Freshwater: Streamflow

SOUTHEAST ALASKA NETWORK – PROTOCOL DEVELOPMENT SUMMARY

PARKS WHERE PROTOCOL WILL BE IMPLEMENTED: GLBA, KLGO, SITK

Justification/Issues Being Addressed

Streamflow is a critical monitoring component of aquatic ecosystems and habitats because many chemical and physical variables are influenced directly or indirectly by discharge volume. For instance, changes in water quality, eutrophication, nutrient and sediment transport are all dependent on streamflow. Decreases in streamflow are associated with increased water temperatures, decreased concentrations of dissolved oxygen, and increased concentrations of chemicals. Streamflow also has important implications for receiving marine ecosystems and habitats. Coastal habitats are important rearing and feeding grounds for many species of fish, mammals, and birds. Variation in the volume and temporal patterns of release of freshwater and nutrients into these important habitats can have profound impacts on coastal marine ecosystems. For example, marine habitats where glaciers or glacial streams meet the sea have been shown to be regions of exceptionally high productivity and biodiversity within Glacier Bay National Park and Preserve (Robards and others, 2003). Streamflow has also been identified as important to estuarine and marine circulation patterns, salinity stratification, and primary productivity (Royer 1982; Royer et al. 2001; Etherington et al. 2007).

It is also important to describe a stream's flow regime, a factor which is cited with increasing frequency as a critical variable that structures aquatic ecosystems and habitat (Poff and Ward 1989; Richter et al.1996; Baron et al. 2002). An ecologically relevant definition of flow regime includes the frequency, magnitude, duration, and timing of high and low flows, as well as the rate of change and interannual variation of streamflow. Changes in streams or streamflow can be used as indicators of changes in climate, basin dynamics, and land use, but only with an accurate and long-term analysis of streamflow regime.

Specific Monitoring Objectives to be Addressed by the Protocol

1. Measure and monitor streamflow for the Indian River, relative to the ability of the park-managed portion to provide adequate in-stream flow to support aquatic life and maintain ADF&G's in-stream flow reservations for anadromous fish spawning, incubation, and rearing
2. Continue to monitor streamflow in the Taiya River near Skagway to establish current conditions of seasonal and annual flow patterns
3. Initiate streamflow monitoring of the Bartlett River near Gustavus to document baseline streamflow conditions
4. Identify and quantify long-term changes or trends in the annual and seasonal patterns of freshwater discharge in the Indian, Taiya, and Bartlett Rivers
5. Determine trends in chemical loads using accompanying water quality data collected under co-located monitoring of physicochemical water quality

Basic Approach

Streamflow is measured as discharge of water within a river channel past a specific point for a given time interval. Streamflow gaging stations typically consist of a pressure sensing transducer fixed to the stream bed at a known elevation. The transducer measures the elevation of the stream's water surface, which is recorded by a data logger. A relation between water surface elevation (stage) and discharge is established by measuring streamflow over a range of stage. Once this relationship is well defined, a rating curve can be developed and streamflow can be computed from the stage data and rating curve. Periodic streamflow measurements are required to adjust for changes in channel morphology, debris, and aquatic vegetation growth, all of which may significantly alter the relation between stage and discharge. In order to keep discharge estimates accurate, six to nine discharge measurements spanning the full range of flow should be taken each year. Moderate and low flows can be measured by wading using current meters and top setting wading rods, however, measuring high flows or flood flows is essential to development and refinement of rating curves. These measurements will need to be conducted by boat or from bridges using conventional current meters in combination with a bridge crane, reel, and sounding weight or using acoustic Doppler current profilers (ADCP). The ADCP is capable of measuring discharge from a moving boat and would be essential to making discharge measurements when no bridge is available from which to suspend a traditional current meter. The USGS has developed extensive protocols for making discharge measurements and operating stream gages (Rantz et al. 1982a, 1982b). Protocol developed for SEAN streamflow monitoring will draw from these protocols.

Principal Investigators and NPS Lead

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Development Schedule, Budget, and Expected Interim Products

Optimally, streamflow monitoring should be continuous. Continuation of streamflow monitoring on streams previously gaged by the USGS (Indian River and Taiya River) is recommended for the following reasons: 1) stage/discharge ratings may already be available 2) the value of streamflow data increases with longer time series, and 3) the location of these gages facilitates frequent visits, which are essential to producing accurate and complete data sets. An additional gage will be installed on the Bartlett River near Gustavus.

Maintaining a USGS stream gage in Alaska presently costs between $25,000 and $40,000 annually, which is cost-prohibitive for the network. SITK has engaged in a partnership with the City and Borough of Sitka, Alaska Department of Fish and Game, and possibly the USFS to reestablish gages on the Indian River. This process requires local personnel conducting discharge measurements and downloading data and contracting to have stage and discharge data computed and archived. Initial cost for SEAN was $10,000, which represented 59% of the total cost of $17,000 for the first year of the project. SEAN's contribution in FY 2008 will be $8,000. The City and Borough of Sitka and Alaska Department of Fish and Game are expected to contribute about $3,000 each. KLGO is considering a similar arrangement for the Taiya River and has submitted a NRPP funding proposal to initiate the process. The Cost of a Teledyne RD Instruments Rio Grande ADCP meter for high discharge measurements is about $23,400.

Ideally, additional stream gages in remote locations would be established; however, the necessity of frequent visits and the costs associated with maintaining remote stream gages is likely to preclude gaging of additional streams.