

# History Repeats? Hydro Dams and the Riverine Ecosystems of Mesoamerica: The Case of La Amistad Biosphere Reserve, Panama, and its Implications

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IMAGINE THAT A THIRD OF ALL THE FISH SPECIES, including virtually all the larger species that contribute to fisheries, plus most of the crayfish, were eliminated from six states of the United States. And assume that this and consequent secondary effects on riverine ecosystems, including several large rivers lying within national parks and forests, were documented in the scientific literature. And let us suppose that the blame for this damage could clearly be assigned to a single type of human activity, undertaken without adequate prior consideration of ecosystem effects.

Now, imagine that decades into the future the exact same activities were proposed for six more states. It is easy to imagine what comes next: Conservationists rush to the barricades, biologists predict the consequences, volumes of correspondence land on the desks of elected officials and bureaucrats, alternatives are proposed, fundraising campaigns are launched....

The second half of this scenario is being enacted right now, not in the continental United States, but just to the south, and the impact stands to be felt in most of the national parks, biosphere reserves and protected areas of the Mesoamerican isthmus, stretching for over 1,000 miles from Chiapas (Mexico) to the Choco (Colombia). This is what will occur in Mesoamerica if current plans for development of hydropower to industrialize the region in the name of free trade are realized. According to an inventory carried out by Conservation Strategy Fund, there are presently 381 dams proposed for the region

(Burgues Arrea 2005) and, while the dams and the economic policies they reflect are being protested, the arguments advanced stem mainly from sociocultural concerns (or, in a few cases, concern for what are essentially touristic resources). The countries potentially affected (Mexico, Belize, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, Panama, and Colombia) do not lack for competent biologists, and are well populated by environmental and conservation organizations at all levels from the very local to the global giants. Yet to date almost no one has seen fit to focus on the rivers beyond those reaches that would be directly affected by dams and impoundments, or to draw on the disastrous and well-documented experience from very similar rivers in the Caribbean islands.

The precedent is from the West Indies. The greater part of the aquatic biota of some of the larger West Indian islands has already been eliminated. The best-documented cases are from Puerto Rico and

Guadeloupe, where nearly all rivers have been dammed, resulting in complete elimination of native fish and shrimps above some dams, and drastic reductions in every case. In Puerto Rico, this has been documented to result in increases in sedimentation, changes in the aquatic insect community, and increases in algal biomass—in other words, gross alteration of the ecosystem with effects that undoubtedly extend beyond rivers and streams.

Everyone knows about the effects of dams on the Pacific and Atlantic salmon of North America. While the rivers of Mesoamerica may not boast such charismatic fishes, the potential for damage, in terms of the number of species affected, is greater. As a consequence of the narrowness of the isthmus, the rivers of the region are necessarily short and thus intimately connected to the sea. And Mesoamerica, like the Caribbean islands, has been relatively isolated over geologic time, so that the primary freshwater fish fauna is limited. As in the islands, groups of marine origin have had an advantage in dispersal, and many of the “freshwater” fishes of the region are diadromous; that is, they need access to salt water at some stage in order to complete their life cycle.

The habit of diadromy extends to close to 100% of the species of shrimp, which inhabit the river systems up to the highest headwaters, beyond the reach of any fishes. In Puerto Rico, shrimps have been shown to account for the majority of secondary production in streams. Seemingly paradoxically, the higher one climbs, the greater the proportion of the biomass in streams is made up of forms which require access to the sea. One dam on a river mainstem can cause gross alteration of ecosystems over hundreds of miles of rivers, creeks, and

rivulets draining thousands of square miles.

In terms of the immediacy of dam threats, one of the most critical watersheds in Mesoamerica is the Changuinola/Teribe, located in Panama's Bocas del Toro Province, and it can be used to illustrate the kinds of situations conservationists need to be more courageous in confronting. The Rio Changuinola and its major tributary, the Rio Teribe, both arise in the La Amistad International Peace Park and Biosphere Reserve (a UNESCO World Heritage site) and flow through the Palo Seco Forest Reserve and the territories of the Naso and Ngobe Indian tribes before reaching the Caribbean, where the Changuinola estuary lies at the center of the 40,000-acre San San/Pondsak wetlands, a Ramsar site.

Bocas del Toro, located on the Costa Rican border, has historically been isolated from the rest of Panama; only in recent years has it been possible to drive to Bocas from anywhere else in the country. The provincial economy has been dominated by the multinational banana industry, which exports its product by sea from the port of Almirante or through Costa Rica. With the banana business in decline and population growing, the Panamanian government has a logical interest in fomenting development in Bocas del Toro. And it so happens that the inland rivers of the province are considered to represent the most outstanding hydro-power resource in the nation.

Most of Panama's electrical supply is oil based and power costs are high, especially in remote areas like Bocas del Toro. Arguments expounding on the need for alternative energy sources on the basis of cost, security, and environmental considerations make sense to the Panamanian public, including those who live in the several urban centers of Bocas del Toro. But it is

curious that this concern for cheap, clean electricity for public consumption arises precisely at the moment when Panama is feeling pressure to hitch its wagon to the star of free trade. Initiatives such as Plan Puebla-Panama (former Mexican president Vicente Fox's pet project to industrialize the Mesoamerican corridor) and SIEPAC (the Electrical Interconnection Network for the Central American Nations) provide incentives to develop hydro resources that have been recognized, but left alone, for decades.

Not surprisingly, Panamanian dam proponents oversell hydro dams as a "green" energy technology, most recently under the rubric of the U.N.'s "Clean Development Mechanism." Since the dams, reservoirs, and all associated infrastructure would lie outside La Amistad (although within Palo Seco), the published environmental impact assessments do not consider any impacts to the World Heritage site. In fact, they are presented as a benefit to La Amistad.

The argument goes like this. La Amistad is acknowledged to have problems with land invasion (much of it by indigenous peoples who claim it was always theirs, anyway) and illegal hunting. Dam construction will improve access to the area, thus permitting ANAM (Panama's environmental authority) to better police the park. Better yet, a portion of hydro revenue will be dedicated to this purpose—by building ranger stations, for example. There may be some truth in these arguments (though access is a two-edged sword), but they represent a pact with the devil. We are being asked to accept *possible* benefits in return for *certain* damage.

The various species of diadromous fish and shrimps in the Changuinola/Teribe sys-

tem represent a huge variety of physical characteristics and behaviors. They range from large adult fish such as the bocachica or hogmullet, capable of ascending the most powerful rapids, to bottom crawlers such as the shrimps and various species of gobies, to passively drifting planktonic eggs and larvae. Some species (most famously the American eel) migrate to the sea as adults to reproduce. Others spawn in fresh water and the eggs and/or larvae are carried to the sea. (One of the most spectacular natural phenomena of Caribbean Central America is the "tismiche," the annual upstream migration of massive groups of juvenile shrimps and gobies, hatched in the estuaries.) Some migrate during high water, others during low water. In all cases, our ignorance of their requirements is greater than our knowledge. There is no way in the world to design dam and reservoir systems to accommodate all these creatures; experience in the West Indies suggests that none of them can be maintained with hydro dams in place. (Of course we are told that hydro revenues will also be used to build facilities for investigators, so that presumably we will be enabled to document the extirpations.)

Virtually no historic information exists on the fish fauna of the rivers of La Amistad, in large part due to their inaccessibility. But recently my institution (Asociacion ANAI, a Costa Rican nongovernmental organization) was able to train four Naso and Ngobe parataxonomists to carry out preliminary surveys within the park. They were able to survey 17 sites, using seines, cast nets, and underwater visual censusing techniques. Due to the extreme difficulty of access, more reliable quantitative methods, such as electrofishing, were not an option; some sites required an hour of boat travel

upstream through whitewater, a five-hour hike in to a remote village, and then another three-hours on foot the next day to reach the park boundary.

The indigenous parataxonomists found 18 species of fish, of which seven (including four of the five largest species) were diadromous. The proportions of diadromous fish at the study sites ranged from 25% to (in three cases) 100%. In almost all cases, they also found both of the families of diadromous shrimp (Palaemonidae and Atyidae) known from the region.

These figures almost surely underestimate the importance of the diadromous component. In our own surveys in the neighboring Sixaola/Telire and Estrella watersheds of Costa Rica (which also arise in La Amistad and where hydro dam proposals are eventually almost a certainty) we usually find that in swift, rocky streams of the type surveyed in La Amistad the majority of individual fish in samples are small diadromous gobies (“chupapiedras”). Chupapiedras are extremely difficult to capture without electrofishing equipment, or to visually assess; they were the second most abundant fish according to the parataxonomists. Including a full count of these elusive fishes, we found that 70–91% of total fish in Costa Rican streams were of diadromous species.

It would be interesting to have information on biomass, but even without hard data it is easy to see how vital is the linkage of the rivers of upland Mesoamerica to the sea. If we consider that shrimp tend to be abundant, and are by far the largest non-fish aquatic forms, that the largest fish species are mostly diadromous, and that the diadromous chupapiedras are by far the most abundant fish, it can be deduced that these

rivers, once cut off from the sea, would be barren environments indeed, populated almost exclusively by insects and a few species of small fish.

Looked at in terms of area potentially affected, the possibilities are staggering. If only the Chan-75 (Gavilan) dam, the lowermost proposed on the Rio Changuinola mainstem, were built, 799 sq mi of watershed and 527 mi of permanent stream within La Amistad would be grossly biologically depleted. To this must be added the effects on the mainstem and tributaries downstream in Palo Seco, the indigenous territories, and below. Elimination of most aquatic production above Chan-75 would also drastically affect those species of fish (some of them valuable fishery resources) that never ascend to the park, but which depend on the gobies, shrimps, and other migratory animals for food.

The worst-case scenario just described for Bocas del Toro is ultimately a very serious threat to all the undammed watersheds on both sides of the continental divide along the entire Mesoamerican isthmus. The possible outcome is the virtual disappearance of the characteristic Mesoamerican river fauna—as has already happened in places like Puerto Rico and Guadeloupe.

The prospect is not hopeless. The Inter-American Development Bank withdrew consideration of financing one of the dams in Bocas del Toro (Bonyic, on the Rio Bon, tributary to the Teribe; Figure 1), citing both cultural reasons and “potential impacts on stream ecosystems” (Montgomery 2005). At least one other major potential lender, HSBC Holdings of London, would find it virtually impossible to finance dams like those described here under their “Freshwater Infrastructure Sec-

tor Guideline,” which, among other stipulations, specifically prohibits “impacts on World Heritage Sites and Ramsar sites.”

Non-biological arguments enter into play. A series of proposed dams on the Pacuare River in Costa Rica, which had the backing of no less a personage than former president and Nobel laureate Oscar Arias, were defeated mainly because of the eco-

nomic importance of the Pacuare as a white-water rafting river. Plans for dams on the Usumacinta River of Mexico and Guatemala have been shelved in deference to the historic and archeological importance of sites that would have been flooded.

As in virtually all instances of damming and flooding, there are human displacement issues involved. In Bocas del Toro, as in



Figure 1. Site of the proposed Bonyic Dam on the Rio Bon (Quebrada Bonyic) in Naso Indian territory, Bocas del Toro Province, Panama. Photo courtesy of William O. McLarney.

many if not most cases in Mesoamerica, these issues overlap with the question of indigenous rights. The relationship of Native American societies to parks has often been an uneasy one, and intelligent discussion of the matter has been scarce. We are presented on the one hand with the romantic vision of indigenous cultures as being naturally in harmony with their environment, and on the other with the viewpoint that “the Indians” represent one of the principal threats to protected areas. Neither viewpoint, in its extreme form, is constructive. The situation in Bocas del Toro may be instructive.

The most commonly heard viewpoint (outside of the indigenous communities themselves, which constitute the majority of the population in the province) is that part of the government’s job is to keep the Indians out of the park and that, apart from policing, one way to do so is to offer them the benefits of the hydro projects (though these may consist of little more than temporary employment and moderately more affordable electricity for a while). However, large sectors of the Ngobe and the Naso, many of whom live far from the nearest power source, are more concerned with stopping the dams than with their putative benefits. In the field, the ANAI-trained parataxonomists found themselves almost oversupplied with volunteers eager to help hold nets, count fish, and attend workshops in the evening after the field work was completed. When given the opportunity to connect “el parque” with their own lives in a positive way, the indigenous communities responded by working to defend the protected area.

For me as an aquatic biologist, the biodiversity conservation issue transcends lines on a map. But that just happens to be

my handle on the question of hydro dams in Mesoamerica. Indigenous communities, whitewater rafters, archeologists, and so on will all defend their own interests first. Those who have a particular commitment to protected areas should be no exception.

It is difficult to get a handle on how many protected areas in Mesoamerica stand to be affected, but La Amistad is not alone. Among the areas that would be affected by existing dam plans are such other high-profile areas as the Rio Platano Biosphere Reserve in Honduras. Presumably most of them have as part of their justification something similar to this, the first justification presented for the establishment of the La Amistad Biosphere Reserve: “to protect a significant example of the biological diversity of one of the richest faunal and floral zones which still remains largely unaltered in the Republic of Panama” (Alvarado 1998).

The promise made is to UNESCO, which entity has typically eschewed aggressive “enforcement” measures. Government agencies throughout the region are under enormous economic and political pressures to close their eyes to biodiversity issues of the less-visible sort. Conservation in Mesoamerica has traditionally focused on the tropical forest (of which, lest we forget, the rivers are a part), and some organizations may have been lulled and backed into what amount to conflicts of interest. For example, the Mesoamerican Biological Corridor project was at one time listed as a “satellite project” of Plan Puebla-Panama—which can perhaps be seen as parallel, on the regional scale, to policing La Amistad with the aid of hydro power revenues. The aquatic and fishery biologists of the nine affected countries have been inexplicably asleep on the headwaters-to-the-sea con-

nection. And the various affected parties have not been talking with each other very much.

There are, perhaps, in every potentially affected watershed—and certainly in every one that I know about—local groups and individuals taking on the hydro dam

issue on the basis of, if not biology, then cultural/indigenous concerns, local economics, recreation, etc. This is as it should be, and protected area advocates and managers need to find their place in this spectrum, at every level from the most local to the regional.

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