Headwater Stream Survey Protocol - Single Survey

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Equipment

Required

1. Retractable tape measure (metric or standard)
2. Field notebook (waterproof recommended)
3. Long transect tape (e.g. 50 m)
4. Continuous tracking GPS (can use a free smartphone app)
5. Camera (can use phone camera)

Optional

1. Rubber boots (highly recommended)
2. Laser range finder for wide streams
3. Waders for deep streams
4. Flow probe for water velocimetry
5. Slick and durable rope, cut to a length of 5 m

Measuring your stride length:

1. Measure your stride length at least twice daily in two different locations in each stream surveyed stream network
2. Lay out long transect tape along stream thalweg.
3. Record the number of steps it takes you to walk the transect. Walk the length of the transect tape at least 6 times, taking different paths.
4. Then determine the number of strides it takes you to walk 5 m.

Surveying streams:

1. Turn on GPS tracking and record start and ending times of stream survey in notebook.
2. Start at the headwaters or drainage divide and work your way downstream, walking up any tributaries you cross. We found that taking measurements in the downhill direction is easier.
3. Pace 5 m along the streams and record stream width perpendicular to stream flow direction. Give dry steams a width of “0”.
4. While surveying streams, record data in your field notebook and create a map of the measurement locations in your notebook. See examples below.
5. For multichannel flow (i.e. a stream island), measure each stream width and sum the widths together. If there are some dry sections along the width transect (e.g. a rock in the measurement, braided stream, grass or a tree, etc.), then you can make an estimate on how much of the stream is dry. So a very braided width measurement could read: 64 cm, 70% dry.
6. Walk far up a channel even after the stream dries up to check that it does not begin to flow again further upstream. If the channel dries out and then comes back again upstream, record a "0" for each dry width measurement you paced. For a long dry gap I would sometimes record as many as 80 zeros in a row.
7. Aim to collect ~1000-2000 width measurements (minimum 500) per surveyed stream network.
8. Take lots of pictures to document stream conditions. Take at least one representative picture of average stream conditions that can be used in a publication.
9. Digitize measurements and stream network maps while the survey is still fresh in your memory.

Miscellaneous Notes

What is a stream? A stream is defined as flowing water within a channel, including transient channels formed by leaf litter or other debris. If there is no channel, we consider the water feature to be overland flow and not a stream.

What is a channel? A channel is a roughly concave geomorphic feature carved by streams. Sometimes channels contain flowing water and sometimes they are dry.

Selecting a catchment: We recommend carefully scoping out headwater catchments in Google Earth to get an idea of scale, conditions, and accessibility. We targeted the headwaters of the trunk stream within a basin (the stream with the most accumulation area going upstream). We were able to survey stream networks with drainage areas ~2-5 km^2 over the timespan of 1-2 days.

Watershed recommended attributes:

1. Safe and lawful access to the entire stream network within a watershed.
2. Stream networks that are gauged or have downstream gauges nearby with at least daily discharge records. A long flow archive is also a plus.
3. Easy access by road to the headwaters of the network.
4. Try to sample drainages that have a few tributaries draining into them. Dendritic style. This allows us to look at higher order streams, which is useful in comparing this work to biogeochemical applications.
5. Avoid selecting stream networks to survey that have streams that flow through bushes/dense underbrush.

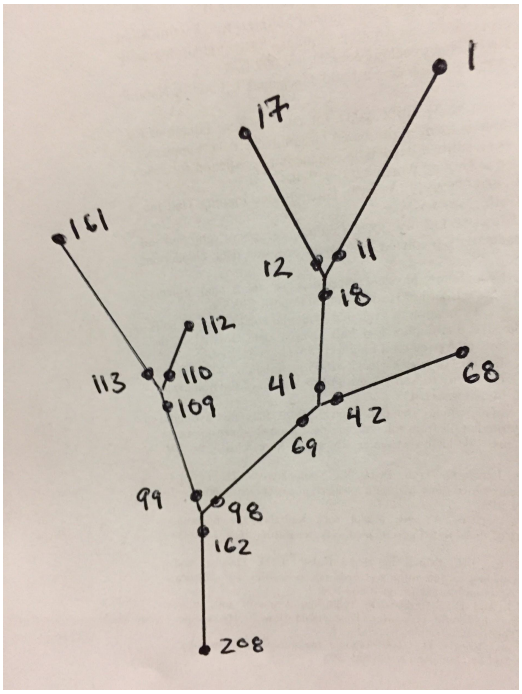
Other tips for surveying streams:

1. Do not include stagnant pools that are not flowing in stream surveys.
2. Survey streams when discharge is not dramatically changing
3. If a tributary with flowing water doesn't connect to the stream network at the surface, figure out where it would most likely connect (e.g. the steepest path down the hill to the next stream) and connect it there in your table and in your stream network diagram. These places where you are connecting together flowing channels but do not have any surface water should have a width of zero.
4. If there are multiple channels but there isn't an island and it looks like the ground water is coming from the hillside and not just hyporheic flow then consider, call it a tributary and label it as a new segment in your stream network map.
5. Quantify measurement error by surveying the same stretch of measurement sites repeatedly during a short time period.

Example data table:

site ID	dnstrm ID	notes	width (in)	% dry
1	2		15	30
2	3		28	
3	4	big root	0	

Example map:



Numbers correspond to the ID of most upstream & downstream survey locations along each stream segment