



A Dam Disaster in Brazil

AND ITS IMPACTS ON DISTANT SEA TURTLE BEACHES

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The recent collapse of a tailings dam at a Samarco ore mine in the municipality of Mariana, Minas Gerais, Brazil, is now being called the worst environmental disaster in the country's history. On November 5, 2015, the dam's collapse led to the deaths of 19 people and released tens of millions of cubic meters of mining waste into the Rio Doce, thereby affecting its entire 650-kilometer (404-mile) path to the Atlantic Ocean. Thirty municipalities in the Rio Doce basin were directly affected, including traditional human communities and 19 protected areas of enormous natural and ecological value. In the state of Espírito Santo at the mouth of the Rio Doce, pollutants ultimately despoiled globally important leatherback and loggerhead nesting beaches (see *SWOT Report*, vol. XI, pp. 14–27). Occasional nesting of green, hawksbill, and olive ridley turtles also occurs along the shores affected by this ecological disaster.

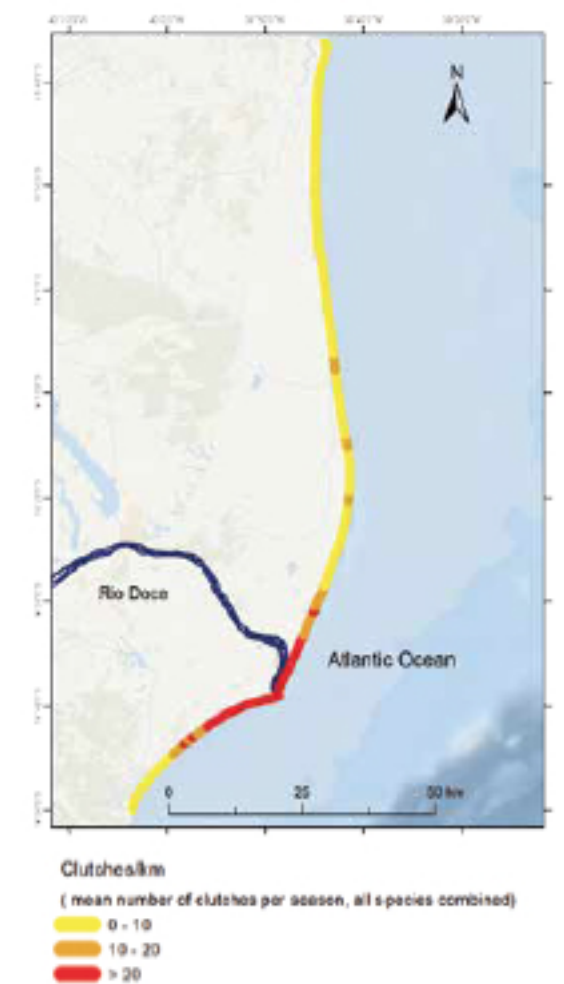
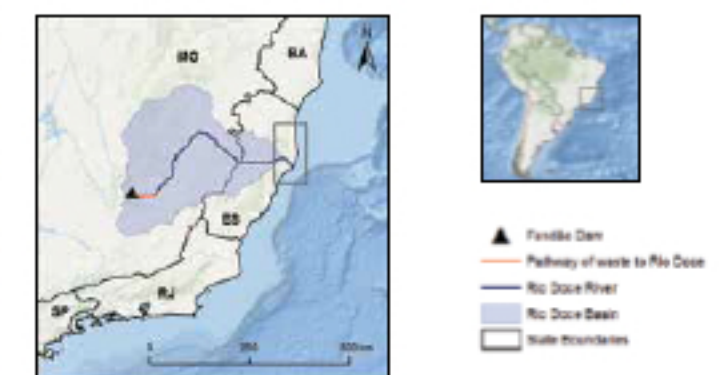
Leatherback turtles in Brazil belong to a distinct subpopulation that is considered critically endangered by the International Union for Conservation of Nature (see *SWOT Report*, vol. X, 28–31) because of its small size and restricted nesting range. In fact, the beaches in Espírito Santo are the only known regular nesting area for these genetically and biogeographically unique animals. Nests occur there in small but increasing numbers (50–200 nests per year). The area is also an important nesting ground for loggerhead turtles, with typically more than 2,000 nests laid per year in the state and a record number of more than 4,000 for 2015–16 during the tragedy.

The waste plume from the Rio Doce reaches hundreds of kilometers into the sea to the north and south of the river mouth and it changes shape and size daily, depending on oceanographic and climatic conditions. The Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) monitors the plume using helicopters and satellite imagery. IBAMA calculates that the dam's collapse has affected about 8,860 square kilometers (5,500 square miles) of ocean adjacent to Espírito Santo and the neighboring Brazilian states of Bahia and Rio de Janeiro. Because most of the waste remains in the Rio Doce basin and continues to flow to the sea, the areas must be monitored over time to fully understand the long-term impacts on beaches, mangroves, sediments, and wildlife, such as phytoplankton, zooplankton, crustaceans, fish, cetaceans, birds, and sea turtles. The results of these studies confirm elevated levels of iron, arsenic, cadmium, lead, and other metals in the waters, soils, and wildlife. Contamination of crustaceans and fish has already led authorities to ban fishing near the mouth of the Rio Doce and to enact other measures to protect human health.

Projeto TAMAR has been monitoring sea turtle nesting in the area annually since 1982. During the nesting season from September 2015 to March 2016, standard beach-monitoring procedures were carried out, and nests from areas exposed to tidal flooding or erosion were relocated. After the Samarco incident, nests laid near the river mouth were also relocated to prevent hatchlings from having their first ocean contact in polluted waters. No apparent change took place in the distribution of nests following the disaster, although hatchlings may have suffered nonlethal impacts that would be too difficult to measure at the outset. Such impacts, if any, may not be evident until those animals return as reproductively active adults in 20 to 30 years. To fully understand the long-term impacts of the spill on turtles and their habitats, we will need to investigate nest sediments, heavy metals in eggs and the tissues of nesting females, and blood samples from nesting females, as well as reproductive fitness and hatchling success. Those parameters will be added to long-term research on reproduction and population trends being conducted by Projeto TAMAR in collaboration with the University of Exeter.

On March 2, 2016, Samarco, Vale, and BHP Billiton (partners in the venture) signed a legal agreement with the government of Brazil, the states of Minas Gerais and Espírito Santo, and their respective environmental agencies. The agreement sets out general rules to remediate and compensate for the spill's environmental and socioeconomic impacts. It also calls for monitoring and studying the affected areas for the short and long terms in conjunction with Brazilian universities and other partners, including the Fundação Renova, an institution created to mitigate and repair damage from the Samarco spill.

Among other important lessons, this disaster serves as an unfortunate example of the weakness of legal requirements for risk assessment and impact studies related to mining activities in Brazil. Large-scale accidents, such as the Samarco incident, typically exceed the spatio-temporal emergency response planning of companies, government agencies, and nongovernmental organizations, yet the waste plume that can arise from those types of disasters respects no boundaries. To ensure that such disasters are effectively prevented in the future, industries must work hand-in-hand with all stakeholder government agencies, nongovernmental organizations, universities, and citizens from the earliest stages of project design. Such proactive collaboration is our only hope of preventing similar disasters in the future. ■



Data: Brazilian states – IBGE; Reproductive data, seasons 2010–11 to 2014–15 (before the disaster) – SITAMAR; Rio Doce Basin – ANA-MMA; Ocean Basemap – Esri Projection: SIRGAS 2000.

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