ECOLOGICAL SURVEYS OF FOUR RIVER CORRIDORS IN GEORGIA

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Abstract. Georgia's rivers are essential elements of its landscape that have undergone historical alteration and continue to experience rapid anthropogenic change. In an effort to compile a statewide assessment of the status and character of Georgia's higher-order streams and their floodplains, the Georgia River Survey undertook to examine a combination of qualitative and quantitative ecological attributes of the state's major watercourses along their entire lengths. During 2003 and 2004 the group spent several weeks on each of the Satilla, Flint, Ocmulgee, and Altamaha Rivers, traveling by canoe from the upper part of each stream's watershed to a point near the seacoast or state line. Advancing at a rate of ten river miles per day, these surveys were intended to provide a broad but detailed view of each stream during a short segment of its spring or summer season. We made detailed observations of the avian fauna and of bank and floodplain morphology and vegetation, made water quality measurements, and collected terrestrial insects. We kept records of land use, disturbance and successional stage, and other objects relevant to environmental characterization. All data and observations were georeferenced. The project is as yet in progress: analysis of the survey's products is not complete, but holds potential for suggesting further research. The survey mode of inquiry was effective and provided a feasible and useful way to document a changing landscape.

INTRODUCTION

Southeastern surface waters are morphologically and ecologically diverse, and the region's streams have been identified as a globally important focus for biodiversity conservation efforts (Olson and Dinerstein, 1998). Georgia's situation at the intersection of several physiographic provinces provides it a set of diverse fresh waters unique even among neighboring states. Of ninety-nine indigenous environments identified in Georgia by Wharton (1978), thirty-nine are aquatic and fourteen of those are lotic freshwater systems.

The juxtaposition of Georgia's ecological diversity, population growth, and urbanization complicates management of its freshwaters and associated ecosystems, and necessitates preservation of these environments. Landscape-based ecological surveys are useful to these ends, serving two primary functions: to provide a historical record of the landscape in this context of flux, and to explore alternative methods of gathering data for the implementation of environmental management and policy.

BACKGROUND

Several characteristics are common to surveys of Georgia's landscape, whether they be meant to stand alone (as Bartram, 1792 and Harper, 1906) or are augmented by reviews of others' work (as Wharton, 1978). These include an ability 1) to report a broad range of observations, 2) to synthesize context with specific observation, and show their interdependence, 3) to provide description of phenomena without aetiology, or, if causality is offered, 4) to do so based on sources other than experiment. There are of course disadvantages to the survey mode of discovery and reporting, but it has unique value. For example the survey mode's ability to incorporate and report phenomena together with their context allows it to provide invaluable historical records of the status of dynamic landscapes, a service that theory-driven research is often ill suited to perform. We view experimental science and the scientific survey as complements rather than competitors.

Attempts to retravel the routes of historical surveys are now common (Sea of Cortez Expedition and Education Project, 2004; National Lewis & Clark Bicentennial Council, 2004). One of the chief objects of these endeavors seems to be to discover changes in landscape elements over time. The importance of the original surveys as baseline descriptions was perhaps unforeseen by their authors. Rivers are dynamic features at many scales, and in order to characterize them we attempted to incorporate this often secondary function of exploratory surveys as historical records into a project with a repeatable methodology. We hoped thereby to design a survey which could 1) stand alone as a relevant piece of observational science, 2) establish baseline data and a method for a riverine monitoring program, and 3) provide a broad descriptive record of the character of Georgia's rivers.

METHODS

We traveled by canoe down four rivers in Georgia. Our methods were designed to facilitate continuous observation of each river from its head to its mouth.

Survey Routes

We paddled the Satilla River in southeast Georgia from SR 64 in Atkinson County to US 17 at Woodbine, Georgia, from April 27 to May 13, 2003, a distance of 165 river miles. We paddled the Flint River from Flat Shoals Road on the Meriwether/Pike County line southwest of Griffin, Georgia, to US 84 at Bainbridge, Georgia, (excepting Lake Blackshear) from June 3 – 29, 2003, a distance of 245 river miles. We traveled the Ocmulgee and Altamaha Rivers from the Lloyd Shoals Dam on the Butts/Jasper County line to US 17 at Darien, Georgia, from May 6 to June 19, 2004, a distance of 370 river miles.

Survey Points

Points along each river at intervals of five river miles were calculated in ESRI's ArcView, using the National Hydrography Dataset (USGS, 2002) as a basis. The first point in each set was placed at the river's origin, except in the case of the Altamaha, which was treated as contiguous with the Ocmulgee. Where the sequence of points was disrupted by an impounded segment of river, the lake was skipped, and the next point placed upon the water's re-emergence from the dam.

Half the points in each of the sets were then designated Full Points, such that they alternated with those of the second designation, the Midway Points. Thus, points of the same type occurred at intervals of ten river miles. We only treated one side of the river at each point, alternating banks every other point, so that a Full Point and its subsequent Midway Point were paired and assigned to the same side. Generally we began each day at a Full Point, paddled five miles to the Midway Point, and then continued five more miles to camp at the next Full Point.

Study Regions

At each Full Point, a stake representing the point was placed on the appropriate side of the river, at the boundary between the riverbank and the floodplain or upland. This boundary usually corresponded to the limit of the river's bankfull stage. A transect bearing, opposite the direction

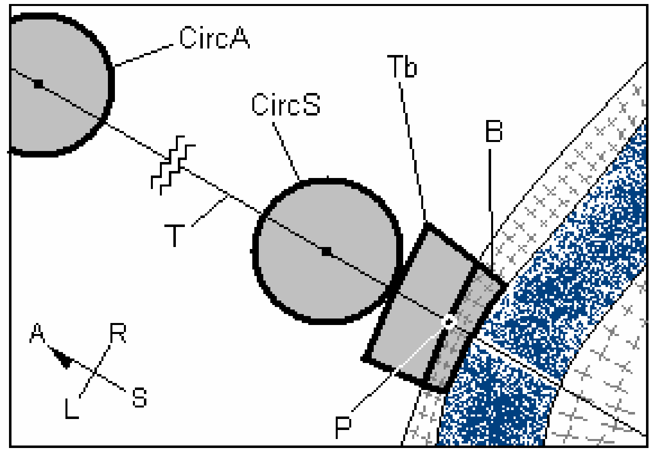

Fig. 1 – Overhead diagram of study regions and accompanying coordinate system, not to scale. Mottled swath is the river channel; crossed swaths are banks; blank field is the floodplain. Study regions are shaded gray: CircA = *Circle A*, CircS = *Circle S*, Tb = *Topbank*; B = *Bank*. P = Point; T = transect line; coordinates A, S, R, L are defined in the text.

of the shortest distance across the river from the stake, was chosen, and a set of study regions (hereafter 'regions') laid out accordingly (Figure 1). An arbitrary coordinate system was used, defined by four cardinal directions: S, toward the river along the transect line; A, away from the river along the transect line; R and L, right and left, respectively, when facing in the A direction. The *Bank* region extended five meters to either side of the transect, and from the water's edge up to the top of the riverbank. The *Topbank* region was a band five meters wide tracing the curve of the top of the bank on its A-ward side. The *Bank* and *Topbank* varied in shape and area across different Full Points. *Circle S* was a circle with a 5-meter radius, and with its center 10 meters A-ward of the Point. *Circle A* was a circle congruent to *Circle S* with its center 210 meters A-ward of the Point.

Vegetation Measurements

Our vegetation assessment protocol was modified from the type commonly used in ornithological field studies to evaluate vegetation characteristics at bird nest sites. Vegetation measurements were designed to complement our qualitative and descriptive observations, and to represent the character of the plant community at the site. Since the structure and composition of the plant community often changes rapidly with distance from the river's edge before stabilizing some meters away, we focused most of our attention on the immediate riparian area. This is reflected in the placement of the study regions, three out of four of which usually lay within about 20 meters of the water's edge. However, since placement of the set of regions depended on local channel morphology, the distance from the river to the *Circle S* region was at some Full Points more than a hundred meters, owing to the presence of wide sandbars.

The placement of *Circle A* was meant to allow a more thorough characterization of the adjacent floodplain or upland ecosystem. Regions *Circle S* and *Circle A* were treated equally so that their data would be comparable, and the two *Circles* were kept at a fixed distance of 200 meters regardless of site geography. In these regions we used a densiometer to estimate canopy cover, and a density cloth to measure visual density of the understory below a height of 2 meters. We identified and measured diameter-at-breast-height (DBH) of all trees (DBH ≥ 2.5 centimeters) within a 5 meter radius, and identified and measured heights of all shrubs (DBH < 2.5 centimeters and height ≥ 0.5 meters) within a 2.5 meter radius. Two 0.25 meter^2 quadrats were randomly placed in each *Circle*, in each of which ground cover was quantified and all plants were identified and measured for height.

Densiometer and density cloth readings were made in the *Topbank*, and two quadrats were randomly placed there. The *Bank* received two randomly placed quadrats, and its cover beneath a height of 1 meter was quantified. The *Bank* was also measured and drawn in detail in three cross sections.

We also noted qualitative attributes of each region and the surrounding area. Characters such as forest composition and structure, topography, evidence of disturbance, successional stage and land use were described, and comparisons were drawn with other Points or to sites on other rivers. At Midway Points, qualitative descriptions were made of the *Bank*, *Topbank* and *Circle S* regions.

Faunal Observations and Collections

Ten-minute bird point counts were conducted in the morning at each of the *Circle* regions at Full Points. We tried to perform them as soon after dawn as possible. One count was conducted at *Circle S* at Midway Points, and this was usually done between midday and late afternoon.

We collected terrestrial insects at our camp each night with a light trap.

Observation in transit

Qualitative description of all observable features and phenomena of the river and its surroundings was the duty of at least one of our members at all times while traveling between points. A second member made note of all birds seen or heard. This effort usually resulted in 4-6 hours of continuous bird observation per day. After surveying four rivers, we have gathered detailed descriptions of much of their lengths, as well as identification, location, and general behavior notes on approximately twenty thousand individual birds.

One canoe towed behind it the probe of a YSI 556 water quality device, which made automatic measurements of water temperature, dissolved oxygen, pH and specific conductance, at 3 minute intervals. With a HACH nephelometer, we measured turbidity at intervals of approximately 1000 meters of stream length. We developed a profile of water characteristics as we traveled, with fine spatial resolution.

RESULTS AND DISCUSSION

We now have georeferenced measurements and descriptions of floristic and avian communities, river morphology and features, human activity, and water quality along four of Georgia's rivers. We have not yet analyzed our data, but our results could be organized to pursue or provoke a broad range of questions (Figure 2). Our observations of riparian and watercourse alteration—anthropogenic and otherwise—and of municipal and industrial pollution, corroborate the dynamism of Georgia's rivers, and confer significance to our baseline data.

A wide range of ecological methods could be incorporated into the framework we employed. For example, an expanded version of our survey would do more to incorporate headwater streams and smaller-order tributaries. We based our methods, however, on work demonstrating that the main stem of a watercourse cannot be adequately understood or considered as independent of the landscape through which it flows because "the river and its floodplain act together as a geohydrobiological system" (Wharton, 1978). A survey could focus on providing distribution data for various taxa. Filling in gaps in present distribution data records could be of great use to researchers, managers, and other interested parties.

In addition to a range of ecological methods, the survey framework lends itself to the incorporation of a range of disciplines. We find significant Meyer's (1997) discussion of the importance of "human attitudes and social institutions" in investigations of stream health. Human attitudes toward our subject rivers were elucidated via exchanges with the people encountered there, anglers in particular. We found it convenient and instructive to gather information from local people simultaneous to surveying the stream itself. It would be possible to employ social science techniques within the framework of a survey like ours, as a way of assessing what Meyer calls "the human dimension" among the citizens to be found on a river or its banks.

We found that the surveying methods we used were both feasible and useful, and could work as a model for a standardized riverine monitoring program. Logistical limitations presented some constraints, but these were balanced by the benefit of making observations that

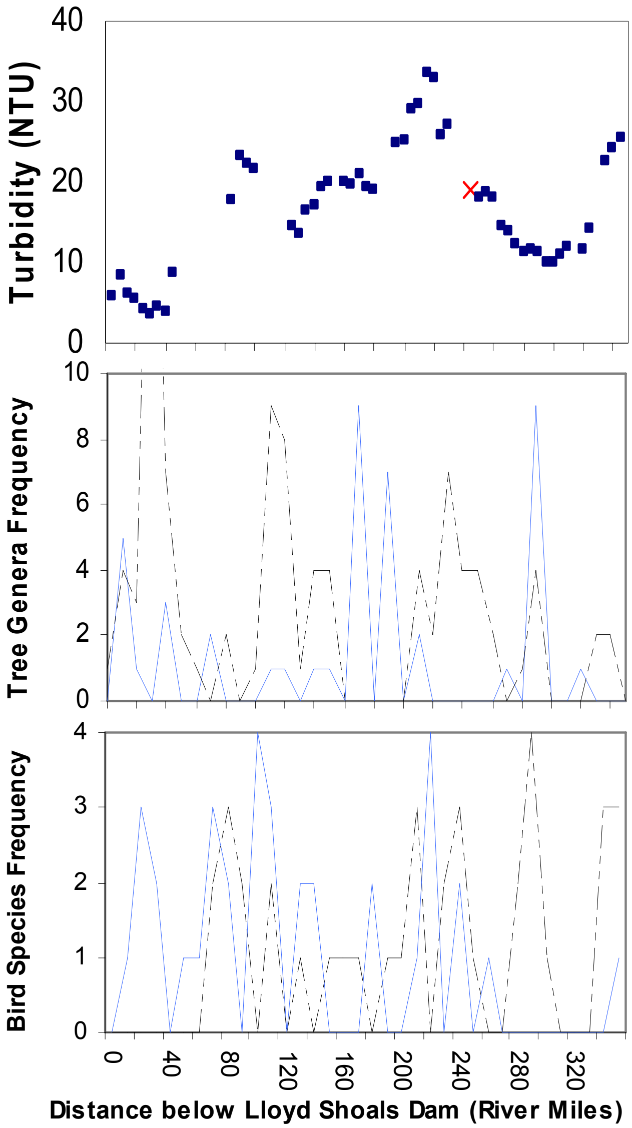

Figure 2. Average water turbidity, previous five river miles, and frequency of two tree genera and two bird species on the Ocmulgee and Altamaha Rivers. Tree and bird point data are summed from *Circles S* and *A*. Symbols: Graph 1: ▪ =Turbidity x =Altamaha start; Graphs 2 and 3: ----- *Quercus* and Prothonotary Warbler; ----- *Carya* and Great Crested Flycatcher.

traversed the riparian landscape at a pace conducive to surveying particular points in detail while still covering a large area.

Travel by river afforded convenient access to floodplain forests. Travel by canoe placed some limits on the amount of equipment we were able to carry. Space considerations affected our abilities to make collections with varying results: we found it impractical to press many plant specimens and store them effectively, but we were able to collect terrestrial insects nightly and to store and transport them all safely. Collection of aquatic insects was impractical partly because it was too time-consuming, and more importantly because with limited equipment it was largely ineffective in the main stem of the river. On the whole, our mode of travel suited our needs quite well: our craft made no noise to impair our observations (particularly of birdsong) or to disturb wildlife, displaced little water and left no wake, and moved at a rate appropriate to our activities. Our mode of travel, our habit of camping along the river's banks, and the amount of time we spent on each river enhanced our concept of the riverine landscape.

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