

PORT MANAGEMENT ECO-EFFICIENCY IN BRAZIL

Authors:

Sandrelly Amigo Lopes: SAMARCO MINERAÇÃO S.A. - sandrelly@samarco.com

Victor Jose de Andrade Patiri - BRAÇO SOCIAL CONSULTORIA - victorpatiri@bracosocial.com.br

Augusto Martini Dultra Palmeira – BRAÇO SOCIAL CONSULTORIA – augustomartini@bracosocial.com.br

Alessandra Santos de Jesus: SAMARCO MINERAÇÃO S.A - alessandra@samarco.com

1. ABSTRACT

The Samarco Mineração Port Terminal, the 11th largest exporter in Brazil, is located in the State of Espírito Santo, a region with a rich biodiversity and a Sea Turtle Environmental Preservation Area.

The company launched an eco-efficiency program which has started focusing on the study of economic, social and environmental gains for the company and its stakeholders. And then it has adopted measures to conserve the nests and sea turtle's reproduction areas located on beaches nearby the company's production stockyard and port.

Considering that lights on a beach can disturb nesting turtles, causing photo pollution, the program has lowered 17 sets of lights at the stockyard reduced the sets of adapted the focus using screens in the port area and reduced the floodlights' installed power from 66% and 34% of original output.

Another essential component of the program was the simultaneous teamwork training to install and maintain the modern lighting systems that was then extended to the Fourth Pellet Project, which has resulted in a 37% increase in the company's production capacity. Such experience shows that photo-mitigation and eco-efficiency can be applied to sea turtle nesting areas close to industrial and port areas and/or urban occupation.

KEY WORDS:

Samarco Mineração Port Terminal, environmental management, photopollution mitigation, eco-efficiency, conservation of sea turtles, Edict no.11/IBAMA-MMA.

2. OBJECTIVE

This paper aims to present the experience of light pollution mitigation conducted at The Samarco Mineração Port Terminal, located close to sea turtle nesting areas. The interventions implemented by this logistics company aimed not to interfere in the life cycle of these animals listed as endangered species.

3. INTRODUCTION

The Samarco Port Terminal, currently the 11th largest exporter in Brazil, is located in Anchieta, south coast of the State of Espírito Santo. Its operation is essential for offloading the company's production and is next to a conservation unit called "APA Municipal das Tartarugas Marinhas" (Images 1 and 2). The sea turtles are threatened with extinction (IUCN,2005) and on the Espírito Santo coast they find an important space to reproduce, feed and survive, specially the loggerheads (*Caretta caretta*).

Their complex life cycle happens between September and March, when the egg laying process take places. The female turtles need special conditions to leave the sea, lay their eggs in the sand and safely return to the water. This implies to maintain the natural conditions as undisturbed as possible. The photo pollution deriving from the excessive or obtrusive artificial light at night impacts on endangered wildlife such as sea turtles. It figures among the human stressors that prevent successful conservation by affecting sea turtles in their nesting beaches and also in the nearby water (LORNE&SALMON, 2007).



Image 1: (left) Location Map of the Samarco Mineração S/A Industrial Complex, in Anchieta, Brazil. **Image 2:** (right): The Sea Port Terminal and Adjacent beaches around the complex. Beach of the center: Além (sea turtle nesting area) and the iron ore stockyard and industrial units.

They can also interfere in different stages of the sea turtles' life cycles because they 1) change the behavior of the nesting females when they select the areas used to dig their nests, 2) disorient nesting females when they return to the sea and 3) disorient the hatchlings when they crawl to the ocean. Because sea turtle nesting normally occurs at night, the clearest negative effect of light pollution is that nesting females usually do not leave the water on beaches where artificial lighting emanates from buildings, roads, highways and public beachside walkways. (PATIRI & PALMEIRA, 2012 a)

In Brazil, The National Institute for the Environment and Renewable Natural Resources - IBAMA issued in 1995 the Edict no. 11 prohibiting the installation of any artificial light sources directed in 63 different beaches and establishes specific standards for lighting levels. Any economic activity in these areas has to control photo pollution.

In accordance with prevailing legislation, Samarco has started since 1998 a project for the conservation of the nests and the sea turtles' reproduction on beaches nearby the company's production stockyard and port. The photo-mitigation actions began in 2010 and is controlling and monitoring brightness levels where their reproduction takes place. As a result, the company has significantly reduced its impact on the local marine biodiversity in the last four years.

4. THE MITIGATION OF ENVIRONMENTAL PHOTOPOLLUTION IN SAMARCO'S PORT TERMINAL

A specific methodology (PATIRI & PALMEIRA, 2012 b) was developed in convergence with the requirements of environmental organizations with the objective of mitigating environmental photo pollution of Samarco's Port Terminal. It consists on adopting specific criteria for the lighting projects as well as for the operational process (business norms), so that the lighting levels in the areas of direct influence are compatible with the requirements for conservation of sea turtles.

This methodology can be divided into three distinct phases, with some overlap and interactions among them:

- **Phase 1 – Design of Guidelines for Drafting Lighting Projects**

The work was started with the study of alternatives and of the economic, social and environmental gains for the company and its stakeholders (2010-11).

- **Phase 2 – Implementation of Lighting Projects**

The engineering project has begun simultaneously and the projects in the iron ore pellet stockyard areas and port were executed later (2012-13).

The lighting project's main actions (2011-13):

- a) Lowering 17 sets of lights at the stockyard (from 45 meter's to 25 meter's in height);
- b) Replacing 2,000 w sodium-vapour lamps with 1,000 w lamps;
- c) Reducing the sets of lights from nine to six floodlights per tower;
- d) Investments to adapt the focus using screens in the port area;

- **Phase 3 – Check Environmental Impact Assessment "Check & ACT".**

With the projects in late-stage deployment, inspections have been done to regularly assess the impact and ensure the eco-efficiency of the lighting projects implemented in areas with environmental sensitivity, weather adversities and high intensity winds. Whenever required, the needed adjustments and lighting replacement parts were carried out by the Samarco maintenance team.

According to Brazilian environmental legislation (IBAMA Edict nº 11/1995) for the remaining areas of sea turtle reproduction, visits were realized, always during the night and during the phase of the new moon since it is the most adequate period to observe and measure eventual contributions of photo pollution. Starting from the beach line, all eventual light contributions (direct and indirect light focuses, light halo and reflections) originated from the provisional structures of the work, whether movable or fixed, as well as from the definitive structures that are being constructed, were systematically observed.

Periodic reports describing the field observations were presented, and in the case of non-conformities, practical and effective solutions to mitigate the environmental pollution were appointed.

5. RESULTS

The floodlights were directed so that dispersal of the light beam was reduced in the sea turtles' nesting area on "Além" beach, which is next to the Samarco's Port Terminal. The floodlights' installed power was reduced from 66.5% to 33.5% of original output. And despite this power reduction, the working environment has gained lighting benefits.

The 2.013/2.014 sea turtle nest season, monitored by IPCMAr and Samarco comprised 130 records of nesting activity. Indeed, during the 2013/2014 season (September 2013 to March 2014), there was a 65% increase if compared to the previous one (September 2012 to March 2013). A record number of sea turtle nests monitored in the last eight years was observed as a reflection of actions previously developed by Samarco and influenced by the project's implementation (Table 1).

Table 1 - Samarco Mineração Port Terminal - Program Controls Occurrence of Sea Turtles. Nesting Season: Number of nesting activities (PRÓ-TAMAR and IPCMar *).

Nesting Season	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014
Number of Nests	53	51	86	67	86	74	86	130

* Source: Technical Reports

The project produced a series of tangible benefits associated among others to environmental improvements, cost reduction and efficiency gains, which are highlighted below:

- a) **ENVIRONMENTAL GAIN:** Guaranteeing on the surrounding beaches brightness levels and natural conditions: successfully preserving sea turtles in the region (safe egg laying and birth of hatchlings). Last reproduction season (2013/2014): Record Number of Occurrences:130 nests were protected.
- b) **IMPROVING SAFETY AT WORK:** Standardizing the lighting at the Iron ore stockyard, improving lighting in work areas (pier and internal circulation routes); facilitating photo mitigated equipment maintenance (replacing lamps and directing the angles of floodlights and other lighting systems).
- c) **PORT OPERATIONS:** By lowering the floodlights at the Port and Iron Ore Stockyard Lighting Towers, the arrival and departure operations for ships (maneuvers) at the Sea Terminal are carried out with increased safety.
- d) **FINANCIAL:** In addition to the environmental asset of conserving biodiversity, the eco efficient solutions installed also produced relevant benefits:
 - A decrease in Installed lighting power of approximately 66%.
 - Annual consume around 880MWh for saving electrical energy deriving from the light of the Iron Ore Stockyard.
 - Revenue of approximately US\$75.000,00/year.
- e) **IMPLEMENTATION IN NEW INDUSTRIAL UNITS:** The improvements (photo mitigation solutions) were extended to the Fourth Pellet Project (P4P), which was completed in 2014 and produced a 37% increase in the company's productive capacity: Samarco's new industrial unit was designed and installed with a modern lighting system.

At the same time, to ensure the effectiveness of actions taken, a continuous improvement process of photo mitigation in Industrial Area was implemented based on Kaizen methodology (IMAI 1992). Until February 2015, 77% of employees involved in activities that could potentially endanger the maintenance of low levels of light on beaches nearby the company's production (stockyard and port) were trained. Regularly maintenance teams check the mitigated photo lighting systems. When required, adjustments and replacements of equipment's are made.

6 . FINAL CONSIDERATIONS

The Eco-efficiency in Port Management contributes to the Conservation of Marine Biodiversity (Turtles), in so far as environmental responsibility minimizes environmental impact and helps to endure benefits to biodiversity, ecosystems and other environmental resources. Moreover such eco-efficiency lighting programme displays alignment with values such as Sustainability:

a) Economic: the implemented programme provided economic gains in energy consumption, where the investment applied to the project pays for itself within three years. Thus, it starts to produce an income with economic gains both, in the system's maintenance process and in energy consumption.

b) Environmental: the implemented programme has contributed to significantly increasing the number of sea turtle nests and birth of hatchlings in the region nearby Samarco's sea terminal and the company's operations, producing tangible and intangible benefits in order to preserve this species, which is threatened with extinction (IUCN, 2005).

c) Social: the implemented programme has improved working conditions and lighting, with gains related to safety at work for the staff who undertake activities at the company's stockyards and port area, in addition to external stakeholders, such as environmental NGOs and other governmental partners at federal and state level, which follow-up and effectively take part in the programme.

Despite such gains and in order to guaranteeing the conservation of the environmental characteristics of the protected sea turtle areas, it is clear that the regular environmental photo pollution control processes should be continued, providing solutions and proposing norms and standards for lighting in the immediate surroundings. Furthermore, the company's operational processes should simultaneously attend to good practices for security and employee health. And eventual impacts of the company's activities should be checked and evaluated. In the case of non-conformities the operational processes should be revisited collectively by the environmental, security and productivity teams, and if necessary, adapted to incorporate eco-efficient measures, leaving the sea turtle nesting areas as close as possible to the original conditions of light before the company's presence.

Complimentarily, environmental education initiatives as well as corporate communications are also encouraged to clarify doubts and to promote environmental awareness among employees and stakeholders in an attempt to achieve success in the challenge of conservation of these endangered animals.

7. REFERENCES

LORNE, Jacquelyn, SALMON, Michael. Effects of exposure to artificial lighting on orientation of hatchling sea turtles on the beach and in the ocean. *Endangered Species Research*, vol. 3: 23–30, 2007. Penryn, UK.

MARCOVALDI, Maria Angela; MARCOVALDI, Guy. *Marine turtles of Brazil: the history and structure of Projeto TAMAR-IBAMA*. *Biological Conservation*, [S.I.], v. 91, 1999, pp. 35-41.

MARCOVALDI, Maria Angela, PATIRI, Victor, THOMÉ João Carlos. Projeto TAMAR-IBAMA: 24 Years of a Community-Based Conservation Program to Protect Brazilian Sea Turtles In: *Maritime Studies – MAST. Special Issue 3(2): Sea Turtles as a Flagship Species – Frazier Jack (Org) Chapter 2*, Amsterdam, Netherlands, 2005 , pp.39-62.

IUCN-2005, The IUCN Red List . Access: www.iucnredlist.org in 04/01/2014.

IMAI, Masaaki. *Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy*, Second Edition . McGraw-Hill Professional, 2012.

IPCMAR. *Sea Turtle Monitoring Report in the area of Anchieta and Guarapari*. - original in Portuguese – **Unpublished manuscript**. Instituto de Pesquisa e Conservação Marinha, 2014.

PATIRI, Victor, PALMEIRA, Augusto - PORT OF AÇU, BRAZIL LIGHT POLLUTION MITIGATION – 32ND Annual Conference International Association for Impact Assessment – IAIA, Porto, Portugal, 2012 a. Access: http://www.iaia.org/conferences/iaia12/Final_Paper_Review.aspx in 12/12/2014.

PATIRI, Victor, PALMEIRA, Augusto - Light Pollution Mitigation – A Proposal Methodology – 32ND Annual Conference International Association for Impact Assessment – IAIA, Porto, Portugal, 2012 b. Access: http://www.iaia.org/conferences/iaia12/Final_Paper_Review.aspx in 12/12/2014.

PRÓ-TAMAR. Monitoring Report of Sea Turtles in Anchieta region. - original in Portuguese – **Unpublished manuscript**. Foundation Brazilian Center for Protection and Research of Sea Turtles, 2007.

PRÓ-TAMAR. Monitoring Report of Sea Turtles in Anchieta region. - original in Portuguese – **Unpublished manuscript**. Foundation Brazilian Center for Protection and Research of Sea Turtles, 2008.

PRÓ-TAMAR. Monitoring Report of Sea Turtles in Anchieta region. - original in Portuguese – **Unpublished manuscript**. Foundation Brazilian Center for Protection and Research of Sea Turtles, 2009.

PRÓ-TAMAR. Monitoring Report of Sea Turtles in Anchieta region. - original in Portuguese – **Unpublished manuscript**. Foundation Brazilian Center for Protection and Research of Sea Turtles, 2010.

PRÓ-TAMAR. Monitoring Report of Sea Turtles in Anchieta region. - original in Portuguese – **Unpublished manuscript**. Foundation Brazilian Center for Protection and Research of Sea Turtles, 2011.

PRÓ-TAMAR. Monitoring Report of Sea Turtles in Anchieta region. - original in Portuguese – **Unpublished manuscript**. Foundation Brazilian Center for Protection and Research of Sea Turtles, 2012.

PRÓ-TAMAR. Monitoring Report of Sea Turtles in Anchieta region. - original in Portuguese – **Unpublished manuscript**. Foundation Brazilian Center for Protection and Research of Sea Turtles, 2013.