



NPS

## Glacier Loss Affects Alpine Stream Vegetation

### Disappearing Glaciers

Changing climate is reducing snowpacks and causing the loss of glaciers worldwide. In 1850, Glacier National Park had 150 glaciers. By 2015 only 26 remained and we expect all to disappear by 2030 under current climate trends. As a result, alpine streams and their associated wetlands may experience changes in vegetation species composition, size, streamflow, and stream power. It is critical that we understand how climate changes can affect alpine riparian ecosystems because they serve to stabilize stream banks, limit erosion, moderate stream temperature, protect water quality, and provide critical habitat for fish and aquatic macroinvertebrates.

Rocky Mountain Network partnered with Colorado State University and Glacier National Park to study the effect of glacier loss on alpine riparian habitats and stream characteristics such as streamflow and substrates. Specifically, we are interested in how riparian vegetation may change as glaciers shift to permanent snowfields and then to seasonal snowfields.

### Highlights

- As glaciers disappear, glacier streams will shift to permanent snowfield and then seasonal snowfield streams. This will result in reduced streamflow and more stable stream channels.
- These changes in stream characteristics will lead to a decrease in riparian plant biodiversity as shrubs are replaced by herbaceous species.

### How Do We Monitor Alpine Streams?

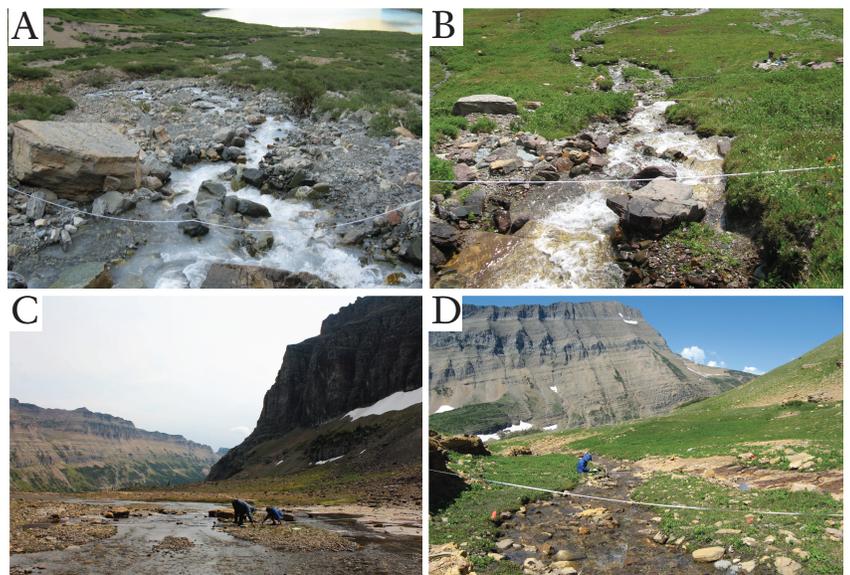
We monitored 14 glacier streams, 12 permanent snowfield streams, and 10 seasonal snowfield streams. Two types of streams were supported by glaciers: glacier-flat (wide, shallow streams in level terrain) and glacier-steep (narrow streams on steep slopes). Along streams we recorded plant species and percent cover; measured channel slope, aspect, roughness (channel resistance), and stability of the substrate (stream bottom materials); and calculated stream discharge (flow) and power.

### What are Glaciers and Snowfields?

**Glaciers** are masses of snow, ice, rock, and sediment that are large enough (at least 0.1 km<sup>2</sup> or 100,000 m<sup>2</sup>) to move under their own weight and gravity and remain year round.

**Permanent Snowfields** persist year round, but are not large enough to move under their own weight.

**Seasonal Snowfields** accumulate snow through the winter, but it melts completely by mid-summer.



The four types of alpine streams we monitored: A) glacier-steep stream, B) permanent snowfield stream, C) glacier-flat stream, and D) seasonal snowfield stream. NPS

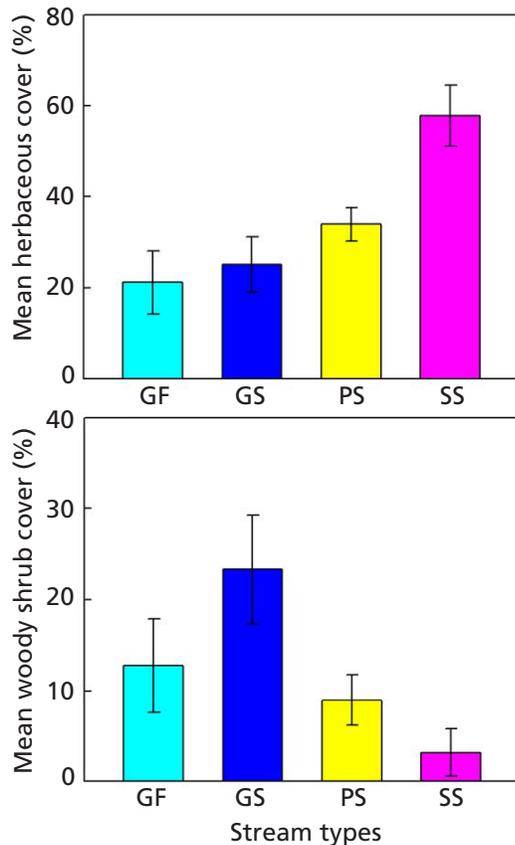
# What We Discovered

## Stream Conditions

- Glacier-fed streams had higher power, more streamflow, and lower substrate stability than other stream types.
- Seasonal snowfield streams had less flow and more stable substrates than other stream types.
- Permanent snowfield streams were variable, sharing characteristics with glacier and seasonal snowfield streams. This is consistent with the idea that permanent snowfield streams are an intermediate step between glacier and seasonal snowfield streams.

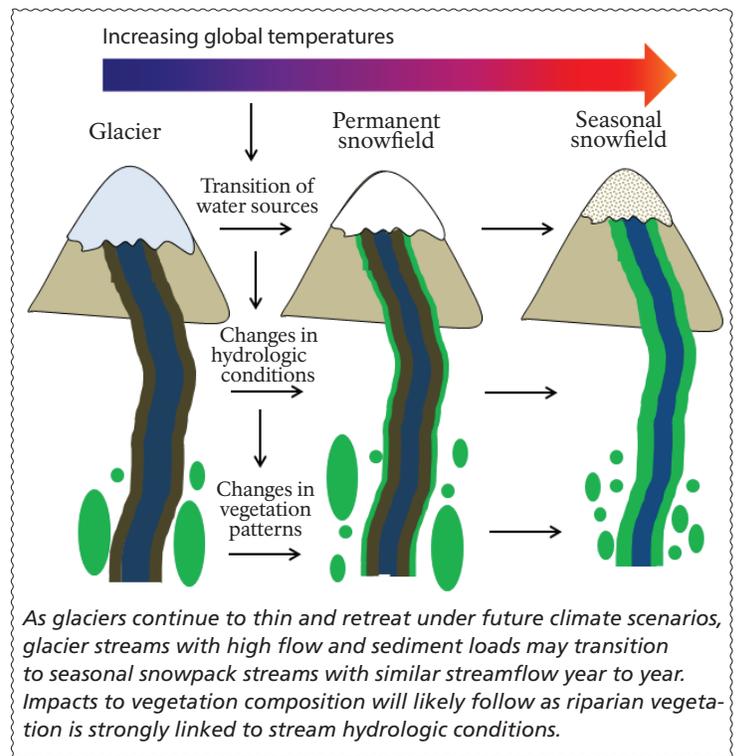
## Riparian Vegetation

- A total of 145 vascular plant species were found: 14 shrubs, 35 grasses, sedges, or rushes, and 96 herbaceous (non-woody) species.
- Glacier streams had more shrubs, including willows (a riparian species favored by intense flooding events), while seasonal snowfield streams had more herbaceous species and generally lacked willows.
- Permanent snowfield streams had similar amounts of shrubs and herbaceous species and the highest number of species due to an overlap in species with the other stream types.
- Permanent snowfield stream riparian plant communities are a transitional step in vegetation succession between glacier stream and seasonal snowfield stream plant communities.



Shrub and herbaceous species cover by stream type shows that permanent snowfield streams have shrub and herbaceous covers between that of glacier and seasonal snowfield streams. GF = glacier-flat; GS = glacier-steep; PS = permanent snowfield; SS = seasonal snowfield.

Resource Brief prepared by Tani Hubbard, Rocky Mountain Network and Rocky Mountain Conservation Cooperative. Graphics courtesy of Freshwater Biology, John Wiley & Sons.



## The Future of Alpine Streams

As all alpine streams transition to seasonal snowfield streams, we will see less diversity in riparian habitats. Alpine streams will be characterized by herbaceous species and willows and other shrubs may disappear. This decrease in plant biodiversity may lead to lower aquatic macroinvertebrate biodiversity and potentially cascading effects downstream.



Researchers identify plants along an alpine stream.

## For More Information Contact

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## Full Report:

McKernan, C., D. J. Cooper, and E. W. Schweiger. 2018. [Glacial loss and its effect on riparian vegetation of alpine streams](#). *Freshwater Biology* 2018:1-12.