Managing the Panama Canal Watershed

Research *article*

Focus *questions*

What makes the Panama Canal watershed unique?

How are stakeholders in the Panama Canal watershed working together to balance their needs with those of a healthy tropical ecosystem?

Why is it important for us to monitor and preserve the health of our watersheds?

More About Watersheds

A watershed, or catchment, is the land area from which a river or lake receives water. Look at Map 4 in your Atlas to see the boundaries of the Panama Canal watershed. What are the boundaries of the watershed where you live? What major body of water defines your local watershed? The Panama Canal is approximately 82 kilometers (51 miles) long; the watershed that contains it is half the size of the state of Delaware. Look on a map and compare that watershed to your own. Log on to Team JASON Online, click on "Digital Labs," and go to the Aquatic Field Study section of the Field Research Digital Lab. Read the online research story "Waters Around the World: Oceans, Watersheds, and Your Local Aquatic Site."

What is unique about the Panama Canal watershed?

The mighty Chagres River is the heart of the 326,000-**hectare** (805,546-acre) Panama Canal **watershed.** You can see the watershed in Maps 4 and 6 of the JASON Atlas. When engineers dammed the Chagres near its entrance to the Atlantic Ocean, the watershed changed forever. Floodwaters submerged thousands of hectares of forests, along with small settlements and towns. The rising waters formed Gatún Lake, which surrounds Barro Colorado Island. At the opposite end of Gatún Lake, workers cut across the mountains of the isthmus to open an outlet for the Chagres on the Pacific Ocean. A second artificial lake, called Alajuela or Madden Lake, was created between 1930 and 1935 with the building of the Madden Dam. Lake Alajuela stores water during the rainy season for use during the dry season. It also generates power and helps control floods.

The Panama Canal restored a passageway between the Atlantic and Pacific oceans that had been blocked by land for 3 million years. Now ships enter the canal from one ocean, rise 26 meters (85 feet) above sea level through a system of **locks,** cross Gatún Lake, drop 26 meters through more locks, and exit into the other ocean. The construction of the canal was one of the greatest engineering feats of its time. It harnessed a wild, unpredictable river and connected the Atlantic and Pacific Oceans to serve the needs of Panama and the world.

Charles Christian Nahl

An 1867 painting by Charles Christian Nahl shows the Chagres River before canal construction.

El Señor Jim

Tugboats guide ships through the canal at Miraflores Locks.

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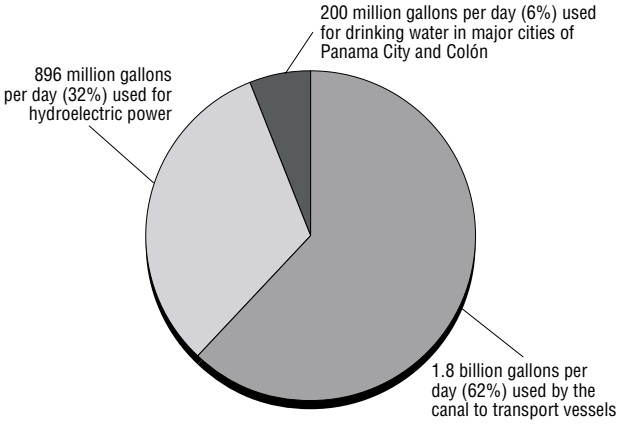
How are stakeholders in the Panama Canal watershed working together to balance their needs with those of a healthy tropical ecosystem?

The Panama Canal watershed's unique history and geography give it a unique set of challenges. The most important is balancing development with conservation. The watershed provides drinking water for Panama City and Colón (Panama's largest cities), electricity for much of Panama's industry, and billions of gallons of water to operate the canal. This is a huge burden on one watershed!



The Chagres River yields approximately 2.9 billion gallons of water a day. This chart shows how that water is used. (Some water from Lake Alajuela is also used to operate the locks.)

A major effort to safeguard the watershed began in 1967. It involved gradually establishing protected areas throughout the watershed. Now nearly two-thirds of the watershed's forest is protected in four national parks: Altos de Campana, Soberania, Chagres, and Camino de Cruces. There is also a nature monument, which includes Barro Colorado Island. Is this enough to maintain the health of the watershed? Scientists like Dr. Stanley Heckadon-Moreno, Dr. Robert Stallard, and Mr. Mark Wishnie believe more needs to be done. Through two different programs, they have been looking at changes in the watershed to better understand how to solve its problems.

The Panama Canal Watershed Monitoring Project

Dr. Heckadon-Moreno and Dr. Stallard led a 4-year study monitoring trends in the watershed's forests, waters, soils, and living things.

Dr. Heckadon-Moreno's research has focused on how population growth and government policies affect Panama's environment. Dr. Stallard's research has focused on **erosion**, particularly in streams that flow into the Panama Canal and the Chagres River. He is very interested in how tropical forests prevent erosion—including landslides, one of the most destructive forms of erosion.

Trees hold soil in place with their root systems. When trees are cut down, soil washes away more easily. This soil **runoff** increases erosion on land and adds **sediments** to water. If enough sediments are deposited in a stream or lake, it begins to fill in. Lake Alajuela, for example, has lost some of its capacity to store water because it is partly filled with sediments. Without tree roots to stabilize soil and hold moisture, unwanted pollutants can also run off the land into lakes and rivers. In heavy rains, the soil in a treeless, hilly area can turn to mud quickly and fall away in a landslide. Landslides are responsible for devastating damage to natural areas as well as to towns and farms.

Another important trend—one that has affected erosion as well as forest health in general—has to do with population. Between 1950 and 1990, the number of people living in the Panama Canal area increased from approximately 22,000 to 113,000. (Atlas Map 4 shows current population centers.) As people settled in the area, they cut down trees to make room for homes, farms, and cattle pastures. In 1952, more than three-quarters of the Panama Canal watershed's lands were forested. Less than 50 years later, just over half the land was forested! Atlas Map 6 shows forest cover in the watershed today.

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The waters of the Chagres River provide electricity and drinking water for Panama City.

In Panama, uncontrolled deforestation is a destructive cycle. First, migrant farmers clear and burn land for agriculture. After several years of intensive

farming, the land is no longer good for crops. Then it is turned over to cattle pasture. Cattle grazing degrades the land still further. Before long, the **alien invasive species** *Saccharum spontaneum* begins to take over.

This non-**native** grass has made large areas of the watershed useless to farmers and wildlife. *Saccharum* first appeared in Panama in the late 1960s, probably arriving on ships carrying construction equipment for the U.S. military. In the 1970s, the Panama Canal Commission encouraged the growth of *Saccharum* because the plant spreads over landslide slopes and reduces erosion. It is now a problem in deforested areas throughout the Panama Canal watershed. *Saccharum* is successful because almost nothing eats it once it is full-grown. It reproduces and grows very rapidly, and does not need animals for pollination or to spread its seeds. *Saccharum* also burns easily during the dry season. While fires kill native plant species, they do not harm *Saccharum,* which rapidly re-sprouts from deep rootstalks. So once *Saccharum* is established, it is very hard to get rid of it!

PRORENA

Mr. Wishnie leads a project called PRORENA, which in Spanish stands for "Native Species Reforestation Project." Through PRORENA, universities, private companies, and the government work together to reforest areas damaged by erosion, overgrazing, and invasive species (like *Saccharum*). PRORENA's partners include the Panama Canal Authority, a private timber company, and the National Environmental Authority. PRORENA works with these **stakeholders** to monitor reforestation projects, tracking the growth of native and non-native vegetation (including trees and other plants). The project also studies changes in plant diversity.

To control *Saccharum,* PRORENA studies the effectiveness of several techniques, including shading, cutting, and treating with herbicide. In one project, the invasive grass is being cut with machetes. Then the area is planted with fast-growing native trees. In other projects, a fast-growing, commercially valuable, non-native tree called teak is planted. Other crops, planted along with the teak trees, keep *Saccharum* at bay until the trees mature. *Saccharum*'s greatest enemy is shade. The best defense against the grass, therefore, is a healthy forest canopy.

Mark Wishnie

Mark Wishnie stands beside a field of *Saccharum.*

PRORENA also works with small farmers to help them decide which native tree species to use to reforest their land. This is especially important along streams, where erosion is greatest. Small farmers can plant fruit and nut trees or other species with commercial value. These trees provide farmers with an income, stabilize streambanks, reduce erosion, and fend off invasive species.

Why is it important for us to monitor and preserve the health of our watersheds?

According to Dr. Heckadon-Moreno, decisions people make today will affect the watershed 20 or 30 years from now. Because of the important role the watershed plays in Panama and in the world, a decline in its water quality and quantity could be devastating. The research of Dr. Heckadon-Moreno, Dr. Stallard, and Mr. Wishnie is critical. By monitoring the watershed's health, they can help find methods to protect it. Solutions lie not only in preserving forested lands in parks, but also in finding ways to use forest resources **sustainably.** Mr. Wishnie's work to help small farmers reforest their lands with productive native species is one way to do this.

Many indigenous people are adding to their income by making and selling art objects using wood and non-timber resources. These activities disturb the forests less than traditional farming methods. Scientist Julie Velásquez Runk is interested in finding out whether the materials for these crafts can be used sustainably. She studies the work of Emberá and Wounaan weavers and carvers. Beautiful baskets woven from the fibers of the *chunga* palm are a

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valuable source of income for them. Other artisans harvest seeds from *tagua* palms and branches and roots from *cocobolo* trees. They carve these materials into figurines, jewelry, and other attractive objects. The Kuna, meanwhile, have a thriving industry making and selling *molas*. These are colorful cloth squares made by fashioning fabric cutouts into pictures and designs.

There is no single answer to the challenges that Panamanians face. Instead, Panama's peoples are finding a variety of ways to meet their economic needs while sustaining their precious natural resources. For example, a growing number of Panamanian farmers and ranchers are beginning to protect secondary forests on their properties, allowing the vegetation to mature. This protects both the local watershed and the biodiversity of the tropical forest. As we have learned, a healthy forest can also have global effects in terms of climate change and carbon storage. How well Panama balances these needs, and how soon, could affect not only Panama, but the whole world.

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Kuna children wearing colorful *molas*.

Fact or *Fallacy?*

Scientists agree that the Panama Canal is the only water route that will exist between one side of North America and the other in the near future.

Fallacy: Research on the effects of global warming suggests that the icy waters of the Northwest Passage (north of Canada) may thaw enough to be navigable year-round in as few as 10 or 20 years!

Journal Question

Why is it important to monitor our watersheds? Explore the JASON XV Aquatic Field Study online to monitor your own watershed and record your observations in your online journal!

Vocabulary

Alien invasive species *n.* A non-native species that competes with and displaces native species.

Biodiversity *n.* A measure of the number and variety of species within a region.

Erosion *n.* The natural process by which wind, water, or weathering wears material away from the earth's surface.

Hectare *n.* A measure of area. One hectare is equivalent to 2.47 acres. There are 100 hectares in a square kilometer.

Lock *n.* A section of waterway, closed off with gates, in which a vessel can be raised or lowered. This involves raising or lowering of the water level within the lock.

Native *adj.* Originally living or growing in an area.

Runoff *n.* Water from rain, snow, and melting ice that flows on the earth's surface into nearby streams, lakes, wetlands, and artificial reservoirs.

Sediments *n.* Sand, fine soil, or mud particles, often deposited on lake or river bottoms.

Stakeholder *n.* A person, or a group of people, with a particular interest, or "stake," in a process or outcome.

Sustainable use *n.* The consumption of a natural resource at a rate that does not exceed the ecosystem's ability to regenerate that resource.

Watershed *n.* An area of land that delivers runoff water, sediment, and dissolved substances to surface water bodies, such as rivers or lakes. Every watershed consists of boundaries, a basin, and a collection area.