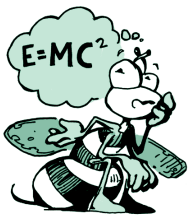
Go With the Flow!

Are Mountain Stream Channels Shaped by Flood and Drought?

Meet Dr. Sandra Ryan

"I like being a scientist because I like to solve problems."



Thinking About Science...

When scientists develop plans to do research, those plans influence and limit what they will discover. If a scientist decides to measure something, that is all he or she can report about. For example, the scientist in this study wanted to know whether streams changed from their normal shape when water was *diverted* from them and into another *channel*. To find this out, she measured the width of the streams' channels. After the research was done, she reported that she should have also measured the channels' depth and the size of the stones in the channels. Because she did not measure those things, she could only report on changes in the channels' width. A scientific study does not always provide the complete answer to a question. It often raises other questions that can be addressed in future research.

Thinking About the Environment...

When humans make changes in the environment, they are not always sure what impact those changes will have on the environment. In this study, the scientist wanted to know if steep mountain stream channels are changed by diverting water from them. In the Western United States, water is often *scarce* where people live. To provide water for people living in cities where water is scarce, it is diverted from mountain streams. It is piped through tunnels across the mountains to *reservoirs* for storage and human use. When this is done, the existing mountain streams have a reduced flow, and sometimes may even be dry.

Introduction

When humans divert water from mountain streams, there is less water in the streams at certain times. *The scientist in this study wanted to know whether stream channels are changed as a result of having*

Dr. Sandra Ryan

less water at certain times, and normal flow at other times. Because most earlier research had been done on flatter, wider streams, not much was known about how channels change when water is diverted away from steep, narrow mountain streams. Melting snow creates most of the stream flow, and this flow can be heavy for days or weeks when snow is melting. When there is a lot of melting snow, water overflows the *diversion dam* and briefly flows again down the stream channel at a normal flow. *The scientist wanted to know what happens to the channel when water is diverted out of it.* Does vegetation begin to grow along the banks of the channels? What happens when water fills the stream channel again, during periods of high snow melt or rainfall? These are the questions Dr. Ryan, the scientist in this study, wanted to answer.

Reflection

- What human needs are being met by diverting water from a stream channel and into a reservoir? Can you think of 10 ways that humans use water?

- What kind of changes do you think occur in a stream channel if the water is diverted out of it?

Methods

The scientist collected information from two main sources to answer her question. First, she identified which streams she wanted to study. She wanted to compare the channels of free-flowing streams with similar stream channels that had been diverted. Dr. Ryan and her colleagues then went to the stream channels and took measurements in person *(Figure 1)*. She identified the stream channel as free-flowing or diverted. Then, she measured the width of all of the channels. Once she knew the widths of the stream channels, she used existing measurements on water flow in these streams to identify how much water was diverted from these stream channels over the years. The existing measurements had already been taken by others and were recorded in a computer.

Reflection

- Why did the scientist compare stream channels that had most of the water diverted from them with free-flowing stream channel widths?

- What are the advantages of using existing measurements to help answer a research question? What are the disadvantages?

Glossary:

channel:
(chan'el) the bed of a stream or waterway

diversion dam:
(di vûr'zhen dam) a barrier used to divert stream water from its regular channel

divert:
(di vûrt') to turn aside or draw off from a path or course

periodically:
(pêr'ê od'i kel lê) occurring at regular intervals

reservoir:
(rez'er vwär) a place where water is collected and stored for use

scarce:
(skârs) not plentiful or abundant

Figure 1. Measuring the stream channel.

Results

Dr. Ryan estimated that the diverted stream channels had been reduced in water flow from between 19 percent to 60 percent *(Figure 2)*. This reduction was considered significant. This means that, when comparing diverted-flow streams to free-flowing streams, the difference is greater than what might have occurred simply by chance. She also found that during years with little snowfall, the diverted streams almost went dry. In years with high snowfall, less water is diverted. In those years, the diverted stream channels were allowed to flow as they would have flowed without being diverted.

During dry years, vegetation often begins to grow along diverted stream channels, changing the channels' shape. However, during periods of high water, the water's "normal" flow erases many of these changes. Dr. Ryan concluded that changes in these diverted stream channels can hardly be noticed. Even though the changes can hardly be noticed, Dr. Ryan is cautious about concluding that diverting water out of mountain stream channels does not cause changes in the channels. She noted three reasons for being cautious: 1) If there are many years in a row without a lot of snowfall, more changes might be observed; 2) The channel surfaces of mountain streams are very stable, and the changes might be occurring more slowly than she could measure with the information available; and 3) Changes in mountain channels might be more detectable if something other than the width were measured. Dr. Ryan suggested that a description of the channel bed, and the depth of the stones in the channel, might be a better indication of change.

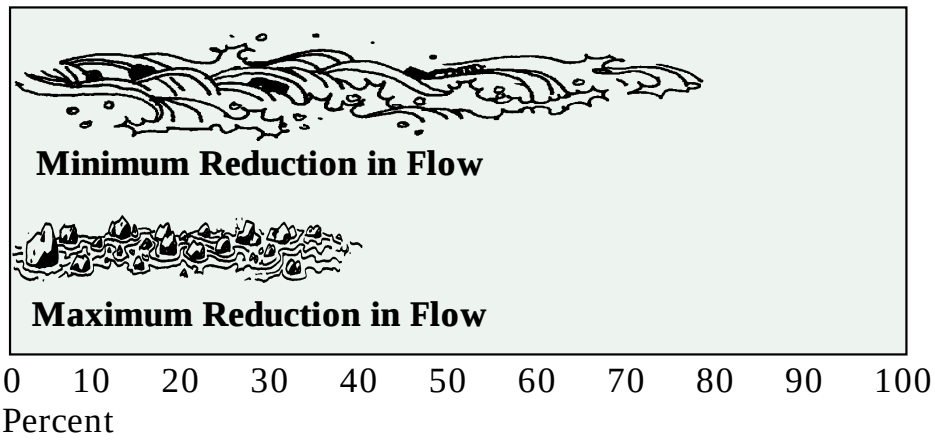


Figure 2. Maximum and minimum flow.

Reflection

- What is the danger of concluding that diverted stream channels are not changed by diverting water out of them?

- What other kinds of changes might be occurring in and around the diverted stream channels? (Hint—Think about the animals that depend on water for survival.)

Implications

Because people will continue to live in cities that are located in dry climates, we will continue to divert water from streams and into reservoirs. To make sure that mountain stream channels are not changed by diverting water from them, managers should allow water to flow normally in them *periodically*. In addition, further study is needed to determine the impacts of water diversion on water-dependent species, such as fish and frogs.

Reflection

- What might happen to fish and frogs in years where there is little snowfall?

- How would you study the impact of water diversion on fish?

- Can you think of any other actions humans can take to reduce the impact of stream diversion on animal species?

From: Ryan, Sandra (1997). Morphologic response of subalpine streams to transbasin flow diversion. *Journal of the American Water Resources Association, 33(4),* 839–854.

Discovery FACTivity

Streams and rivers get their water from rainfall and melting snow. Water flows downhill because of gravity, and eventually flows into the oceans. Vegetation near streams and rivers helps to hold soil in place, keeping it from being carried by rainfall and melting snow into streams and rivers. When vegetation near streams and rivers is disturbed or removed, it can no longer hold the soil in place. When this happens, soil may flow into streams and rivers. What activities might cause vegetation to be disturbed near streams and rivers?

Line an 18"x24" cardboard box with plastic. Place an oblong bowl, such as an aluminum foil roasting pan, at one end. Fill around the bowl with soil, and build up the soil in the rest of the box. Shape the soil so that you are creating a hill. The top of the hill is at one end of the box, and the bottom is at the other end, where the bowl is. Create a small channel, like a stream, from the top of the hill down to the bowl. It can have curves, just like a stream. The channel should be lower than the surrounding soil, and the soil should gently slope toward the channel. Get pebbles and small rocks and place them in the channel. See Figure 3. The channel represents a stream, and the bowl represents a pond. Now, get a watering can with a sprinkler head (the kind with small holes in it). Using the watering can, water the soil at the top of the hill. When you water, you are simulating rainfall. Be sure not to water more than the pond can hold!

Observe what happens to the soil as the water falls. Does it stay in place? If not, where does it go? When human activities and natural events cause vegetation to be disturbed near streams and rivers, what do you think happens to the soil? Do you think this is good for the land and streams or rivers? Why or why not?

For more information, see: www.xmission.com/~rmrs/staffs/labs/laramie/lar_rm4352.html

Figure 3. Setup for FACTivity.