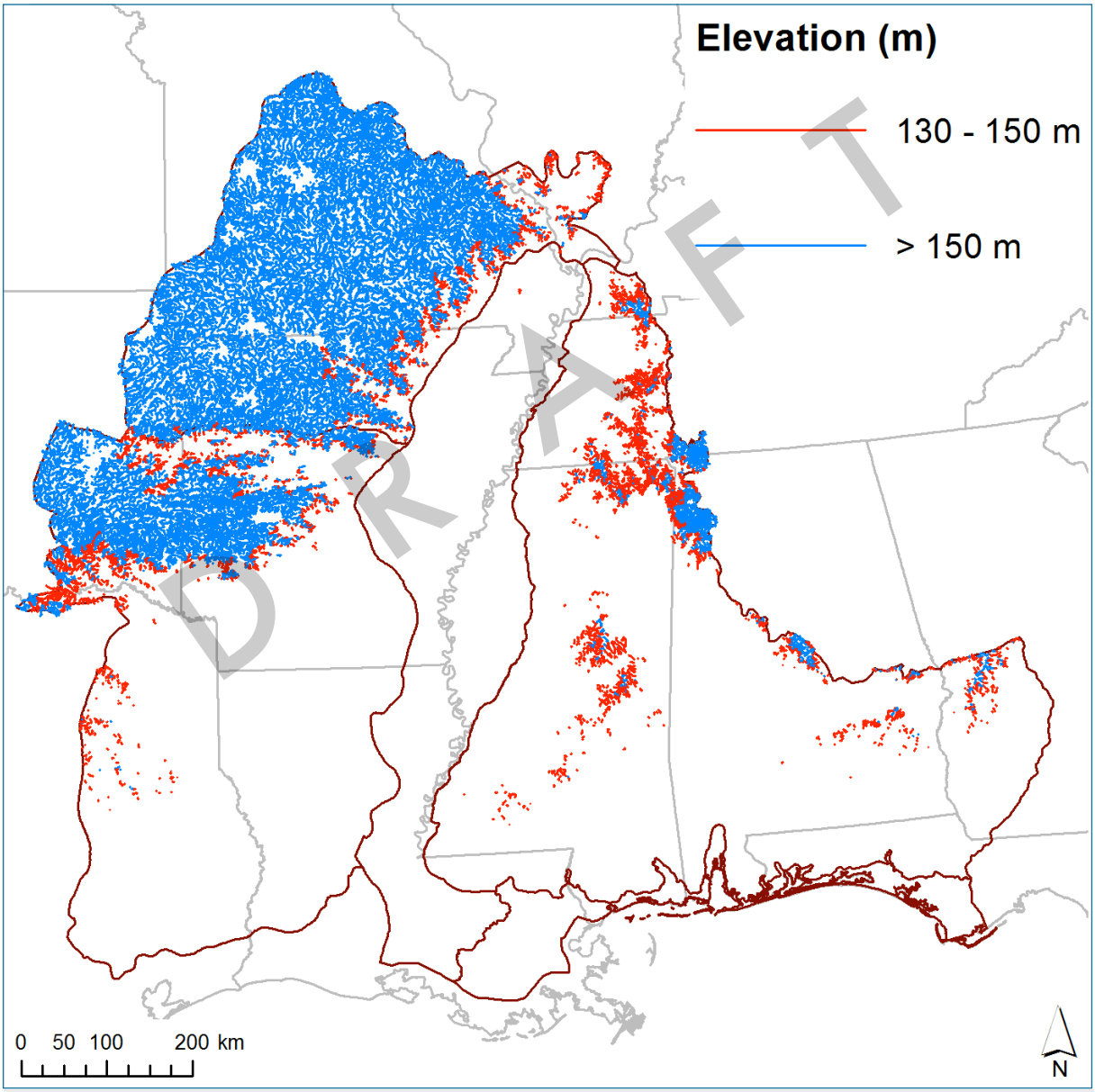


Figure 1. Distribution of upland streams and rivers using the >130m and >150m thresholds and satisfying the other selection conditions indicated in the text.

Summary of Findings for Landscape Endpoints

AMOUNT

Maintain current river miles

The distribution of upland streams and rivers in each subgeography based on >130m elevation is shown in Fig 1. The Ozark Highland (OZH) subgeography has the most such streams and rivers, with 46,220 km (62% of total for the GCPO). The West Gulf Coastal Plain (WGCP) has 19,448 km (26% of total for the GCPO), and the East Gulf Coastal Plain (EGCP) has the smallest amount at 8,910 km (12% of total for the GCPO). Most upland streams in the EGCP (69% of total for the EGCP) are at elevations below 150m. Figure 2 at right shows the slope of upland streams within the subgeographies of the GCPO, with high gradient streams concentrated in the Ouachita, Boston and Ozark Mountains of the OZH subgeography.

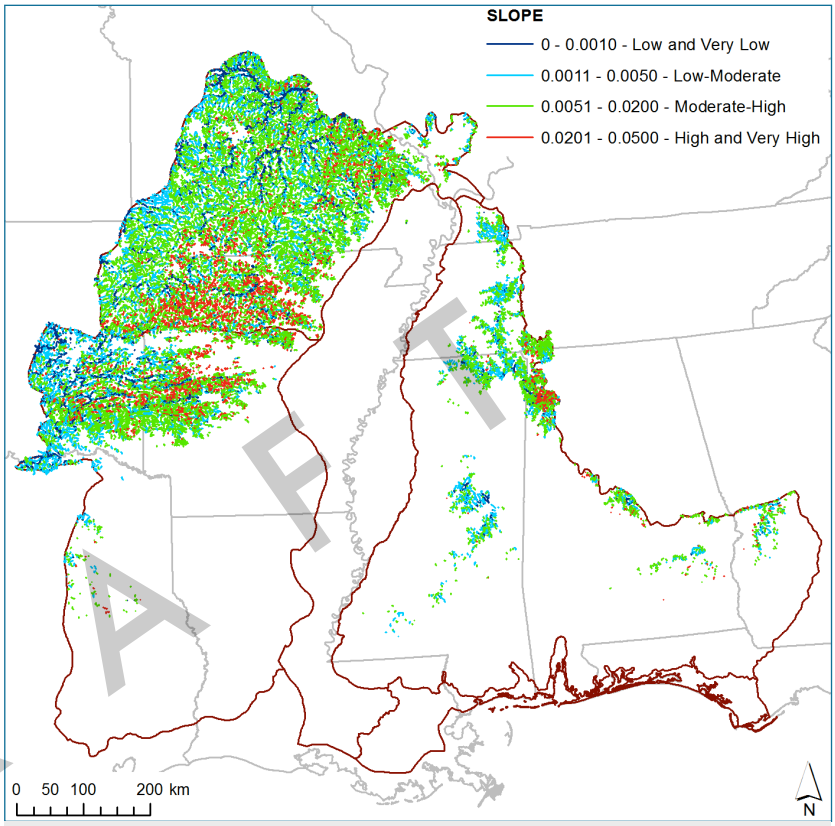


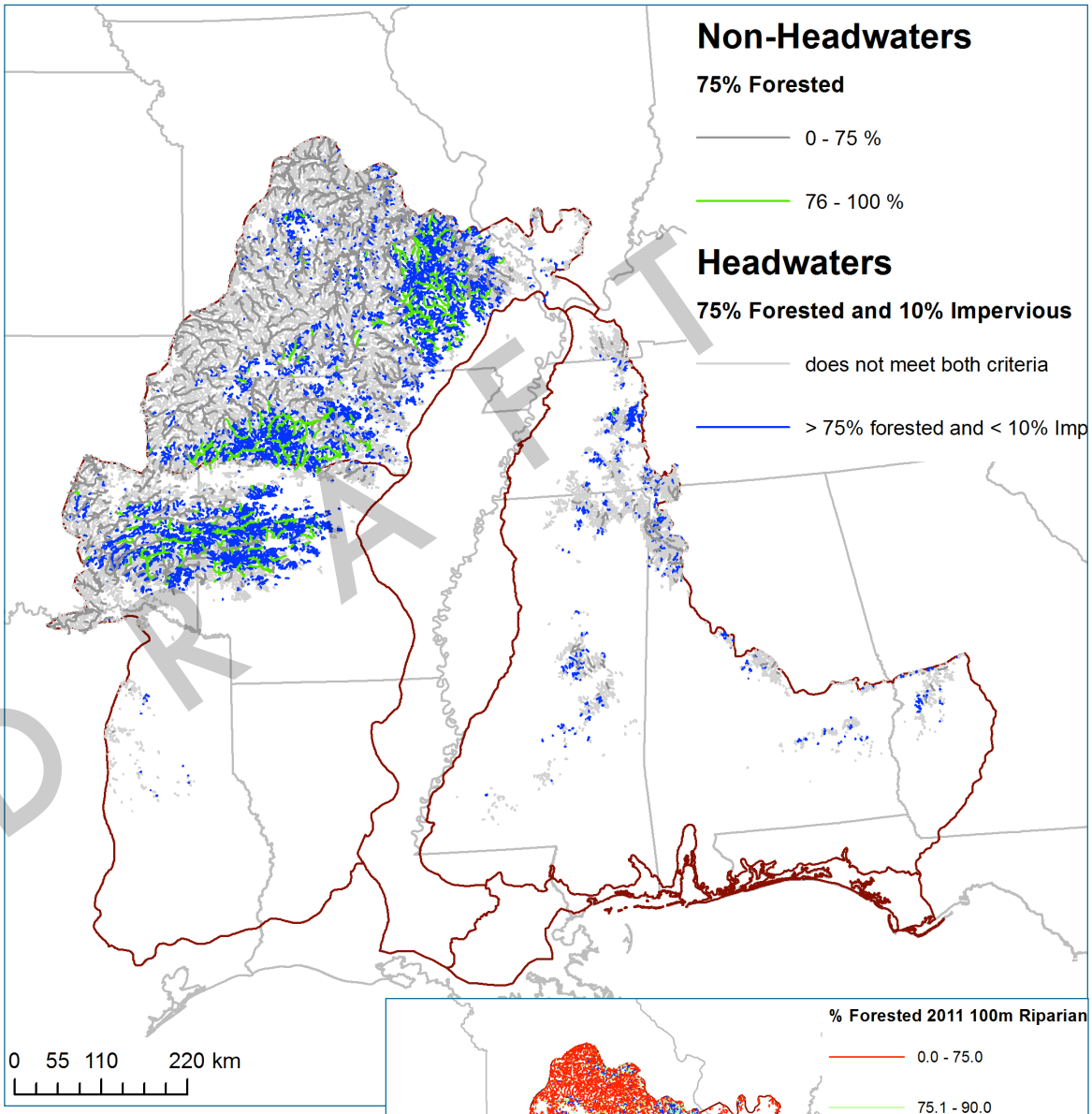
Figure 2. Slope classification of upland streams and rivers having elevation > 130m.

CONFIGURATION

Watersheds >75% forested, with <10% impervious cover

The analysis presented here applies both criteria of > 75% forested watershed condition and < 10% impervious cover only to headwater upland streams with watersheds < 50 km^2, because that is what the impervious cover threshold model assumes. For upland streams and rivers having watersheds greater than 50 km^2, we only applied the criterion of > 75% forested watershed configuration. Headwater upland streams (< 50 km^2) make up the majority (54,497 km; 73%) of total upland streams and rivers length for the entire GCPO, with 58% within the OZH. The headwater definition applies to 69%, 75% and 91% of upland streams and rivers in the OZH, WGCP and EGCP respectively. The overall percentage of upland streams and rivers across the GCPO in the best forested condition class is highest in the OZH (59%), with 15% in the EGCP meeting this landscape endpoint (Figure 3). For all of the subgeographies, the overwhelming majority (97-100%) of upland streams and rivers meeting the forested cover criterion also met or exceeded the impervious cover threshold. For the remaining 27% of non-headwater upland streams, the percentage falling into the best condition classes is somewhat lower: Only 21%, 29%, and 0% of non-headwaters upland streams and rivers have > 75% forested watershed area in the OZH, WGCP, and EGCP respectively.

Figure 3. Upland streams and rivers in both headwaters (watershed >50km^2) and non-headwaters (watershed <50km^2) categories. Headwaters reaches must satisfy both criteria of >75% upstream forested watershed area and < 10% upstream impervious area. Non-headwaters reaches satisfy only the criterion of having upstream watershed area that is >75% forested.



Intact riparian corridors consisting primarily of hardwoods within 30 m buffer of stream

Riparian conditions for upland streams and rivers are slightly better overall in the WGCP where 50% of stream buffers are >75% forested and 24% are > 90% forested. In the OZH and EGCP, 34-35% of stream buffers are > 75% forested and only 14-17% are > 90% forested (Figure 4). However, because the OZH has the highest upland stream density it holds the highest proportion of all upland GCPO streams in the best condition (58% of all upland streams having >90% forested riparian buffer). The WGCP Ouachita mountains and OZH Boston Mountains have the highest density of upland streams with best riparian condition.

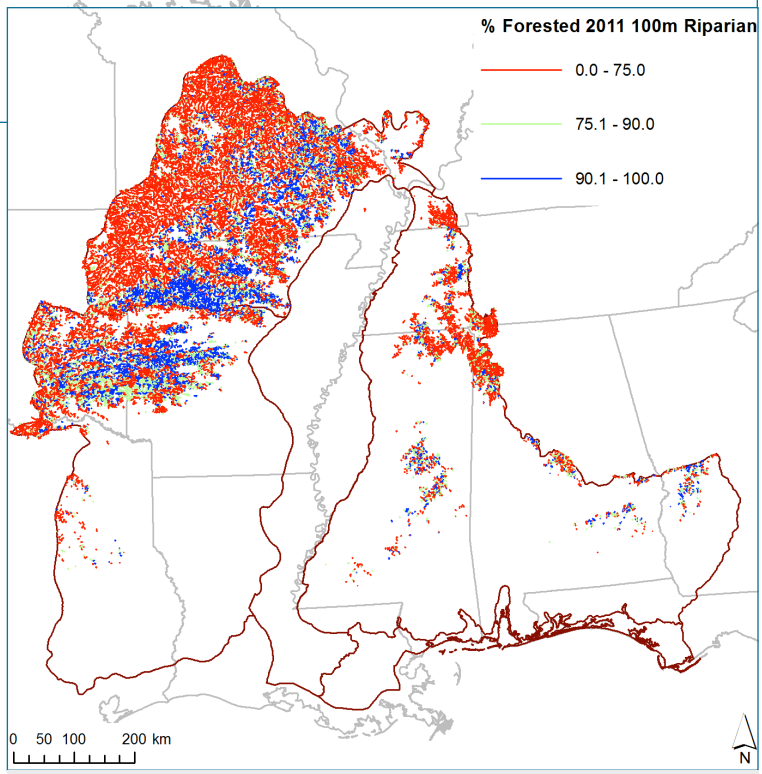


Figure 4. Locations of upland streams and rivers and the associated percent of forested riparian corridor condition within the local catchment.

Interconnected stream systems

Within each of the subgeographies, the proportion of upland streams and rivers having not upstream network dams was roughly equal at 71-72%. Within the entire GCPO geography, the OZH has the greatest amount of upland streams and rivers, so it also has the greatest proportion of streams having no upstream dams (Figure 5). Across the GCPO, upland streams and rivers having zero upstream dams were typically located at higher elevations compared with that having upstream dams. Further development of the Southeast Aquatic Connectivity Assessment Project (SEACAP) into the GCPO will greatly increase the accuracy and relevance of this metric, culminating in development of a tool that prioritizes dams for removal or fish passage based on a suite of ecologically-relevant metrics.

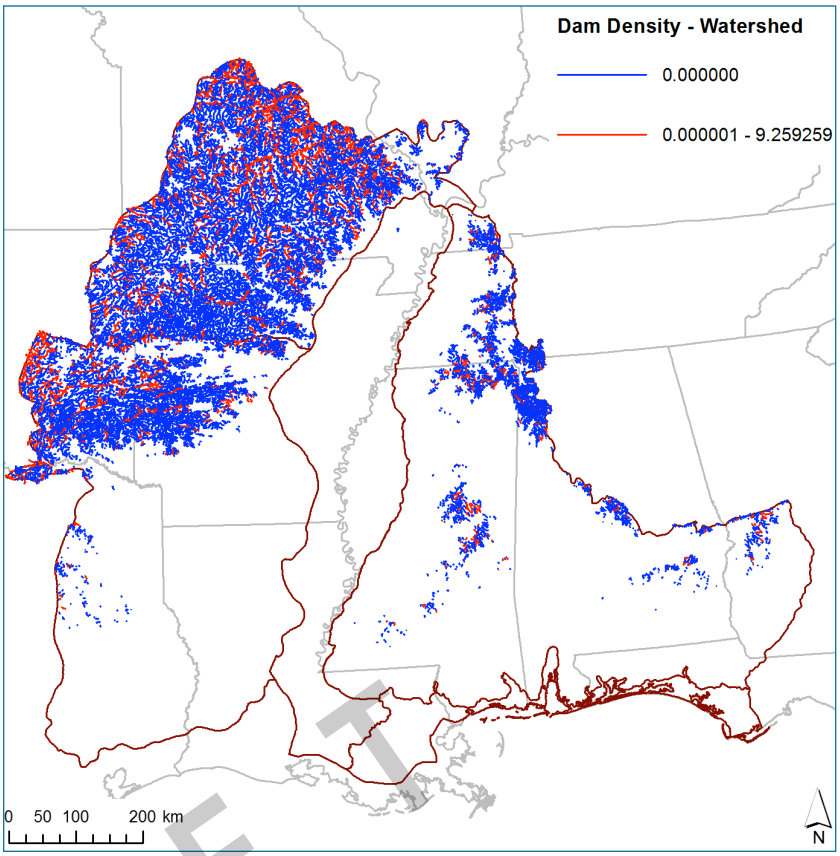


Figure 5. Locations of upland streams and rivers and the associated density of any upstream dams based on the National Inventory of Dams database.

CONDITION

High water quality – minimal contaminants and nutrients

This Assessment used data sources to find combinations of low housing density and natural landcover to assess the risk for contamination from septic system discharge. Though the OZH have a greater amount of upland streams and rivers, the WGCP has a greater amount of streams satisfying this condition (52% of GCPO total). Across all subgeographies, only 15% of all upland streams and rivers fell into the best condition class (>75% of natural cover and < 1 house sq km^2). As with other metrics, most of these upland streams and rivers are located in the Ouachita, Boston, and Ozark mountains. Other data sources that may address this endpoint in future include: Pesticides, SPARROW nitrogen and phosphorus loading, % upstream cropland, % upstream urban.

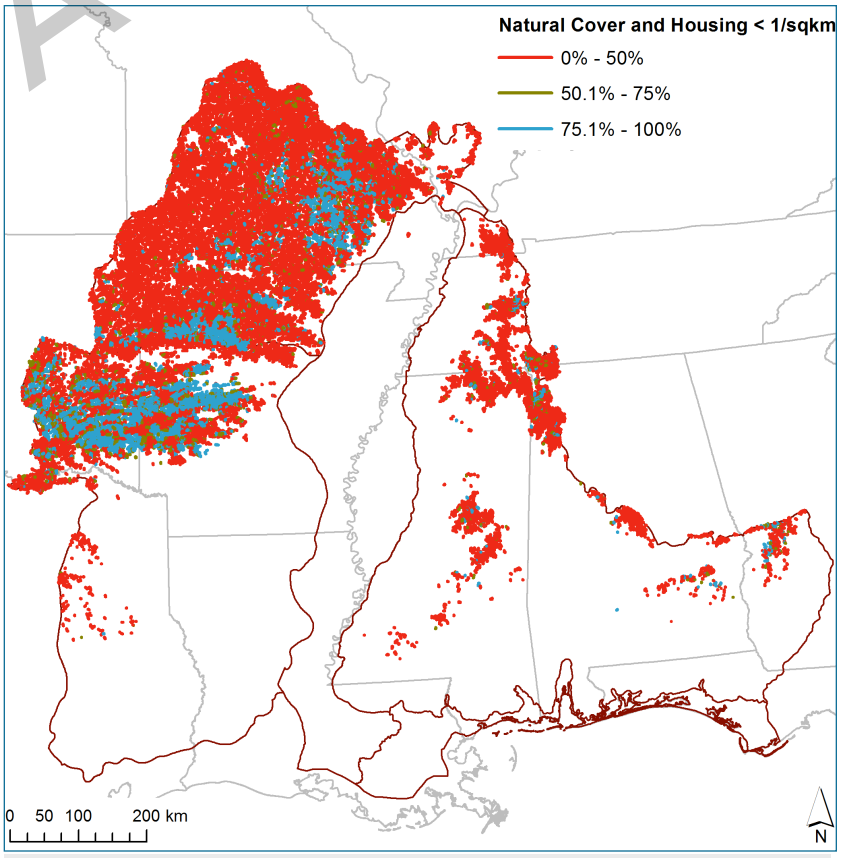


Figure 6. Percent of local catchment area satisfying the combined criteria of < 1 house / km^2 (from 2010 US Census data) and natural landcover (from 2011 NLCD).

Temperatures – low

The range of thermal conditions for upland streams and rivers is largely driven by latitude and elevation (Figure 7). Average August air temperatures are below 26 degrees C throughout most (89%) of the OZH subgeography. By contrast, 99% of average August air temperatures are greater than 26 degrees C in the WGCP. Temperatures in the EGCP fall in between these two extremes with 98% having average August air temperatures in the range of 25-27 degrees C. Results from this assessment may be best interpreted as a relative measure of summer high temperature patterns over a large landscape. Air temperature is at best a coarse correlate of water temperature. This is particularly true for streams that are largely spring-fed, immediately downstream from a dam with cooler outflows, or narrow with good riparian cover.

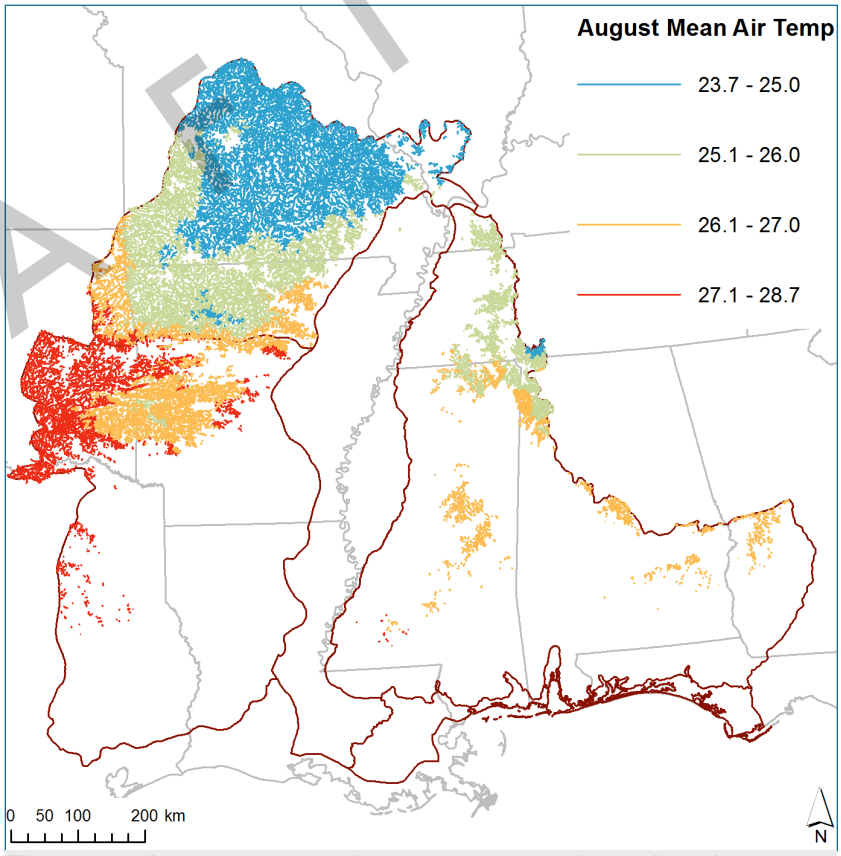


Figure 7. August mean air temperatures based on long-term (1980-2010) PRISM climate data.

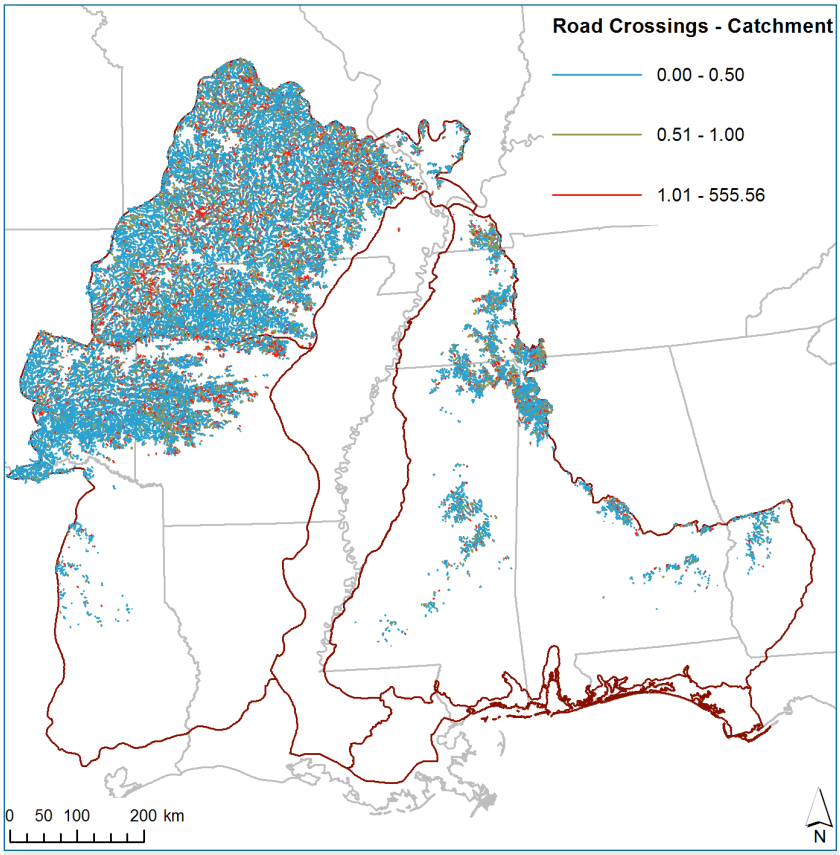


Figure 8. Locations of upland streams and rivers and the density of road-stream intersections within the local catchment of each stream reach (crossings/km^2).

Sediment - minimal

To measure this endpoint, arbitrary thresholds were set for "best", "acceptable" and "poor" density of road crossings: < 0.5, 0.5-1 and > 1 crossings/km^2 within the local catchment. All of the subgeographies have roughly equivalent percentages of road-stream crossing densities in the "best" condition (71-77% of total within the subgeography; Figure 8) as defined by the arbitrary thresholds set in this analysis. Because the OZH have the greatest amount of upland streams and rivers, it also contains the greatest amount of streams in the "best" condition for this landscape endpoint. Unpaved roads are typically a major contributor to sediment in streams – especially during high water periods. However, other types of watershed disturbances may also deliver sediment to a stream, including timber harvest, aggressive agricultural practices, and development — all of which could be assessed using other available datasets.

Natural flow regimes maintained

Groundwater flow regime: low flow variability, low peak flows, low frequency of low flows
Runoff Flow regime: moderate flow variability, moderate peak flows, moderate frequency of low flows
Intermittent flow regime: high flow variability high peak flows, high frequency of low flows

Distribution of natural flow regimes relies on an analysis by Leasure et al. (2014)* The geographic extent they used for that study differs from that used for the current analysis (Figure 9). All stream segments classified by Leasure et al. that also fell within 1 km of upland streams and rivers based on the definition used here were selected for analysis (Figure 10, next page). Of those selected streams, the dominant majority (60%) fell into the "intermittent flashy" class. This natural flow class is typified by small drainage areas (< 22km^2) and streams in this class run dry 1-3 months out of the year. Intermittent streams are clearly an important feature of this landscape and aquatic organisms native to these streams are adapted to these seasonal extremes. The Leasure et al. data do not, however, address the question of where streams flows are likely to remain in natural condition. These predictions should be compared with current conditions to evaluate flow departure from natural conditions. Results from the analysis of upstream impoundments and upstream watershed conditions may also be applied here as indirect measures of flow modification.

* Leasure, D. R., D. D. Magoulick, and S. D. Longing. 2016. Natural Flow Regimes of the Ozark–Ouachita Interior Highlands Region. River Research and Applications 32: 18–35. doi:10.1002/rra.2838

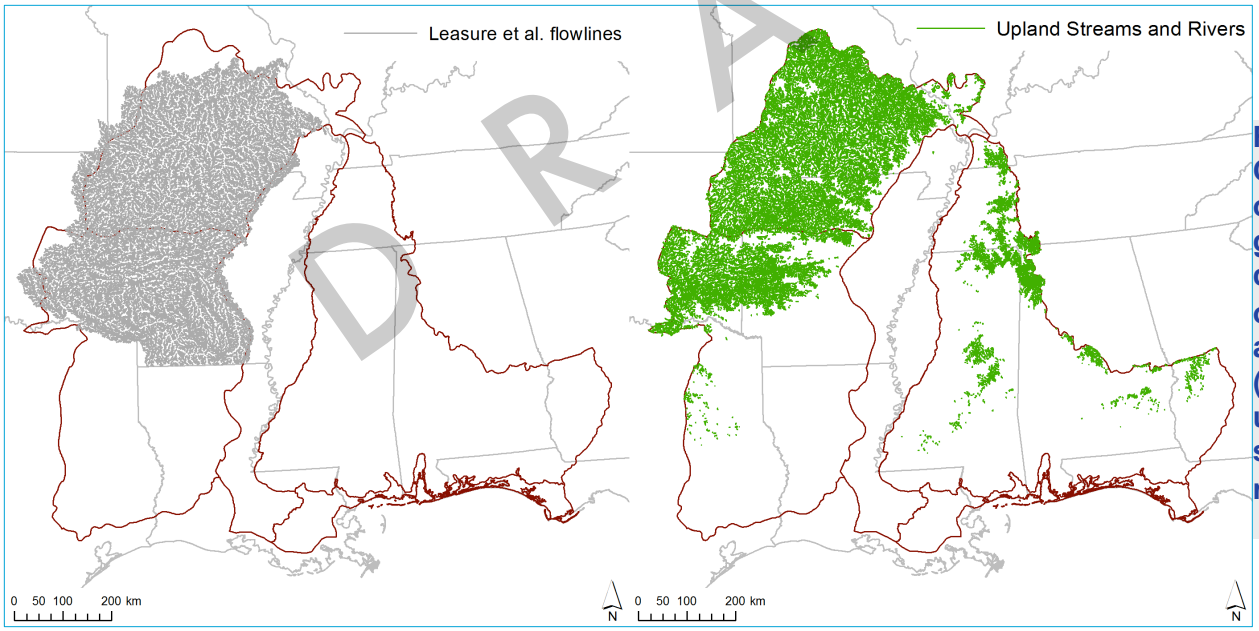


Figure 9. Comparison of the geographic distribution of Leasure et al. flowlines (left) and upland streams and rivers (right).

Dissolved Oxygen (DO) – high

This endpoint lacks suitable geospatial data sources for its assessment. Rapidly moving water interacts extensively with the atmosphere, so small, turbulent streams having limited pollution can maintain oxygen concentrations near saturation with seasonal and diurnal changes driven by temperature. Smoothly flowing rivers having less turbulence have reduced interaction with the atmosphere and may have lower oxygen levels. High natural organic and anthropogenic nutrient loadings can lead to higher biological activity and higher biological oxygen demand (BOD). The impacts of high BOD may be acutely felt in summer when high water temperatures reduce oxygen

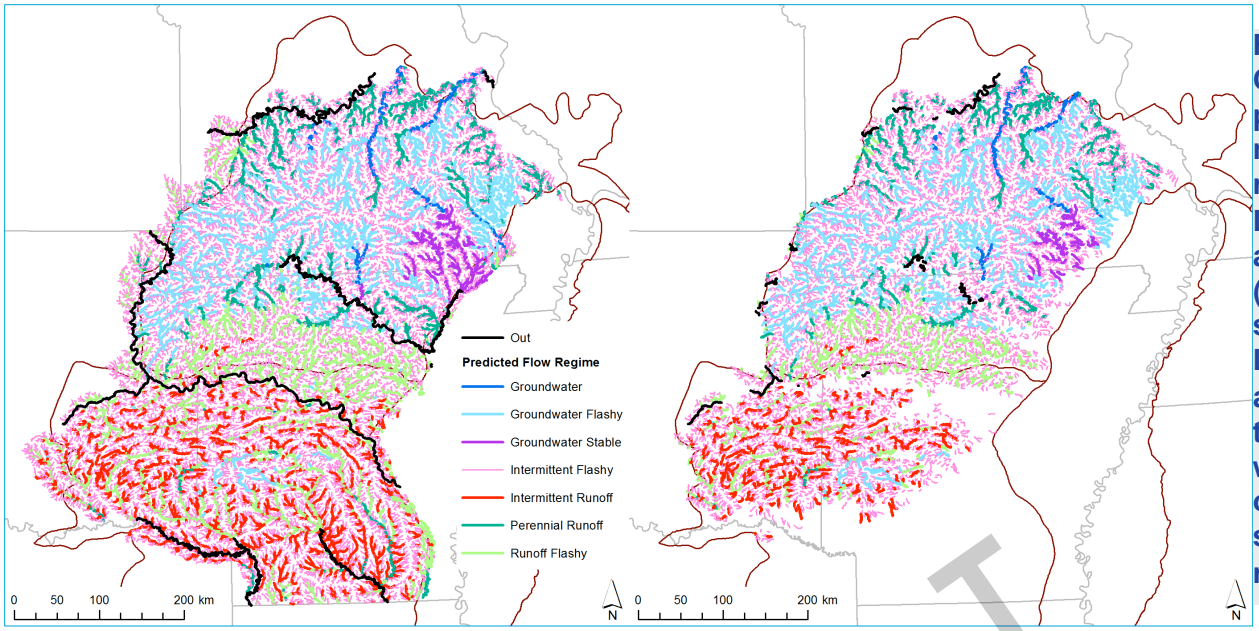


Figure 10. Comparison predicted natural flow regime for all Leasure et al. flowlines (left) and for selected Leasure et al. flowlines that fall within 1km of upland streams and rivers.

solubility. Intact watersheds and riparian zones composed of natural vegetation can, however, help to temper nutrient delivery from anthropogenic sources. Factors affecting dissolved oxygen content include: stream size, flow velocity, nutrient loading, temperature and watershed condition.

Of the non-seasonal variables, flow velocity may be the most important and stream gradient strongly influences flow velocity. In upland streams and rivers of the Ozark Highlands, however, high gradient streams having a slope of greater than 2% are strongly associated with "intermittent flashy" stream classes that tend to dry up for extended periods during the summer. A suitable combination of stream size, slope and/or stream velocity that is able to maintain high quality DO and flow throughout the summer months is yet to be determined. When summer low stream flow and high temperature are most likely to impact stream DO conditions, streams having intact watersheds and riparian corridors with low risk for anthropogenic or organic nutrient loading may be most likely to maintain suitable DO conditions. High quality streams for DO may therefore also be captured by assessments of high quality landscape endpoints detailed above including: watershed, riparian, contaminant and sediment characteristics.

Confluence of the Buffalo and White Rivers in the Ozark Mountains of Arkansas, Riley's Station Canoe Launch - Thomas & Dianne Jones via Flickr

Structure:

Variety of substrates: gravel to boulder
Abundant leaf litter

Suitable geospatial data to capture these two landscape endpoints could not be found and are therefore not mapped.

Substrate quality lacks adequately detailed supporting landscape level data. Abundant leaf litter may be partially determined by local riparian condition (estimated above) but this endpoint is also driven by flows which are not currently captured or quantified. Future investigations could assess the relationship between species reference data and potential indirect measures to determine if any landscape level data exist that suitably capture the intent of these endpoints.