



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 rating curve for each of these sites. A rating curve is a graph of stage vs. discharge for a given location. The equation that best fits the curve enables the derivation of a continuous time series of discharge from a continuous time series of stage. For example, preliminary results based on the refined curve for the Lake Brooks outlet (Figure 1), indicate that mean daily discharge in 2016 was similar to that averaged across the previous decade (2006-2015;

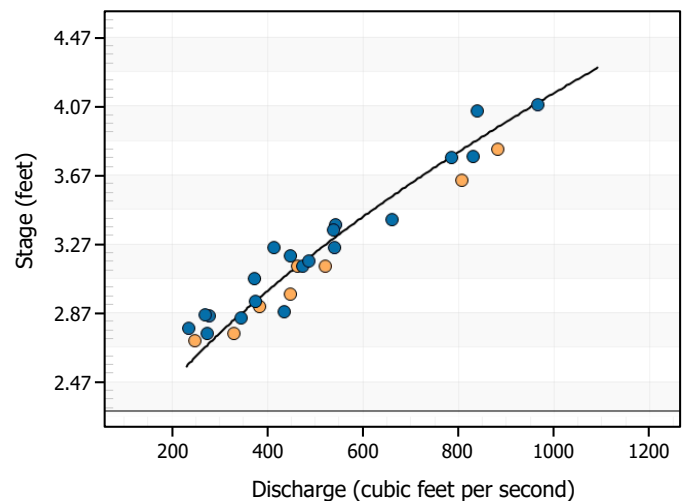


Figure 1. The updated rating curve for the Lake Brooks outlet includes the original 8 stage and discharge measurements from 2006-2007 (orange dots), as well 20 additional measurements (blue dots) from 2011-2016.



Figure 2). High variability among individual years was also apparent, reflecting year-to-year differences in the timing and type of precipitation within the watershed. Wildlife biologists at Katmai are examining whether stage or discharge relates to the foraging success of brown bears on the Brooks River, downstream of the Lake Brooks outlet. They hypothesize that, in years with relatively low summer water levels, bears access more feeding habitat, increasing their success at foraging for salmon and, in turn, their rate of survival.

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.

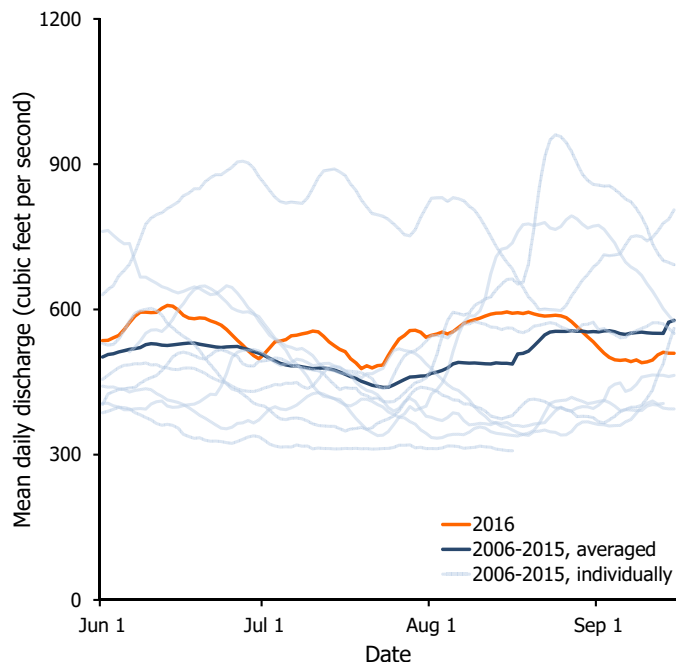
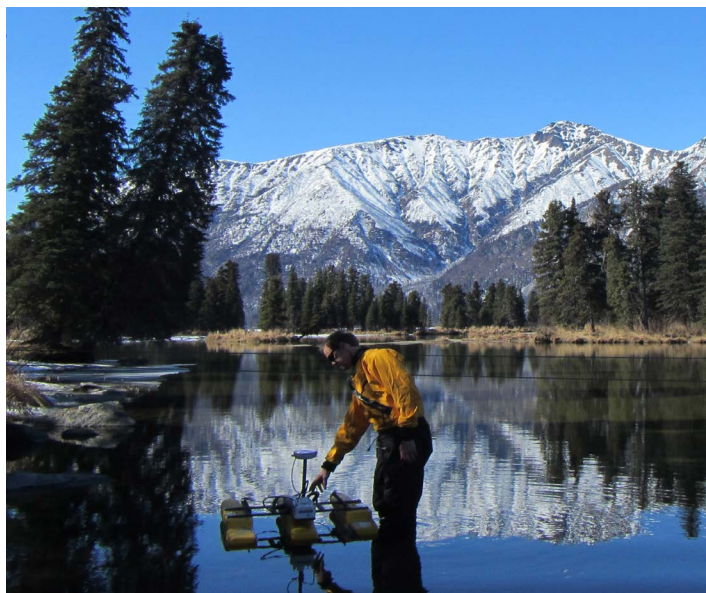


Figure 2. Mean daily discharge estimated for the Lake Brooks outlet during the open-water season. Estimates are shown for 2016, as well as individual years back to 2006 and the average for that decade (2006-2015). Estimates were smoothed using a 3-day moving average. Data from 2014 were not included due to level logger failure that year.

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/Evan Booher



Using a transit level (right) and stadia rod (left) to survey level logger elevation at the outlet of Lake Clark in Lake Clark National Park and Preserve.

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