



Water Quantity

Hydrology and geology are the two principle drivers that dictate the structure and function of all aquatic systems. In the broadest sense, hydrology encompasses the distribution and movement of water and its interactions with the surrounding environment, whether in the ground, on the landscape, or in the atmosphere. Hydrologic parameters, such as *stage* and *discharge*, are useful for understanding patterns observed in aquatic systems. *Stage* refers to the vertical movement of water and is measured as the height of the water's surface relative to a chosen reference point. *Discharge* refers to the longitudinal movement of water and is measured as the volume of water that moves past a given point over a unit of time. These two parameters broadly pertain to water quantity and they affect various physical, chemical, and biological processes from nutrient loading to the timing and success of fish spawning.



NPS/Evan Boohar

Measuring discharge at the outlet of Lake Brooks in Katmai National Park and Preserve during spring of 2015.

Findings

The Southwest Alaska Network (SWAN) monitors water quantity by measuring stage and discharge at the outlets of four high-priority lakes: Naknek Lake and Lake Brooks in Katmai National Park and Preserve, and Lake Clark and Kijik Lake in Lake Clark National Park and Preserve. In 2017, we refined the existing rating curves for three of these sites and created a new curve for the fourth (Kijik Lake). A rating curve is a graph of stage vs. discharge for a given location (Figure 1). The equation that best fits the curve enables the derivation of a continuous time series of discharge from a continuous time series of stage. Preliminary results based on the new curve for the Kijik Lake outlet, indicate that mean daily discharge during the most recent 5 summers on record ranged from approximately 70 to 930 cubic

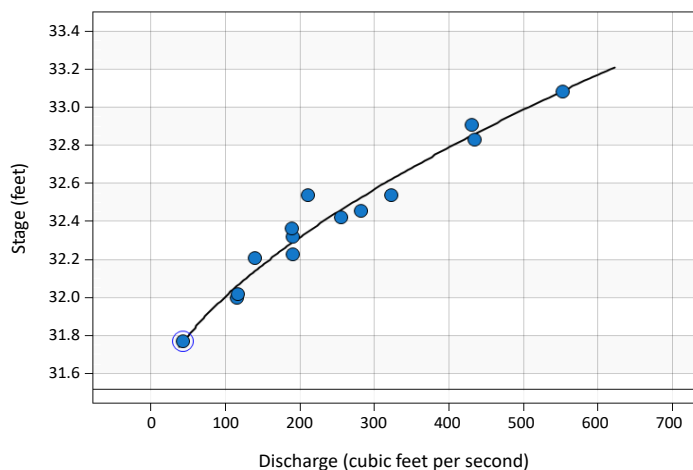


Figure 1. The rating curve for the Kijik Lake outlet site is based on 14 paired measurements of stage and discharge collected from 2014 to 2019.

feet per second (cfs; Figure 2). High variability among individual years was also apparent, reflecting year-to-year differences in the timing of precipitation within the watershed. For example, the timing of peak daily discharge in 2018 (930 cfs on August 15) tracked the timing of peak daily precipitation that summer (1.45 inches on August 13), as rain from a dissipating typhoon swept southwest Alaska. Watersheds like this, where rainfall determines the timing, duration, and magnitude of peak discharge, are classified as “rain dominant.”

Methods

Discharge is measured periodically using an Acoustic Doppler Current Profiler (ADCP) attached to a boat or cableway. Stage is recorded hourly using a non-vented pressure transducer (level logger) attached to a fixed point year-round. Surveys are conducted to establish the elevation of the level logger relative to a benchmark and two reference points, because the level logger elevation may change when it is retrieved, downloaded, and redeployed.

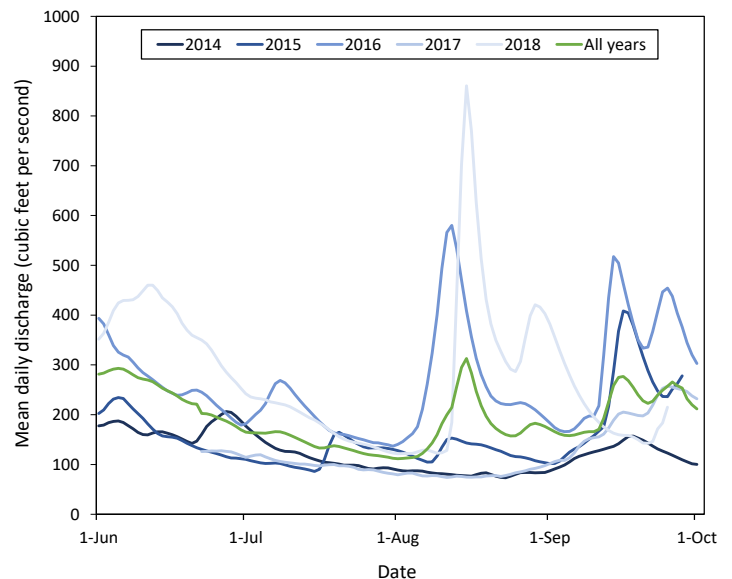


Figure 2. Mean daily discharge estimated for the Kijik Lake outlet during the open-water season. Estimates are shown for individual years (2014-2018), as well as all years averaged for that time span. All estimates were smoothed using a three-day moving average, hence the highs and lows shown above are somewhat muted compared with those cited in the text. “Rain-dominant” watersheds like this are projected to become more common in Alaska, as warming air temperatures increase the proportion of precipitation falling as rain vs. snow.

NPS/Evan Booher



Preparing the Acoustic Doppler Current Profiler for a discharge measurement at the outlet of Kijik Lake in Lake Clark National Park and Preserve.

NPS/Dan Young



Using a transit level and field computer to survey and record level logger elevation at the outlet of Lake Clark in Lake Clark National Park and Preserve.

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