Science Module: Stream Ecology

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WHAT IT DOES

Streams are a critical part of Earth's water cycle. By carrying sediments, nutrients, and other materials downstream, streams ensure the health and resilience of both the environment directly surrounding them and the environments of rivers, lakes, and estuaries into which they flow.

RELEVANT SCIENCE

Measuring Stream Health

Due to the number of potential factors that can impact the health of streams, ecological assessment of stream health often involves checking a variety of indicators. These indicators include:

1. Physical Structure: How much sediment does the stream contain? Are high volume flows threatening to erode stream banks?
2. Chemical Composition: How much dissolved water is in the water? Are chemicals from industrial discharge or agricultural runoff at safe levels?
3. Living Organisms: Are the species that we expect to see in a given stream present and doing well? Have any invasive species changed the original ecosystem?

Biological Indicators of Stream Ecology

Mayfly in Butte, California. Image by Greg Schechter. CC BY 2.0 (https://creativecommons.org/licenses/by/2.0/), via Wikimedia Commons.

Ecology is the study of living things and their habitats. In the case of stream ecology, scientists are often concerned with the organisms – such as plants, animals, and bacteria – that live in and on the water as well as the larger organisms that depend on the health of the water for their wellbeing. As the health of organisms upstream is often a relevant indicator of the health of a stream overall, humans can make valuable judgments about stream health based on the condition of these organisms.

For example, insects that are highly sensitive to stream speed, composition, and pollution – such as mayflies – can act as indicators, or "canaries in the coal mine." If ecologists know to expect populations of mayfly larvae in a given stream, the absence of mayflies can indicate a problem in the health of that stream. Sometimes, ecologists studying an area might not know what to expect regarding species density and diversity. In these cases, they could compare the stream in question to a healthy reference stream. Then, if the two streams had similar small-invertebrate communities, that would indicate that the stream in question was healthy.

Streams and Human Welfare

Streams that flow into other bodies of water – called tributaries – are especially relevant for evaluating downstream risks to humans. For example, an event occurring 20 miles upstream of the clearest lake could transform that lake into mud. Such an event could prevent the safe use of that water for agriculture, drinking water, recreation, or hydroelectric power production.

Streams also provide many vital ecosystem services to humans. Healthy streams contribute to the health of game species, safeguard the quality of drinking water, and help mitigate downstream flooding. Thus, the monitoring of streams and stream ecology can help to more quickly address or mitigate negative impacts on human health and development.

Key Terms: Stream Health

Tributary: a stream that meets and forms part of a larger river.
Ecosystem service: the benefits that humans receive from nature.
Game species: animals that the government has allowed to be hunted for food or sport by humans.

Human Impacts on Stream Health

Given the importance of streams for both the environment and humans, it can be valuable to consider impacts that human activities have on streams. These impacts generally take two distinct forms: (1) nonpoint source pollution and (2) point source pollution.

Nonpoint source pollution occurs when runoff from rainfall and snowmelt "picks up and carries away natural and human-made pollutants." Examples of nonpoint pollution sources include: (i) fertilizers, herbicides, and insecticides from agricultural lands, (ii) oil and grease from roads and energy production, and (iii) drainage from abandoned mines.

Point source pollution comes from "any single identifiable source of pollution from which pollutants are discharged, such as a pipe, ditch, ship or factory smokestack." Together, these forms of pollution can have significant, negative impacts on stream health, sometimes directly impacting the health and wellbeing of human populations.

Key Terms: Types of Pollution

Nonpoint source pollution: pollution that results from runoff picking up pollutants as it travels over various terrains.
Runoff: the water from rainfall and snowmelt that moves over and through the ground.
Point source pollution: pollution from any single identifiable source.

In addition to pollution, human activity can also alter the hydrologic character of landscapes. Hydrology is the science that addresses the properties, distribution, and movement of Earth's waters. In turn, hydrologic alterations can impact streamflow – the amount of water flowing in a stream. This can have serious consequences as increased streamflow can alter rates of erosion, while decreased streamflow can result in stagnancy and reduced connectivity. Some examples of human-induced mechanisms of streamflow change include:

- Surface-water withdrawal for thermoelectric power
- Dam construction and flow regulation for hydropower
- Urbanization and increased impervious surface construction

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