Article 23

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Historical Change in a Warmwater Fish Community in an Urbanizing Watershed

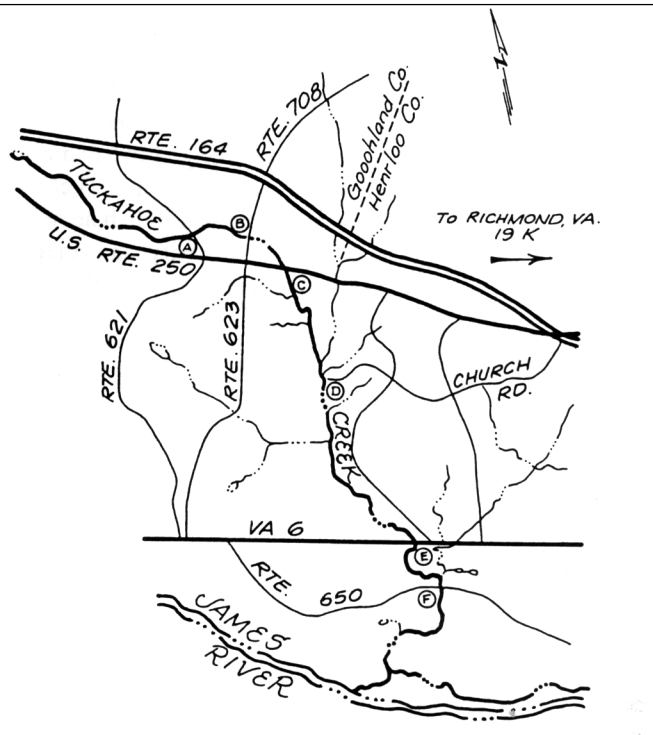
Most investigators exploring the link between urbanization and stream quality sample stream indicators from a large population of urban watersheds. An alternative approach is to sample a single watershed at two points in time (i.e., take a historical snapshot of stream indicators before and after the watershed develops). Alan Weaver and Greg Garman recently applied this method to track changes in the fish community of Tuckahoe Creek, a watershed that has been shifting from rural to suburban land use over the last three decades. The study provides several interesting insights into how a warmwater fish community can change over time in response to watershed development.

Tuckahoe Creek is the last major tributary to the James River above the Fall Line in Virginia (Figure 1). The creek is 17 miles long and drains a watershed of over 40,000 acres. On average, the creek is 12 feet wide and two feet deep. Its upper reaches have a moderate gradient, and possess a substrate of sand and impacted cobble. As the creek descends toward its confluence with the James River, however, it begins to interact with a large wetland complex and wide floodplain. At this point, the creek's substrate changes to silt and detritus.

Situated only a dozen miles west of Richmond, Virginia, the Tuckahoe watershed has experienced considerable development pressure over recent decades. Several indicators of the rapid watershed change that has occurred are profiled in Table 1. In the late 1950s, for example, the watershed was dominated by forest and crops, and had a population density of only one person to every two acres. Over the next 30 years, however, population in the watershed nearly tripled, reaching an average density of 1.5 people per acre. The length of roads, water crossings and amount riparian development also increased dramatically over this period. Although Garman and Weaver did not estimate impervious cover as part of their study, a ballpark estimate can be derived using the Stankowski population density/ impervious cover equation. The equation projects that impervious cover was 5% in 1958 and grew to 12% by 1990.

The fish community of Tuckahoe Creek was extensively sampled in 1958, when the watershed was still in a rural condition. While the stream conditions reported in the 1958 survey by Flemer and Woolcott were certainly not representative of "pre-settlement conditions," they did not appear to have changed much from the late 1800s. Indeed, remarkably little change was observed in the Tuckahoe Creek fish community from 1958 to as far back as 1869, according to historical records.

In 1990, Weaver and Garman replicated the fish sampling methods on the same stream that had been surveyed 32 years earlier by Flemer and Woolcott. The research team pinpointed the location of six stream reaches sampled in 1958 from site landmarks, and employed identical seining methods and sampling effort used in the earlier study. The researchers quantified changes in watershed variables between the two surveys by analyzing census data, quad maps, documents and selected aerial photography. As a further indicator of watershed change, Weaver and Garman computed the Index of Biotic Integrity (IBI) for Tuckahoe Creek during the 1990 survey, and compared it with IBI scores for Byrd Creek, a nearby reference stream in a largely



Six stations in Tuckahoe Creek were sampled in both 1958 and 1990. (Designated A-F.)

Figure 1: Location of the Tuckahoe Creek Watershed (Weaver, 1991)