

THE ALGAE OF WALLER CREEK

Jerry Coleman, Tim Wright, and Kenny Totz
St. Edward's University

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Correspondence: Dr. Jerry Coleman, c/o Botany Dept.,
University of Texas at Austin, Austin, TX 78713

Introduction

The creek bed of Waller Creek extends nearly 7 miles from north of St. John's Ave. to the mouth at Town Lake, just west of Interstate 35. The 4 1/2 square mile watershed which it drains (Swezey, 1991) lies entirely within the Austin city limits, and the creek is therefore heavily impacted by human activities. Much of the watershed is residential, but runoff from a large portion of the eastern downtown district, most of the University of Texas campus, a number of commercial and industrial areas, and hundreds of miles of paved roadway also drains into the creek. In addition, much of the creek bed is underlain with sewer lines. None of the watershed can properly be called rural; the few larger tracts of undeveloped land are maintained as grass for recreational use.

The deeply-scoured channel shows evidence of severe flooding (Swezey, 1991). Much of the floodwater is direct runoff during and immediately following heavy storms. An increase in impervious cover from increased development over the last 50 years has probably increased both the frequency and the intensity of flooding. The higher density of both residential and industrial use has also probably increased the levels of various pollutants loaded into the stream.

The composition of periphyton communities is strongly influenced by the innumerable physical and chemical aspects of stream water (e.g., papers in Wetzel (ed.), 1983). Therefore, knowledge of this community can give insights into specific water quality questions, such as the frequency and intensities of flooding, and nutrient and pollutant loading. The City of Austin has shown an increased interest in the

quality of all the creeks within its limits, both to protect the quality of Town Lake (the Colorado River) which receives the water from most of the creeks, and to protect and improve creek water quality for its own inherent value. While the hydrogeology of Waller Creek has been well studied for the purposes of flood protection (see refs, Swezey, 1991), the ecology of the stream communities is not as well known. Therefore, the goals of this study are: 1) to identify important members of the algal community, especially, if possible, indicator species, 2) to monitor temporal and spatial changes in species and abundances, and 3) to locate and identify any specific influences which might affect the algal community.

Methods

The research team conducted monitoring expeditions near the middle of each month from June through November, 1991. Only the stretch of the creek from the creek mouth to the 45th Street bridge was monitored. This appeared to be the extent of constant stream flow, at least during the summer months in which most of this study was undertaken. In the June through August trips collections were made from eight selected locations (Table 1), plus from anywhere an unfamiliar species was suspected. On later trips collections were made from where field appearance suggested a change in the composition of the algal community. Field notes were taken on the abundance of algae, visual appearance of the creek (e.g., color, turbidity, appearance of oil sheens, flow), and any obvious influences on the creek water quality (e.g., storm sewer and miscellaneous pipe outflows). Samples were returned to the lab for examination and identification. Due to the difficult technical nature of unambiguously assigning a species-level identification within many

genera, the algae were identified only to the level of genus.

In mid-June, large pieces of clean limestone, each at least twice the size of a standard brick, were set into the creek to monitor the algal colonization of bare surfaces. Two rocks were placed at each of four locations. It was intended that monthly samples of the new algal growth would allow the standardized quantification of colonization and subsequent growth rates of the filamentous green algae and its associated epiphytes.

Results and Observations

The genera of algae identified are listed in Table 2. Many of these are documented in the accompanying slides (Appendix 1). As our major focus was on the growth of filamentous green algae, less effort was made to monitor the members of other algal groups. Nevertheless, the more common types were identified and are listed.

In July, one month after they were placed in the creek, only half of the limestone rocks were recovered after extensive searches. They all had a thin patina of green, indicating colonization by algae. In August, none were recovered as runoff from a heavy storm during the previous two weeks had scoured the creek bed. While this precluded further documentation of bare surface colonization, it provided a strong indication of the importance of storm flow as a scouring mechanism of the creek bed, and as mechanisms for exposing new rock surfaces and burying previously-colonized surfaces.

Most hard surfaces in the creek were colonized by algae, at least by

the basal holdfasts if not by filaments of varying length. Algal cover and filament length were in general greater downstream, especially below the small dams in the 5th and 6th Street area. Even well upstream, however, large patches of uncolonized rock were rare. Regrowth following the late summer flood was also noted to be faster in the downstream sections.

Cladophora was the dominant filamentous green algae genus in most locations and in most months. Initially, we had trouble identifying Cladophora in the field, as its color varied from bright green to dark brown, and its length varied from a thin coat on the rocks to strands greater than 10 cm. The color differences were found to be related to the general health of the algae, and to the relative cover of the filaments with epiphytes and silt. The length differences were found to be related to the length of time since the last large rainfall, and to the relative protection afforded the algae by local conditions.

A closely-related filamentous green alga, Rhizoclonium, was also found in many locations throughout the season. Some identifications of Cladophora may in fact have been in error, particularly early in the season when the filaments were too short to show their characteristic branching pattern. Spirogira, another genus of filamentous green algae, was found only in free-flowing sections of upstream areas, except once on the first trip (mid-June). There did not seem to be any pattern to the appearance of the other genera found (Table 1).

As only a single year's growth was monitored, no clear seasonal changes were discernable: changes from month to month seemed more likely the result of variation in rainfall. The final two collections contained an increased number of diatoms, non-filamentous green algae,

and other free-living or epiphytic Protists, but conclusions from this observation are difficult to draw. Filaments were longer in July than in June, but by August filament lengths were again short, presumably the result of the early-August flood. Substantial regrowth was seen by the September trip, especially downstream, with further growth noted in October. Filament lengths were more variable in November: in some areas shorter filaments suggested regrowth following mild scouring during late October rains, while in other areas (especially downstream) the longest filaments of the year were found.

While Anabaena and Oscillatoria, two filamentous cyanobacteria, were not uncommon, nowhere did they rival the filamentous Chlorophyta in abundance. The two cyanobacteria were found only in locations where stagnant conditions were most likely--in drying pools both upstream and downstream, and within large masses of filamentous algae in the slow-moving waters in the last few blocks near the creek's mouth.

Numerous specific influences on water quality were noted, but most seemed transient in that they were not repeated in following months. Still, on each trip at least one location was noted where "something" was occurring. Usually these were unusual odors or discharges from a pipe. About half of the time the odor was clearly of organic sewage, but never did the odor seem to emanate from sanitary sewer lines. Some storm sewer pipes had large amounts of algae growing near their outfall, although this growth was also scoured by storm runoff. Other storm sewer pipes (particularly in the downtown area) dripped water with a chemical smell; the growth of algae near these pipes was often much reduced.

Exceptions to the transient nature of the specific influences

were: 1) immediately downstream from the Shipe Park swimming pool near 45th street, 2) where large rocks had recently been scoured by floodwaters (especially in narrow channels), and 3) where rocks had been overturned exposing fresh surfaces (especially in gravel beds), and the downtown area in general. The area below Shipe Park showed almost no algal growth until September, after the daily releases of chlorinated water had ceased. The downtown area (roughly 12th St. to 4th St.) had a much higher concentration of pipes draining into the stream, the sum total of which was a noticeable increase in stream turbidity, and the frequent appearance of local oil sheens on the surface. In this area, the creek bed substrate was siltier and noticeably more foul. Dark-colored and somewhat slimy sediments were also frequently found.

Discussion

The growth of filamentous green algae can be limited by nutrient availability (e.g., Dorich et al., 1984; Hart and Robinson, 1990). The observed greater algal growth downstream suggests that the urban area was acting to fertilize algal growth through nutrient inputs. Cladophora can be an indicator of nutrient-rich water (Wharfe et al., 1984; Dodds, 1991; Whitton, 1970, and refs therein), and as it was found in all locations in the creek, nutrient input cannot be attributed solely to the urban sections of the watershed. Evidently runoff from homes and streets in the residential areas also contribute sufficient nutrients to support Cladophora growth upstream from the urban area.

Spirogyra, found only in the very upstream sections of our survey, is generally more common in "cleaner" waters than is Cladophora. This suggests that nutrient enrichment of the stream may be close to a

critical level sufficient to cause a change in species, and that Cladophora has largely replaced Spirogyra. An alternative explanation for the observed pattern is the greater susceptibility of Spirogyra to removal by physical abrasion during storm surges (Power and Stewart, 1987). The greater volume and velocity of storm water further downstream may have scoured Spirogyra from the rocks. No information was found as to the historical distributions of these two species in the creek. However, it is interesting that in nearby Barton Creek, which is less impacted by urban influences (lower nutrient levels and less severe flooding), Spirogyra was seen much more commonly (Wright and Totz, unpub. data).

Fortunately, perhaps, scouring of the creek bed was sufficiently frequent that algal buildup and subsequent decay did not present a major eutrophication problem during the period of this study. However, when scouring is less frequent (during long periods of low rainfall, especially where the channel is relatively wide), or where low flow reduces the opportunity for oxygenation of the water (e.g., in isolated pools), temporary stagnation could occur. It was noted that the two filamentous cyanobacteria Anabaena and Oscillatoria were found only in occasional stagnant pools in the upstream residential areas, and somewhat more commonly in stagnant pools and in the wider channels with low flow in late summer and early fall near the mouth of the creek (below 3d Street). Cyanobacterial growth can be an indication of eutrophic or stagnant conditions (Sterner, 1989).

In conclusion, Waller Creek seems to be well loaded with plant nutrients which could support large growth of algae, but during the course of this study nuisance growth was not seen. The frequent "flushings" from storm events seem to have the effect of scouring the

creek bed such that the accumulated algal biomass flows to Town Lake, where it is probably decomposed. Much of the nutrient load seems to be added upstream of the downtown urban district, but the downtown district probably adds a large quantity of chemical pollutants. While few specific permanent influences on algal growth were found, continued monitoring by landowners adjacent to the creek might identify sources of pollution not identified as important by this study. Non-point sources of pollution, especially urban runoff, are probably the largest contributor of pollutants, and thus stream quality is not likely to improve substantially without expensive retrofits or large changes in land use. Overall, we expected much worse than we found, and were less disappointed by the water quality per se than in the incredible amounts of trash in the stream (especially where it was trapped by fallen trees).

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Table 2. Algae genera.

Tentative identifications are indicated by a '?'.

Filamentous Chlorophyta

Cladophora--very common, all months, all sections of the creek

Oedogonium

Mougeotia

Rhizoclonium

Spirogyra

Ulothrix

Non-filamentous Chlorophyta

Anacystis?

Chlamydomonas

Closterium

Cosmarium

Eudorina?

Euglena

Filamentous Cyanobacteria

Anabaena

Oscillatoria

Chrysophyta

Diatoma--many species noted

Fragilaria

Gomphonema?-- common, dominant Cladophora epiphyte

Navicula

Synedra

Tabellaria?

Genera were identified and classified according to Prescott (1964) and USDOI (1966).

Table 1. Selected monitoring sites

1. 25 m below the 1st St. bridge, below a storm sewer outfall
2. North end of Palm park, north of the 3d St. bridge
3. Between 4th and 5th Streets
4. Waterloo Park
5. adjacent to new UT tennis courts, equivalent to 13th St.
6. south end of Hancock Golf course, just north of 38th St.
7. Below Shipe Park, behind the Elizabet Ney house
8. south of the 45th St. bridge

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