Mineral extraction in a pristine tropical watershed

Impacts of the Ok Tedi Mine on fish and fisheries in the Fly River basin, Papua New Guinea

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Principle: Habitat alteration in tropical aquatic freshwater ecosystems has profound effects on biodiversity and livelihoods.

Experience: Sixteen years of monitoring fish abundance and distribution following construction of a large mine on an undamaged tropical river.

Most important lessons learned: 1) Prediction and mitigation of development effects in tropical aquatic ecosystems is impossible without a long-term research and monitoring program, 2) mining operations carried out within the boundaries of a river catchment without adequate environmental safeguards may have serious adverse effects on tropical river fisheries.

The Fly River system and its fisheries

The Fly River system in Western Province, Papua New Guinea (PNG), has the highest water flow of any river in Australasia. Because of the very high rainfall in the region, the Fly outranks all the world's major rivers in terms of runoff per unit of catchment area. The river catchment consists mainly of primary tropical rainforest and open savannah grasslands, while the river itself is completely unregulated by dams, water diversions or other abstractions. The river system also has a large, intact floodplain system of lakes and other wetlands, with a network of channels linking the river to its floodplain. There are few such river systems remaining intact in the world.

The Fly River system supports the most diverse freshwater fish fauna in the Australasian region, with 128 recorded native species representing 33 families. Seventeen species are known only from the Fly basin.

The primary human use of the aquatic ecosystem is the subsistence fishery, which forms part of the traditional way of life of villagers living along the river. Most fish are consumed by the villagers, with catfish being the preferred species, compared to barramundi and black bass in a limited commercial fishery.

The inland and marine fisheries of Papua New Guinea are under the jurisdiction of the PNG. Department of Fisheries, which manages and regulates the fisheries. The commercial and artisanal fisheries of the Fly River system have generally been characterized by a non-interventionist approach to management. As a result, there are very little data available on these fisheries. The main approach to fish and fishery restoration in the Fly River system is currently one of investigating environmental management through mitigation of mining impacts rather than through active management of the fishery itself.

The Ok Tedi Mine

The only other significant impacts on the fish resource of the Fly River system, besides fisheries themselves, arises through mining activities in the headwaters of the Fly and Strickland Rivers. The Ok Tedi copper and gold mine is situated in the upper catchment of the Fly River and is one of the largest copper mines in the world. Because of the high rainfall and geological instability of the region, construction of a tailings dam was not feasible, and the mine has been operating without waste retention since its opening in 1984. The Ok Tedi mine discharges up to 80,000 tons of waste rock and 120,000 tons of tailings directly into the Ok Tedi/Fly River system every day.

At the outset of mining operations, it was a statutory requirement that the environmental impacts of mining be monitored and that the effects of mine waste discharges not lead to unacceptable damage to fish and fisheries. As a result, environmental monitoring of mine impacts began in 1981, with long-term hydrological, chemical and biological monitoring programs being established in 1983. The extensive monitoring program means that the Fly River system is one of the most intensively studied tropical river systems in the world. Since the early 1980s, the Ok Tedi Mining Ltd. (OTML) biological monitoring program has formed the only routine sampling in the Ok Tedi, Fly River and its delta. A variety of faunal groups are routinely monitored, but the main emphasis of the monitoring program is on freshwater fish populations.

Mine effects

Declines in fish catches and biodiversity in main channel sites in the Ok Tedi, upper and middle Fly appear to be directly related to the environmental changes associated with waste discharges from the Ok Tedi copper mine. This has resulted in riverbed aggradation of over 6 metres in the Ok Tedi river, and also increased Total Suspended Solids (TSS) and heavy metal concentration. Fish catches in the Ok Tedi and middle Fly were the most badly affected, with catch reductions in the Ok Tedi of up to 95% and the elimination of most fish species. In contrast, changes in fish catches at floodplain sites in the middle Fly area (declines of up to 75%) appear to be related to hydrological changes associated with El Niño. Fish catches at sites in the lower Fly area remain high.

This case-study shows clearly that fish populations in this major tropical river system exhibited significant declines in abundance and diversity, almost to the point of extinction in

some areas, associated with the long-term discharge of mine-waste. Although the Fly River system is, by world standards, a major river system, this has not prevented mine-waste pollution from a single point source from having devastating environmental effects over large stretches of river. The ability of the river system to assimilate waste materials has clearly been exceeded, causing major changes to the aquatic and terrestrial environments and large reductions in fish population abundance and diversity.

The importance of monitoring

One of the major findings from this case-history is the importance of a detailed, long-term biological monitoring program and the utility of fish populations as indicator organisms. Large tropical rivers are complex ecosystems, with many factors affecting biotic communities and an extensive data set is required to begin to assess environmental change due to anthropogenic disturbance.

This case-study shows the importance of undertaking not only a detailed long-term fish population monitoring program, but also of carrying out adequate research to identify the underlying environmental mechanisms behind the declines. The lack of such information has clearly impaired the ability to mitigate the effects of the Ok Tedi mine.

Perhaps the most important single lesson to be learned from this experience is the urgent need for more international cooperation amongst environment, conservation and fisheries agencies and the need to be more pro-actively involved in the protection and management of a country's resources. There is also an urgent need to implement legislation, which would not allow major resource developments to proceed without adequate protective measures.