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Prepared in cooperation with the U.S. National Park Service

Streamflow Permanence in Mount Rainier National Park, Washington

Streams that flow throughout summer ("permanent" streams) provide critical habitat for aquatic species and serve as an important water supply. Streams that go dry seasonally or only flow after rainfall or snowmelt are a natural feature of mountain systems, including Mount Rainier National Park (hereinafter, "Park"). However, in years with substantially less than normal snowfall, like 2015, more streams go dry, resulting in less water for Park infrastructure and unknown consequences for stream ecology.

A Streamflow Permanence Model Calibrated to Simple Flow/No Flow Observations

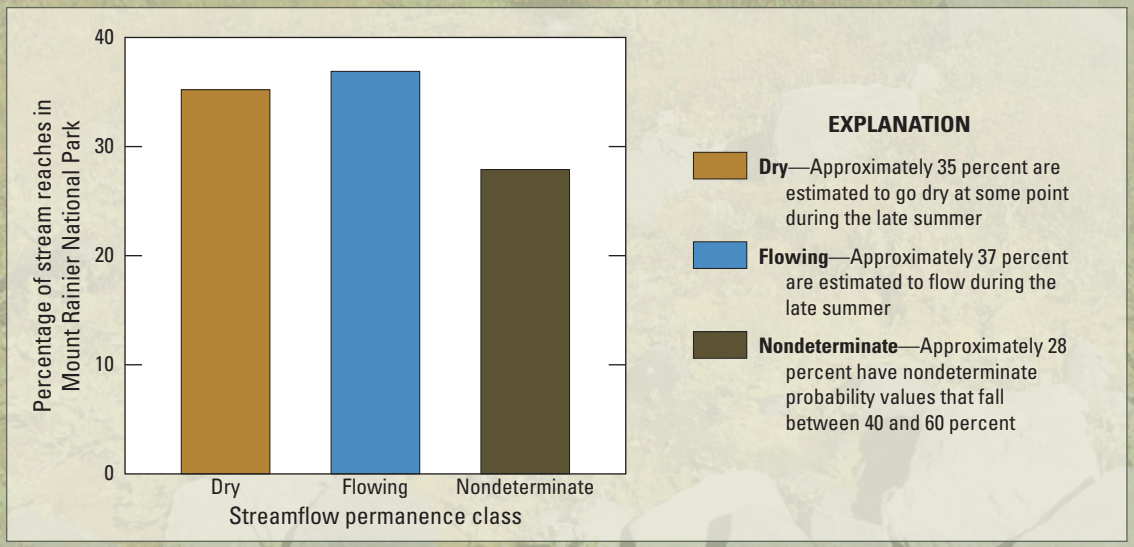
Motivated by observed and anticipated snowpack declines (Mote and others, 2016), the U.S. Geological Survey and the Park developed an empirical model to estimate which streams are likely to go dry during late summer. The model was calibrated using simple flow/no flow observations for small streams that were collected prior to the start of fall season precipitation throughout the Park and surrounding area during late summer 2018, 2019, and 2020. The model uses variables that describe geology, topography, climate, and land cover to predict flowing or dry conditions. The model was developed to improve upon the existing multi-state, regional-scale probability of stream permanence model developed for the greater Pacific Northwest Region ($PROSPER_{PNW}$).

The model outputs the probability, between 0 and 100 percent, that a stream section will have late-summer surface flow. Streams with probability of late summer flow above 60 percent can be classified as "likely flowing," while those with probability less than 40 percent can be classified as "likely dry." Intermediate values between 40 and 60 percent can be classified as "nondeterminate." Nondeterminate probability values may represent streams that switch between flowing or dry depending on climate conditions. These values may also reflect the model's limited ability to capture potentially important processes that influence streamflow permanence at those locations, such as water movement in the subsurface beneath the stream channels.

Typical dry stream in late summer.
Photograph by U.S. National Park Service.

Typical flowing stream in late summer.
Photograph by U.S. National Park Service.

Many Streams in Mount Rainier National Park are Estimated to Go Dry Each Summer



Banner photograph: Cascade Frog (*Rana cascadae*). Photograph by Sarah Dunn, U.S. Geological Survey.

Background photograph: Unnamed tributary to Fryingpan Creek near Summerland Camp, Mount Rainier National Park, Washington. Photograph by U.S. National Park Service.

U.S. Department of the Interior
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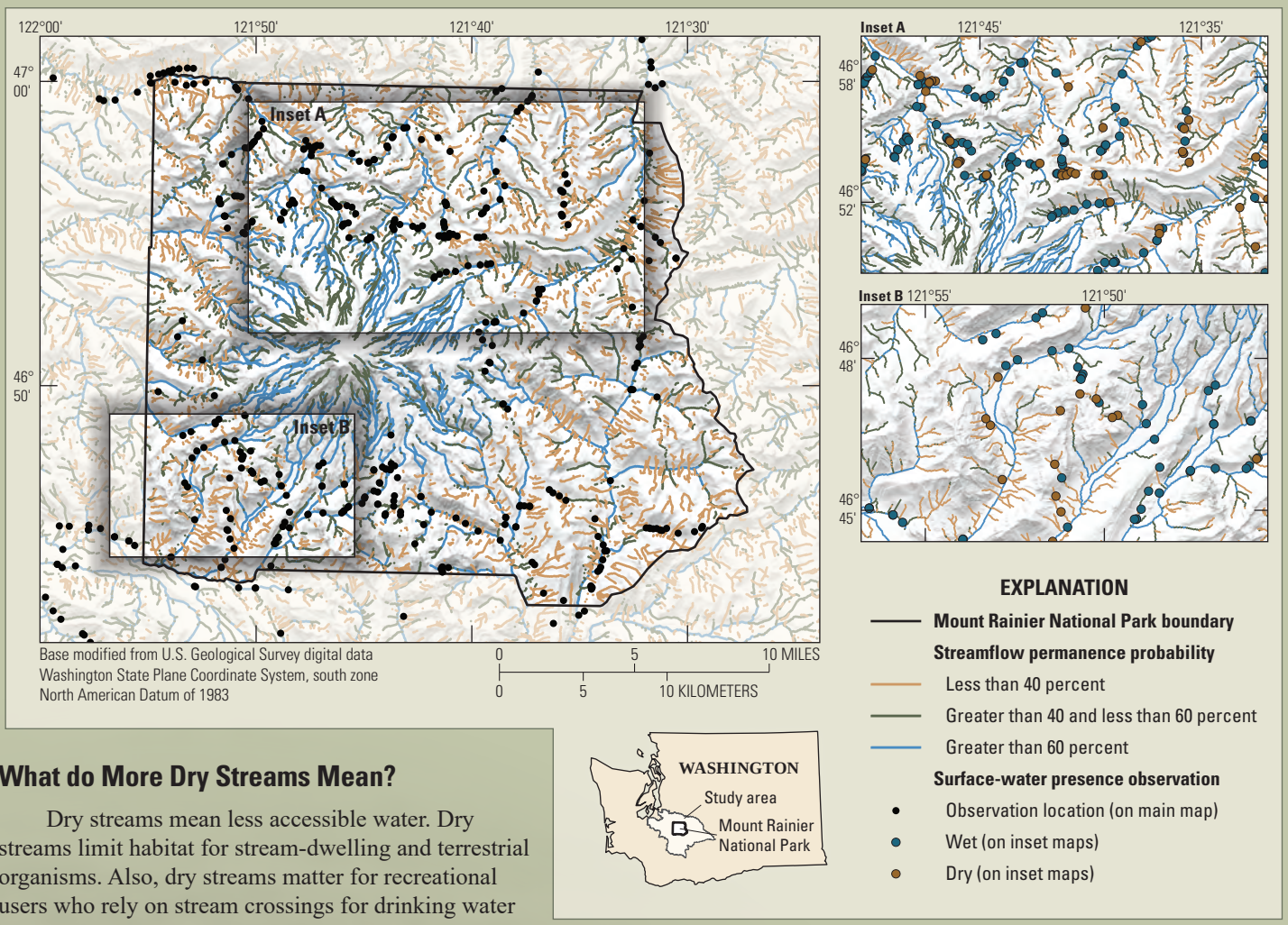
Stream Location Matters

Streams that do not flow from glaciers or high-elevation perennial snow regions have a higher probability of going dry. Additionally, in lower snowpack years, the streams are expected to dry earlier and stay dry longer into summer.



What do More Dry Streams Mean?

Dry streams mean less accessible water. Dry streams limit habitat for stream-dwelling and terrestrial organisms. Also, dry streams matter for recreational users who rely on stream crossings for drinking water and for Park surface-water supply systems.

The results of this study will help the Park identify regions with limited surface water, especially in years with less snowpack. The U.S. Geological Survey has plans to expand on this work to better predict when and for how long streams go dry.

Learn more: Jaeger, K.L., Sando, R., Dunn, S.B., and Gendaszek, A.S., 2023, Predicting probabilities of late summer surface flow presence in a glaciated mountainous headwater region: Hydrological Processes, v. 37, no. 2, e14813, accessed December 28, 2023 at https://doi.org/10.1002/hyp.14813.

Reference cited: Mote, P.W., Rupp, D.E., Li, S., Sharp, D.J., Otto, F., Uhe, P.F., Xiao, M., Lettenmaier, D.P., Cullen, H., Allen, M.R., 2016, Perspectives on the causes of exceptionally low 2015 snowpack in the western United States: Geophysical Research Letters, v. 43, p. 10,980–10,988, accessed December 28, 2023, at https://doi.org/10.1002/2016GL069965.

Cascade Frog (*Rana cascadae*). Photograph by Sarah Dunn, U.S. Geological Survey.

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