

Land Use Characteristics of Trout Watersheds in Maryland

Land cover has a direct influence on the biological community found in a watershed's streams and rivers. Precipitation flowing off the landscape enters a stream system, impacting stream flow, water quality, temperature, and habitat. All of these factors determine the types of organisms that a stream can support. For sensitive species, such as trout that have a narrow range of conditions needed for survival, major changes to a watershed's land use can have negative consequences.

Watersheds that support wild trout populations are some of the most threatened stream systems in the Mid-Atlantic. This report outlines initial results comparing land use characteristics of brook and brown trout watersheds in Maryland. Percent land use cover was calculated for all 14-digit watersheds in the highland and eastern piedmont region of Maryland. The National Land Cover Data (NLCD 2016) layer was used for this work. Land cover was then compared at the 14-digit scale to trout and temperature data collected by the Maryland Department of Natural Resources Freshwater Fisheries Program and Maryland Biological Stream Survey (MBSS).

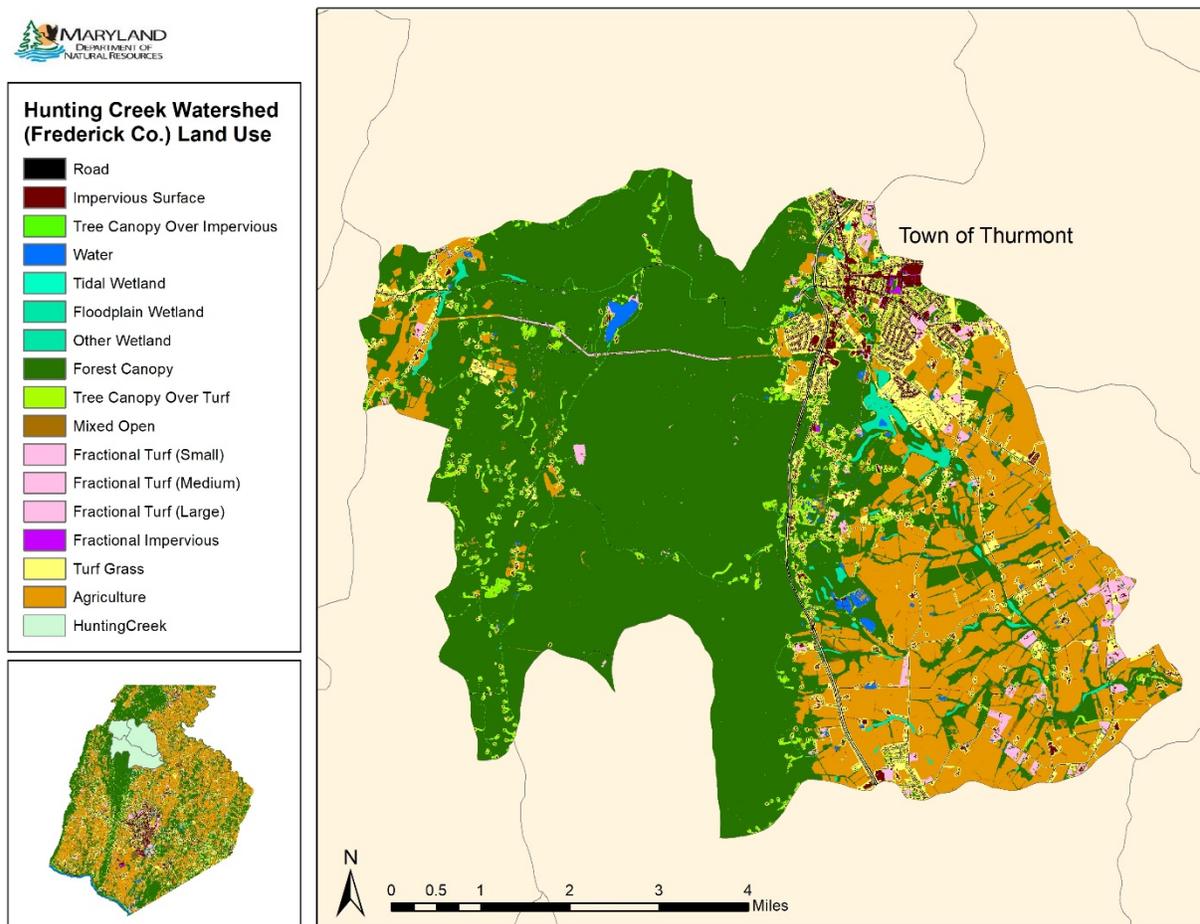


Figure 1. Map showing example of land use categories for Hunting Creek watershed in Frederick County. Three 14-digit watersheds are represented. Land use for this map are based on The Chesapeake Conservancy's data layer.

Land Use and Trout Distribution

This analysis showed differences in land use characteristics between brook and brown trout watersheds (Figure 2). Brook trout stronghold watersheds represent those with the most robust populations and highest densities in the state. Average percent forest cover in these watersheds is 84%. The average percent forest cover in watersheds where brook trout are present is 70%. For watersheds where brown trout are present, the average percent forest cover is 52%. Finally, in watersheds where trout are not present, average percent forest cover is 46%. Brook trout require a higher percentage of forest cover within a watershed if they are to maintain a viable population in a stream.

This is further highlighted when land use and trout presence is examined on a regional scale (Figure 3). Average percent forest cover for brook trout watersheds was higher in West I and West II than in Central Region watersheds. The Central Region of Maryland has experienced the greatest decline in brook trout watershed numbers over the past several decades. This region has had the greatest increase in development and land use change with the growing human population in the Washington DC/Baltimore Metropolitan area. The remaining brook trout watersheds in this region had an average percent forest cover of 52%. Many of the brook trout populations in these watersheds are significantly reduced and in danger of extirpation.

Brown trout watersheds had similar average percent forest cover of around 46% across Eastern, Central, and West II regions. Generally, brown trout are less sensitive than brook trout and are able to tolerate slightly higher summer water temperatures. This may be reflected in the lower percent forest cover. One important note for the brown trout watersheds is that a small number of these watersheds represent tailwater locations (i.e. Lower Gunpowder River) or limestone streams in Washington County. These are unique situations where land use may have less of an influence than the source of the stream water.

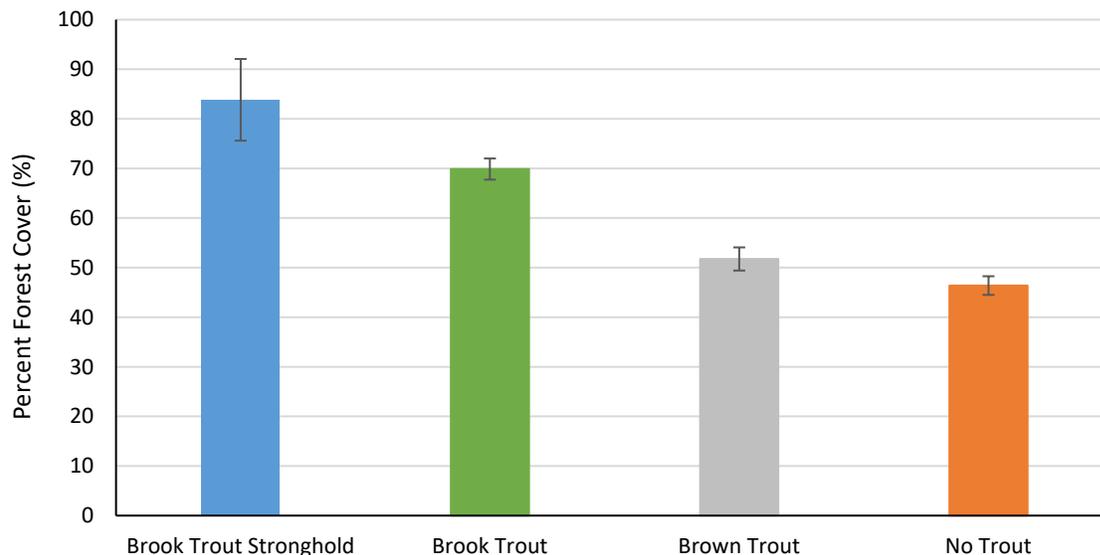


Figure 2. Average percent forested land cover in 14-digit watersheds that support brook and brown trout populations. Brook trout stronghold watersheds are those that support the highest most robust densities in the state.

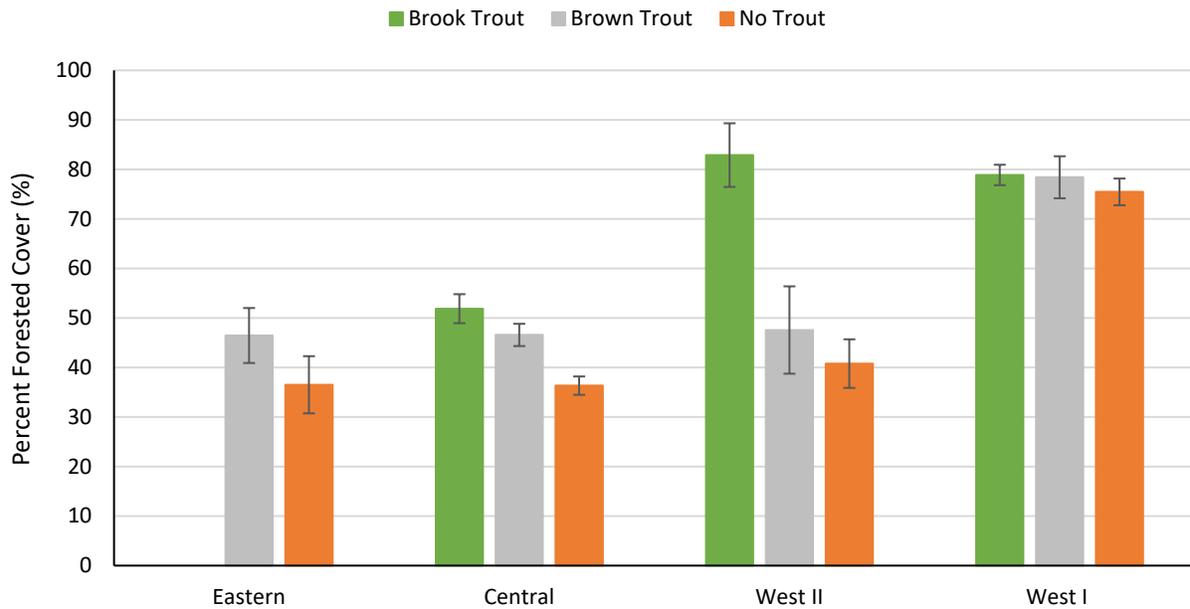


Figure 3. Average percent forested land cover in 14-digit watersheds that support trout populations based on region (Eastern Region = Cecil; Central = Anne Arundel, Baltimore, Carrol, Harford, Howard, Montgomery, Prince Georges; West II = Frederick, Washington; West I = Allegany, Garrett).

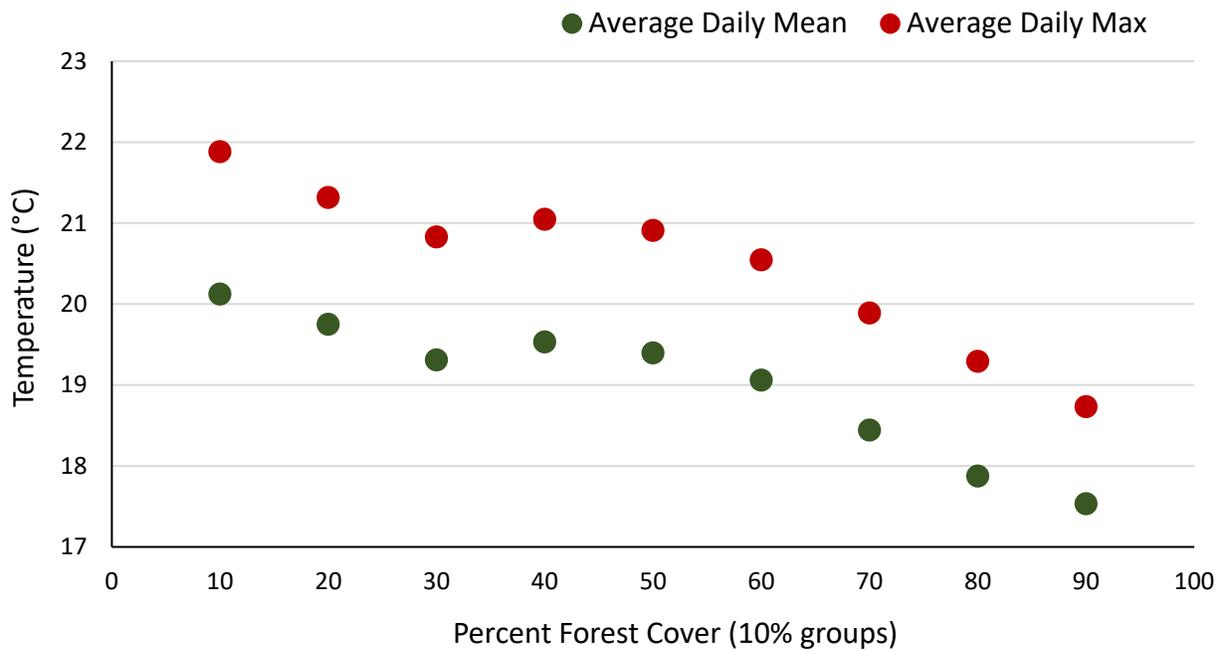


Figure 4. Average daily mean and maximum summer water temperatures for 14-digit watershed related to percent forest cover.

Land Use and Temperature

Land use characteristics are a key factor in stream temperature conditions. When percent forest cover is plotted against average daily mean and maximum stream temperatures there is a clear trend of decreasing water temperature with increasing forest cover (Figure 4). As percent forest cover approaches 70%, average daily maximum stream temperatures dropped below 20°C. This temperature is often used as thermal threshold for long-term trout survival. Forest cover provides direct shading to the stream and allows greater infiltration of precipitation into the groundwater. Cold groundwater inputs in the form of seeps and springs have been shown to be extremely important areas of thermal refuge for trout during the summer months. Watersheds with lower percent forest cover generally have higher percent agriculture and/or development. Instead of infiltrating into the groundwater, these watersheds have higher amounts of direct surface runoff into streams. Water flowing off these types of surfaces can be significantly warmer, raising stream temperatures. As increasing water temperatures exceed the upper thermal critical level of the different trout species, they cannot survive.

Management Implications

Trout can serve as indicator species of a watershed's condition, with brook trout being the most sensitive to changes in forested land cover. Cold high quality water is the basic requirement for the existence of brook trout populations. In order to maintain current brook trout watersheds in Maryland, conservation and protection of the existing forest cover is critically important. Brook trout populations can thrive in watersheds that have a high percent of forested land cover (>80%). When percent forested land cover starts to drop below 70% there is a decrease in brook trout densities. Forest cover helps maintain appropriate water temperatures that brook trout require for survival during the critical summer period. A forested watershed also acts as a filter to help remove sediment and pollutants resulting in better water quality conditions. Heavily forested watersheds often represent areas with the least impacts from human development or ones that have had enough time to recover from historic disturbances.

Conservation efforts that focus on limiting forest loss in trout watersheds are of primary importance in preserving this resource. Efforts that look to increase forest cover within trout watersheds are another good option. Private landowners and watershed groups can help improve trout watershed conditions by participating in tree planting and riparian buffer programs. Multiple groups such as county soil conservation districts, Maryland Department of Natural Resources Forest Service, Trout Unlimited, and The Chesapeake Bay Program all offer grants and assistance with these types of projects. Often there is minimal or even no cost to landowners who participate. All of these efforts are a step in the right direction towards preserving the trout populations and the watersheds that support them in the state.

Any questions about trout watershed land use analysis please contact Michael Kashiwagi (Michael.kashiwagi@maryland.gov) or Adam Eshleman (Adam.Eshleman@maryland.gov).