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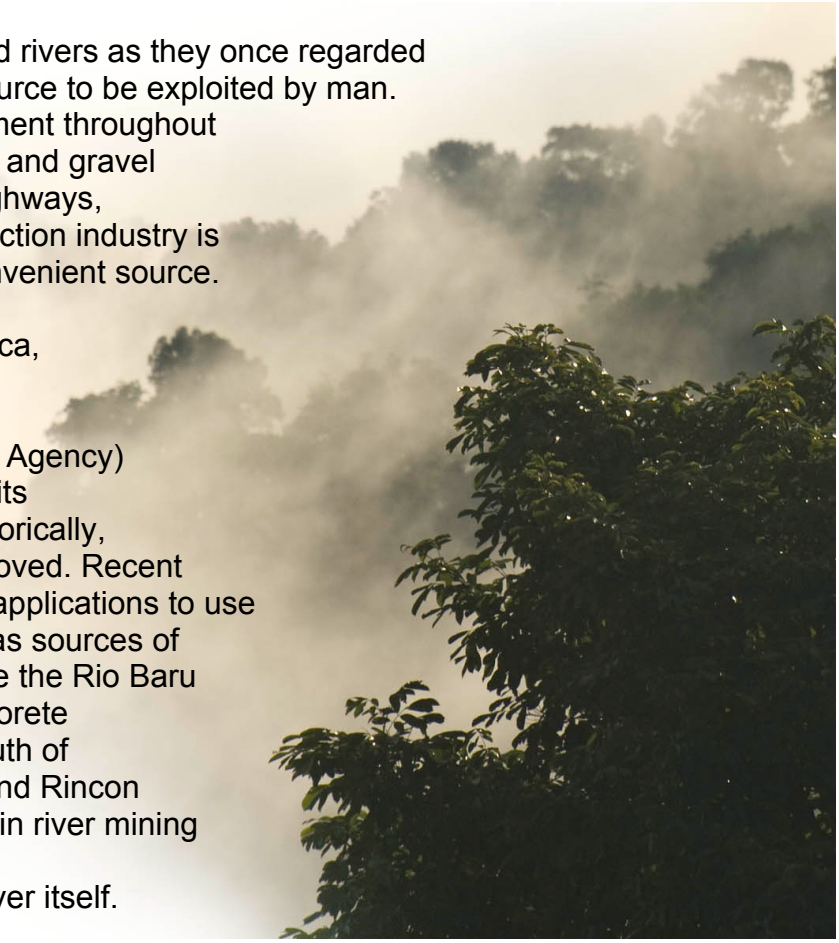
Is Costa Rica Killing Its Rivers?

Twenty eight in-stream gravel mining applications on twelve rivers in one of the most diverse tropical ecoregions in the world. How can this be happening in Costa Rica in the 21st century?

Costa Rica has earned worldwide acclaim for its environmental accomplishments. It has enacted laws to protect forests, biodiversity, and marine areas, and its fine system of national parks and reserves attract more than a million tourists every year. Yet it continues to neglect one vital area of the environment: It has thus far failed to give adequate protection to its rivers and streams, with consequences that could destroy or degrade much of this country's wonderful natural endowment.

Traditionally, Costa Rica has regarded rivers as they once regarded forests – as an easily renewable resource to be exploited by man. Since the increased pace of development throughout the country brings a demand for sand and gravel as materials to be used in building highways, resorts and infrastructure, the construction industry is turning to streams and rivers as a convenient source.



Rivers are public property in Costa Rica, and the cost of applying for a river-mining permit from SETENA (Costa Rica's National Environmental Agency) is relatively low, compared to the profits from the sale of sand and gravel. Historically, these permits have been readily approved. Recent years have seen a sharp increase in applications to use remote and hitherto pristine streams as sources of construction materials. Examples are the Rio Baru near Dominical, the Rios Uvita and Morete near Punta Uvita, the Rio Naranjo south of Manuel Antonio, and the Rios Tigre and Rincon on the Osa Peninsula. This increase in river mining poses a grave environmental threat with impacts that go far beyond the river itself.

Here's what happens when a sand and gravel-mining operation - called in-stream mining - excavates the bed of a living river. Removing material causes an immediate change in the existing river geometry, that is, the shape and course of the river. All of the little meanders and pools, the riffles, rocks, bars and bends, as well as the streamside vegetation are removed. This, of course, devastates the existing river ecosystem.

This simplified geometry increases the speed of the river. It increases the water's velocity. This means that there is more energy in the system because those little variations in the river's bed

that acted to slow the river's speed were removed by the mining. With the meanders, pools, and bars removed, the sand and gravel in the river have no place to stop. This leads to what river scientists call shallow braided streamflow. Basically, the stability of the river is gone, nothing stops moving, the deep holes and slow stretches of river do not form, and the constantly moving gravel prevents them from forming anew.

MATERIALES OCCIDENTE MINE ON THE RIO TIGRE, JULY 2009

Mother Nature tends to right human wrongs over time and repair herself after disruptions of this sort. A one hundred year flood is a good example. These big floods completely change a river's geometry - holes turn into bars and banks cave in. The river sometimes completely shifts its course to the opposite side of the flood plain. But these changes are just a small part of the physics behind riverbed stability.

When an entire riverbed is removed, the armoring that Mother Nature has built up over geologic time spans is removed too. You can think of this armoring as the highly compacted foundation of the river that has been pounded upon for millennia by floods, literally, of Biblical proportions. It supports the river. Remove it and the river collapses. The floods that create the armoring are far larger than the 100-year flood and produce devastation of immense proportions. In-stream mining impacts a river on a scale that overwhelms thousands of years of natural processes. Once its armoring is removed, it takes geologic time to replace it. The impacts are so profound that many areas in gold-rich North America, where placer mining destroyed entire riverbeds, have restoration programs today to repair the damage done over a century ago.

Impacts are not just limited to the river. Now the secondary impacts come into play. Increased erosion leads to loss of the streamside or riparian environment as the banks cave in. The streamside habitat is a unique habitat that bridges the land and water, consisting of species that generally exist only along the riverbanks. These species not only provide unique vegetation and fruits, but they also have roots highly adapted to holding the riverbank in place against the erosive forces of the river. Their loss leads to even more bank erosion that extends far into the flood plain.

The riparian habitat is home to much of the river's wildlife and food sources. Cut banks and their overhanging root systems are the ideal home for the kings of the river – the fish, reptiles, amphibians and aquatic mammals such as river otters. A large part of the insect population is also specifically adapted to this unique habitat. The insects live in and on the riverbank and on the streamside plants. Not only does the insect life regularly fall into the river becoming food, but many of these insects have aquatic larvae with specific life cycles that require bank-side vegetation for the creatures to haul themselves out of the water to mature, mate or feed. Once the banks are eroded this habitat is gone, and so are these creatures. We have not even mentioned the impact on birds.

All this vegetation loss means more sun now hits the river. This completely changes the aquatic environment: It is now brighter (predators can see better) and warmer (which many species cannot tolerate). Compounding all of this, the warmer water lowers the absorption of oxygen for the aquatic creatures to "breathe." *The results are a vastly changed river environment that can no longer repair itself.*

MATERIALES DE OCCIDENTE MINE ON THE RIO TIGRE, JULY 2009

Riverbed mining has impacts that reach far beyond the bed of the river. The river is the heart and circulatory core of a regional ecosystem. If the river is damaged, or removed, the damage impacts the ecosystem around it and continues when the mining stops. The alteration of the riverbed feeds on itself and can become more destructive with time, even extending to the headwaters of the river. As more damage is done to the river, the impacts on the surrounding area increase. Biodiversity is drastically reduced and species eliminated. Erosion can extend upriver in a process called incision. This brings all of the troubles faced in the mined river section to the upstream river, in unmined areas. The incision erodes away the river armoring and the results upstream, even in the unmined areas, are the same as in mined areas.

Biological effects can extend far, far from the river as well. Think of it like this: if the food in the river disappears, those creatures that depended on that food must look elsewhere to eat. The food they find elsewhere was once some other creature's food. Those other creatures are then forced to look elsewhere themselves to survive. This process cascades through ecosystems to the furthest reaches of a watershed. The results are loss of diversity, as some species simply cannot compete.

The cumulative impacts degrade the river and all of the ecosystems around it, including forests, agriculture, and human communities. Flooding can increase downstream as erosion fills the river below the mined area with sediment. Bank erosion can be so extreme that the entire floodplain, with all of its rich agriculture land, is eroded away. The river aquifer that has formed over geologic epochs is laid open to pollution by rapid inflows and outflows from the freshly eroded banks and the degraded armoring. The impact on farms and towns is devastating as homes are flooded, bridges washed out, fields destroyed, and water sources polluted.

The damage does not stop at the river's mouth. Receiving waters where rivers empty into bays and estuaries are blanketed in fine sediments that smother reefs and mangroves. Once these habitats are gone, the creatures that depended upon them for survival and reproduction are gone too. Bays, gulfs, and even entire areas of ocean can be impacted as fine sediments drift in the water creating a murky environment unsuitable to creatures that evolved in a clean water environment. Fisheries and marine wildlife populations are degraded. This brings an end to the lucrative sport fishing business as well as to the livelihoods of fishermen who depend on these populations to feed their families.

Perhaps the saddest part of this "river-cide" accompanying the current development boom, is that it is completely unnecessary. Costa Rica has abundant resources of sand and gravel, as well as even better construction materials such as caliche and decomposed granite, located outside of riverbeds. Some of it is nearby in the flood plain. Some of it is in upland areas where there are prehistoric riverbeds, underlain by the same river gravel that is in the rivers. These materials can be removed through pit mining with far less impact and ultimately less cost than from the flowing rivers.

Most developed nations have now banned the practice of in-stream mining. Costa Rica needs to join them. They need to stop using their streams as "convenient" sources of sand and gravel. They must stop now before the natural bounty of living rivers, with their otters, caiman, frogs, fish, crustaceans, water birds, and streamside species, disappears completely, and with it the amazing biodiversity that has made Costa Rica's tropical forests and pristine coastal waters a magnet for tourists and scientists and a precious resource for future generations.

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More information about the Rio Tigre can be found at:
http://www.riotigre.tripod.com
http://www.meltonengineering.com
Bruce's short film *The Fight for the Rio Tigre* can be seen at:
http://meltonengineering.com/The Fight for the Rio Tigre 031510.swf