THE RESTORATION DIAGNOSTIC

Case Example: Tijuca National Park, Brazil

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SUMMARY

Located in the middle of the city of Rio de Janeiro, Tijuca National Park is currently one of the largest urban forests in the world (Drummond 1996). But in the mid-1800s, the area that is now the park was degraded and devoid of its original forest cover as a result of agriculture—mainly coffee plantations. Efforts to restore tropical forests to the area first began in the early 1860s. In 1861, Brazil established Tijuca Forest and Paineiras as the first conservation area in the country. The next 15 years saw 68,000 trees planted, with another 20,000 during the subsequent 10 years (Rodrigues et al. 2007). Efforts to reintroduce additional native animal species took place in the 20th century. And in 1961, the Brazilian government designated the area as a national park (Freitas et al. 2006).

The restoration of Tijuca has had a number of positive impacts, including (Freitas et al. 2006):

- Improved water supplies for Rio
- Improved air quality for Rio
- Recreational opportunities for Rio’s citizens and visitors
- Reintroduction of twenty-five bird species, seven mammal species, and one reptile species
- Habitat for forty-nine species of mammals, of which eleven are on regional threatened species red lists and four are on the International Union for Conservation of Nature Red List of Threatened Species.
WHICH FEATURES AND KEY SUCCESS FACTORS WERE EXHIBITED?

Restoration in Tijuca exhibited several of the features and key success factors of forest landscape restoration.

Motivate

Factors motivating restoration included:

- **CRISIS EVENTS.** Starting in the 16th century, the Atlantic rainforests surrounding Rio de Janeiro were gradually cleared to make way for sugarcane fields, coffee plantations, pastures, and charcoal production. By the 19th century, reduced vegetation combined with population growth and lower-than-average rainfall levels resulted in a crisis for the city’s water supply. Rio experienced severe droughts in 1824, 1829, 1833, and 1844 and milder water shortages during the intervening years. Deprived of forest cover, small streams were drying up during the winter and the local streams were experiencing flash floods during the rainy season. By the mid-1800s, these water crises threatened the growth of Rio de Janeiro, which was then the nation’s capital and largest city (Drummond 1996).

- **BENEFITS.** Restoration was expected to provide environmental benefits that, in turn, would address the water crises and improve human well-being. Many expectations were realized. In particular, restoration of vegetation modulated water flows, slowing runoff during rainy seasons and retaining water during drier seasons. It also increased soil moisture, reduced erosion, and created recreational opportunities for citizens (Freitas et al. 2006). Restoration also ended up providing social benefits. Tijuca National Park, with its forest-covered mountains towering over the city, has become an iconic image of Rio. As such it invokes a lot of national pride and is part of local and national identity. This cultural benefit has continued to motivate Brazilians to sustain the restoration of this area.

- **AWARENESS.** National and global culture has influenced the development and sustainability of restoration activities. From the early 1900s to 1950s, many writings by influential conservation leaders influenced attitudes toward recognizing Brazilian restoration and conservation potential. Sampaio, Corrêa, Mello Leitão, and Hoehne opened the way for modern conservation efforts (intellectual, institutional, and scientific) that are now a part of the public agenda and popular consciousness. Some authors wanted nature to be protected so that it could remain a central part of the Brazilian national identity (Drummond 1996).

Enable

Several enabling conditions were in place to facilitate restoration in Tijuca, namely:

- **ECOLOGICAL CONDITIONS.** The steep slopes of the Tijuca region were conducive to abandonment of agriculture and grazing. Pockets of forest remnants in the hills allowed the natural recolonization of old fields by native tree species, rapidly transforming the landscape (Oliveria 2007). For the planted forests (which comprised just 200 hectares of the restored area), seedlings of many native tree species were readily available from the Paineiras Forest, the Botanical Garden of Rio de Janeiro, and a farm in Guaratiba owned by Manuel Gomes Archer, the manager of the Tijuca Forest. In the Paineiras Forest and in Guaratiba, however, the seedlings had to be collected from inside the remains of native tree stands, an activity that demanded a lot of time and physical effort (Drummond 1988). Fire is the biggest disturbance threat to Tijuca (Carreiro and Zipperer 2011). To address this problem, the Brazilian government banned sky lanterns in 1998; Law 9605, Article 42 identified releasing sky lanterns as an environmental crime, punishable by up to three years in prison (Folha de S.Paulo 2008).

- **POLICY CONDITIONS.** Starting in the mid-1800s, national and local government agencies enacted laws, regulations, and management plans to preserve remnants of the original forest in Tijuca, restore degraded areas, and manage the watershed (Drummond 1996).

Implement

Some capacity and resources were in place that helped with implementation, including:

- **LEADERSHIP.** The Emperor of Brazil, Dom Pedro II, pushed the idea of managing upstream landscapes to improve downstream water supplies. Working under the Emperor’s command, Manuel Gomes Archer became the first manager of Tijuca Forest, responsible for the basic groundwork for restoring the landscape and maintaining the watershed. After his first fifteen years as manager, Archer recommended to the government that agronomic schools start including forest science to improve the understanding of the importance of forest-based ecosystem services such as water and soil conservation (Rodrigues et al. 2007). In 1877, Lieutenant-Colonel Gastão de Escragnolle succeeded Archer. Like Archer, Escragnolle had close ties with the Imperial Court and Rio’s nobility, and thus had sufficient political support and funds to hire more workers for restoration (Drummond 1996). Escragnolle concentrated on improving infrastructure within the park, which eventually turned Tijuca Forest into an area appropriate for public recreation (Freitas et al. 2006).
KNOWLEDGE. Archer, his team, and his successors received technical assistance from the Botanical Garden of Rio de Janeiro. In addition, Archer had second-hand information about forest planting and management practices from Germany, possibly through personal contacts and printed sources circulating in the Imperial Court (Drummond 1996).

TECHNICAL DESIGN. The restoration plan had a good technical design. Over the first ten-year period of restoration (1862–72), planted trees had an 80 percent survival rate due to this expertise (Drummond 1996).

FEEDBACK. Effective performance monitoring and evaluation is in place. For example, fire is a current threat to Tijuca National Park. Data on fire events in the national park have been recorded since 1991 (Matos et al. 2002). Initially, management responses focused only on fire suppression, since fire-disturbed sites would be subsequently invaded by exotic grasses, creating emergent exotic communities within the native forest. Recently, park management has been addressing both fire suppression and declining forest condition through the creation of plant communities with low flammability along the boundaries of forest stands. Tijuca has therefore demonstrated adaptive management for maintaining restoration (Carreiro and Zipperer 2011).

LOOKING FORWARD
Restoration in Tijuca exhibited some characteristics that were a product of the social and political context at the time, but are not good practices for forest landscape restoration today. First, in creating the Tijuca Forest, Emperor Pedro II expropriated farmland from local people in 1861 (Correa de Lima et al. 2004). Second, Archer used about ten slaves to assist with tree planting and other activities during the 1860s (Drummond 1988). Forest landscape restoration in the 21st century needs to respect human rights and follow best practices such as free, prior, and informed consent (Hertz et al. 2007).
REFERENCES


ENDNOTES

1. There is no major river in Rio de Janeiro. Consequently, since the city’s founding in 1565, the small but permanent streams running down the mountains of Tijuca were a major source of drinking water for the city (Carreiro and Zipperer 2011).

2. A member of the commission that drafted Brazil’s first Forest Code (1934) (Franco and Drummond 2008).

3. Wrote about the need to restore the land with native species, not eucalyptus, which were involved in the first large restoration project in Brazil.

4. Mello Leitão was also a pioneer in Brazil in the use of the radio to broadcast his knowledge and ideals in biology and nature protection. Besides exercising personal influence in important political and academic environments, he helped train new scientists (Franco and Drummond 2008).

5. Dedicated his entire career to the examination of Brazilian flora. His career was linked to the rise of the Instituto de Botânica do Estado de São Paulo (São Paulo State Botanical Institute) (Franco and Drummond 2008).

6. A sky lantern or Chinese lantern is a small hot air balloon made of paper, with an opening at the bottom where a small fire is suspended.
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