Decoding Decades of Water Quality Data in Parkers Creek

By Mary Hoover, Regional Conservation Partnership Coordinator

Introduction

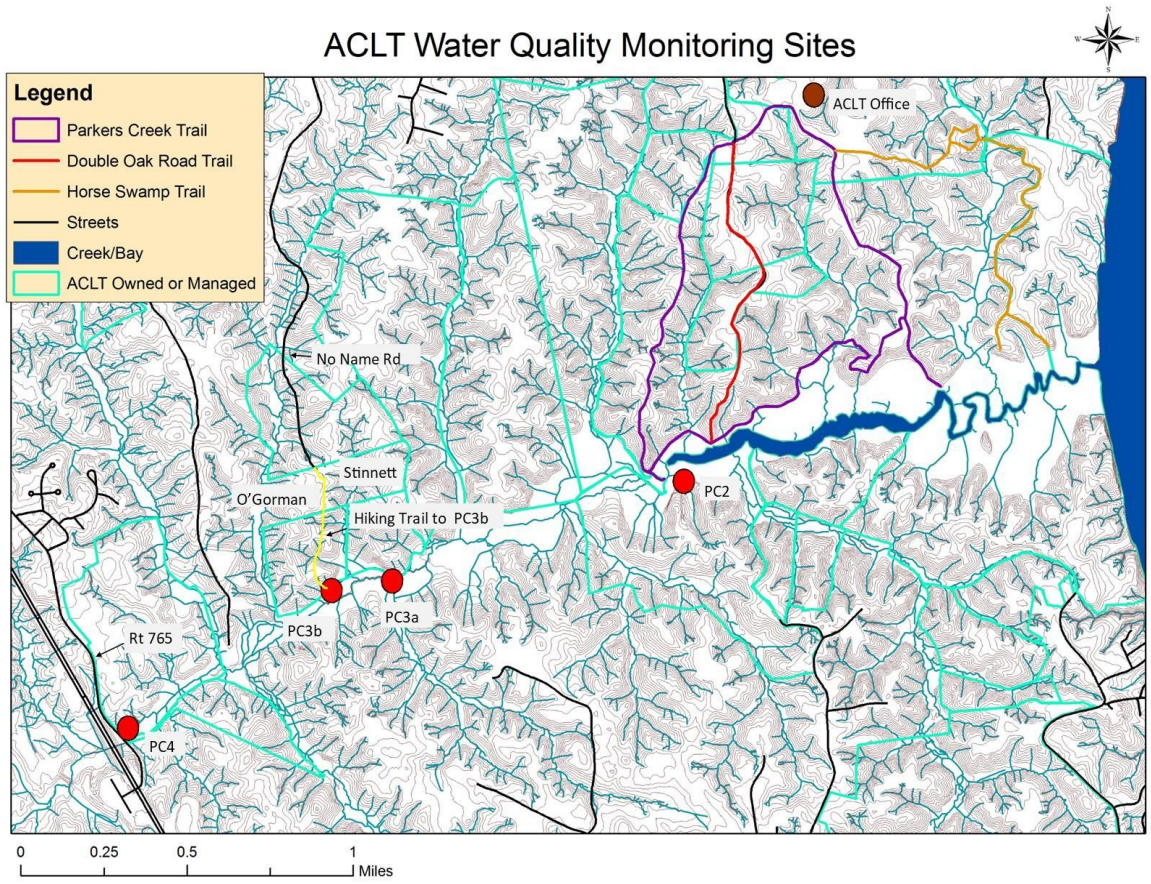
If our streams could talk, what would they tell us? Perhaps they'd gush over the busy beaver activities taking place upstream. Or maybe they'd lament the overgrowth of algae, suffocating their resident fishes and macroinvertebrates. Unfortunately, our streams cannot talk in the same way humans can. However, they can communicate with us in other ways, and it is our job as stewards of the land to listen. For decades, the American Chestnut Land Trust (ACLT) has been listening to the streams of Parkers Creek by collecting extensive water quality data. Our longest-running monitoring program, the mainstem monitoring program, has been ongoing since 1998. With nearly three decades of monitoring data in hand, we now have a time series from which we can discern statistically meaningful trends. This article explores the recent analysis of several key parameters in Parkers Creek: nitrate/nitrite, ammonium/ammonia, chlorophyll a, phosphate, and total suspended solids. Together, these parameters help us interpret what our creek has to say about its health and the effectiveness of our conservation efforts.

ACLT volunteer taking a water sample at PC2, ca. 2008.

Background

The mainstem monitoring program began in 1998 to track stream health over time. By collecting samples each month, we hoped to understand how Parkers Creek responds to seasonal patterns, changes in land use, and our own land management and conservation efforts. One major concern is the ongoing development of the Prince Frederick town center—the largest town center in Calvert County—which could have downstream impacts on water quality. Regular monitoring is crucial for catching potential problems early on.

While the program started with monthly sampling, it later transitioned to a quarterly schedule due to cost and volunteer capacity. The map below shows the locations of all sites monitored throughout the years. In 2011, site PC3A was replaced with PC3B. Today, three sites are monitored quarterly: PC2 (furthest downstream, by the raft), PC3B (midstream), and PC4 (furthest upstream).



As stated above, some of the key parameters we monitor include ammonium/ammonia, nitrate/nitrite, phosphate, and total suspended solids. These represent some of the most common forms of nitrogen, phosphorus, and sediment, which are the three main sources of pollution in the Chesapeake Bay. We have also studied chlorophyll a, a pigment found in algae that can indicate algal bloom conditions.

Ammonium (NH_4), ammonia (NH_3), nitrate (NO_3), and nitrite (NO_2) are all forms of nitrogen. In small amounts, nitrogen is a necessary nutrient for aquatic life. However, in excess, it can produce algal blooms, reduce oxygen levels, and harm aquatic species. Monitoring these compounds helps us detect nutrient pollution that may come from land use sources, like septic or runoff from developed areas.

Phosphate (PO4) is a form of phosphorus, another nutrient essential to life but harmful in excess. Like nitrogen, high levels of phosphorus can stimulate overgrowth of algae and lead to harmful blooms.

Finally, total suspended solids (TSS) indicate the amount of sediment suspended in the water. High TSS can reduce water clarity, block sunlight from reaching aquatic plants, and clog fish gills, to name a few deleterious effects. High TSS often suggests erosion in streams, but it can also come from surrounding runoff.

Results

Before diving into the specifics of what we found, it's worth mentioning some good news: over nearly 30 years of monitoring, the overwhelming majority of water quality data from Parkers Creek has remained within the "good" threshold for each parameter. This is an impressive achievement, especially given the continued development pressures in the Prince Frederick town center. While we do see some statistically significant upward trends at certain stations and times of the year, most of the data indicates a healthy and happy creek. This is a major testament to ACLT's stalwart conservation efforts and the resilience of the green sanctuary we've built together with your support. That said, a few trends stand out, and we will explore those in more detail below.

The table below summarizes the "hard" and "soft" trends found at each station, over each sample month. Hard trends, denoted by the darker green and darker pink, are considered statistically significant. Statistical significance is determined by calculating a probability value, or p value, and values < 0.05 are considered significant. Soft trends, denoted by the lighter green and pink, are not *yet* statistically significant, but are hovering right around the cusp and could become significant in the future if the trend continues. Soft trends

have a p-value < 0.1. Increasing trends are represented by upward arrows, and decreasing trends are indicated by downward arrows.

Station ID:	PC 2				PC 3B				PC 4			
Month:	MAR	JUN	SEP	DEC	MAR	JUN	SEP	DEC	MAR	JUN	SEP	DEC
NH4/NH3	-	↗	-	-	↑	-	↓	-	↗	↑	↑	-
NO23	↑	↑	↑	↑	-	↗	-	-	↗	-	-	-
Chl-a	-	-	-	↑	-	-	-	↑	-	-	-	↗
TSS	-	-	-	-	-	-	-	-	-	-	-	-
PO4	-	-	-	-	-	-	-	-	-	↓	-	-

Legend:	
↑	increasing hard trend
↗	increasing soft trend
↓	decreasing hard trend
↙	decreasing soft trend
-	no trend

Nitrogen is a key nutrient for aquatic ecosystems. However, too much nitrogen can tip the ecosystem balance, causing algal blooms that deplete oxygen and harm aquatic life. Our mainstem monitoring program tracks a couple of prevalent forms of nitrogen: ammonium/ammonia (NH4/NH3) and nitrate/nitrite (NO23). A quick glance at the table above shows that both forms of nitrogen saw the most increasing trends out of all the parameters.

At PC2, the most downstream site, NO23 showed a strong upward trend every season. There was also a slight increase in NH3/NH4 during summer, but no significant changes in other seasons. At PC3B, NO23 softly trended upward in the summer, and NH3/NH4 showed a spring increase but a decrease in the fall, suggesting seasonal variability rather than an overall trend. At PC4, the station furthest upstream, NO23 showed slight spring increases, and NH3/NH4 trended upward in spring, summer, and fall.

These nitrogen trends are relatively modest and do not yet appear to be driving major shifts in algal growth or oxygen levels. However, particularly at PC2, these trends may indicate early signs of nutrient enrichment. Despite increasing trends, nitrogen concentrations remain within the “good” range, and Parkers Creek continues to support a healthy aquatic ecosystem. Continued monitoring will help us track whether these concerns persist, allowing us to adjust our management practices as needed.

Chlorophyll-a is a pigment found in algae, and it's commonly used as an indicator of algal growth in surface waters. Across the board, chlorophyll-a trends were relatively stable. We saw no significant upward or downward movement, which suggests that the stream's algae levels haven't significantly increased over time and that nutrient-driven algal blooms remain largely under control. However, a few exceptions stood out: a statistically significant upward trend at PC2 in December; a similar December increase at PC3B, and a soft increase in December at PC4. Although increasing in winter at each site, Chlorophyll-a levels remained mostly under 20 µg/L, the level above which algal blooms typically occur.

Total Suspended Solids (TSS) measures the amount of particulate matter, like soil and sediment, floating in the water. High TSS can cloud water, block sunlight from aquatic vegetation, clog fish gills, and carry other pollutants. In the mainstem of Parkers Creek, TSS was the most stable of any parameter. Across all stations and seasons, we found no statistically significant increases or decreases. This stability is encouraging, given the potential for sediment to enter streams due to development in the watershed. The lack of any trends speaks to the success of our strong forested buffers, keeping our suspended solids in check.

Finally, phosphorus is another key nutrient that can cause problems in high concentrations. Like nitrogen, excess phosphorus, usually in the form of phosphate (PO4), feeds algal blooms in streams. Luckily, phosphorus in the Parkers Creek mainstem has never been an issue over our decades of monitoring, with only one station exhibiting any trend in concentration. PC4 showed a hard decrease in phosphorus in the summer. This trend further reinforces that phosphorus, although a major pollutant in the Chesapeake Bay, is not currently a parameter of concern in Parkers Creek.

Conclusion

After almost 30 years of listening, the streams have spoken: Parkers Creek is healthy, resilient, and thriving—thanks to our dedicated staff and generous supporters. A few mild trends remind us to stay vigilant, but with continued water quality monitoring and conservation efforts, we can ensure our beloved Parkers Creek watershed stays protected for years to come.