PORT OF AÇU, BRAZIL LIGHT POLLUTION MITIGATION

Authors:

Victor Jose de Andrade Patiri - BRAÇO SOCIAL CONSULTORIA - victorpatiri@gmail.com
Augusto Martini Dultra Palmeira – BRAÇO SOCIAL CONSULTORIA - augusto.martini.palmeira@gmail.com
Sérgio Ferreira da Fonseca - ANGLO AMERICAN - sergio.fonseca@angloamerican.com
Wanderson Primo de Sousa - LLX MINAS RIO - wanderson.sousa@llx.com.br
Alberto Luiz Bernardo - ANGLO AMERICAN - alberto.bernardo@angloamerican.com

1- ABSTRACT

The Port of Açu, the largest port and industrial complex work currently undertaken in Latin America, is located in a region recognized by the Brazilian Environmental Agency as an important remaining area where sea turtles reproduce. Given that Brazil is a signatory to the Convention on Biological Diversity (CBD) – Nairobi, Kenya, 2000, there is a National Action Plan for Sea Turtles (NAP) that guides conservation activities for the five species of sea turtles appearing in the country's waters. Since the Port of Açu is located in an area of environmental sensitivity, it must comply with the guidelines set forth therein.

This paper addresses the challenge to mitigate the light pollution of the Port of Açu and to harmonize its deployment with the conservation of sea turtles. These issues are explored through a case study analysis of a light pollution mitigation strategy developed between the years 2008 and 2011 in a port and industrial complex. The case study can be divided into three distinct phases: Phase 1: Design of Guidelines for Drafting Lighting Projects; Phase 2: Implementation of Lighting Projects - On-the-Spot Assessment; and Phase 3: Check Environmental Impact Assessment "Check & ACT."

KEY WORDS:

Porto do Açu, environmental management, photopollution mitigation, eco-efficiency, conservation of sea turtles.

2 – OBJECTIVE

This paper aims to present the experience of light pollution[1] mitigation conducted at LLX / Minas Rio, a joint venture between LLX Logística S.A. and Anglo American Participações em Mineração LTDA, during the construction process of the Açu Port, located in São João da Barra, state of Rio de Janeiro, Brazil, close to sea turtle nesting areas. The interventions implemented by this logistics company aimed not to interfere with the life cycle of these animals listed as endangered species.

3. INTRODUCTION

Light pollution is a serious concern for the environment. Its impacts jeopardized wildlife, such as sea turtles. It can also potentially interfere in different stages of the sea turtles' life cycles because 1) it changes the behavior of the nesting females when they select the areas used to dig their nests, 2) it disorients nesting females when they return to the sea and 3) most importantly, it disorients 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

[1] Light pollution, also known as photopollution or luminous pollution.

do not leave the water on beaches where artificial lighting emanates from buildings, roads, highways and public beachside walkways. These females are often forced to seek out less appropriate areas, which reduce the possibility of successful nesting.

In Brazil, the last remaining areas where sea turtles are known to reproduce (East and Northeast coasts of Brazil) are considered a priority for preserving these endangered species. A specific legislation was drafted to promulgate federal law restricting the presence of artificial light in the main nesting areas.

The National Institute for the Environment and Renewable Natural Resources - IBAMA issued Edict no. 11/1995. This is a legal instrument to restrict the presence of artificial light in the main sea turtle nesting areas and to provide legal means of regulating future lighting projects in the vicinity of priority areas considered critical for sea-turtle protection and management. The law banned the installation of any light source that is greater than zero lux in intensity 50 meters above the high tide in nesting areas at different Brazilian beaches.

According to An Atlas of Sea Turtle Nesting Habitat for the Wider Caribbean Region, the stretch of beaches between the beaches of Praia do Açu, Maria Rosa and Farol present a stretch of "registered spawning" of between 100 and 500 occurrences per year (Dow et Al, 2007 pp-112-114).

In this way, for the proposed enterprises in these areas (e.g. Porto do Açu), the licensing environmental organizations establish specific criteria to restrict and control photopollution. In this context, the LLX-Minas Rio develops work to control excess illumination in Porto do Açu in its off-shore and retro-areas (the logistics support areas).

4. THE MITIGATION OF ENVIRONMENTAL PHOTOPOLLUTION IN PORTO DO AÇU

To meet to the requirements of the environmental organizations a specific methodology was used to mitigate environmental photopollution (Patiri, Martini, - in press) - in Port of Açu that can be divided into three distinct phases, with some overlap and interactions among them:

- Phase 1 – Design of Guidelines for Drafting Lighting Projects;
- Phase 2 – Implementation of Lighting Projects;
- Phase 3 – Check Environmental Impact Assessment "Check & ACT".

- **Phase 1: Design of Guidelines for Drafting Lighting Projects.**

This phase started in 2008 with the establishment of technical standards for the building of specific lighting projects (*off-shore* and retro-areas - the logistics support areas).

Initially preliminary studies were conducted that considered the observations of specific characteristics of the enterprise, for example, the temporary and definitive structures, the operational processes, and respective lighting needs and the geomorphology of the region (terrain features, local relief, presence of geographic accidents).

After the analysis of this combination of intrinsic factors of the enterprise, its area of direct influence and its respective interferences were verified regarding questions of environmental sensitivity . In this case, the process highlighted the aspects that refer to the challenges of the conservation of this remaining important area for sea turtle reproduction.

From these considerations the implementation of a collective norm was suggested with the aim of controlling excess illumination. It was directed toward areas of project engineering and the environment to mitigate environmental photopollution by establishing guidelines for elaboration of lighting projects.

This document was set as a technical reference to assist in the development of future projects. The guidelines prioritized:

a) Information about aspects that contribute to environmental photopollution, such as: formation of sky glow; incidence of glare and light trespass and reflection;

b) Aspects on sea turtle bioecology and information about the appearance of these animals in the direct area of influence of the enterprise;

c) Incentive for utilization of the eco-efficiency of the lighting systems and the control of the light dispersion, such as:

i. Eco-efficient luminaires that present high output

ii. Adequate types of lamps for the development of the operational activities during the construction and operation phase and principally of the greatest energy efficiency;

iii. Restriction on the power of the lamps;

iv. Height of Erected Luminous Spot: criteria that establishes permitted heights for the supports of the luminaires.

v. Confinement of Luminous flux: for luminaires that have dispersions of light movement, installation of light screens is recommended.

Based on the referred standards, projects were designed to limit the dispersion of light.

- **Phase 2: Implementation of Lighting Projects.**

Between 2009 and 2011 the implemented projects were monitored. When necessary experimental adjustments were made and presenting satisfactory results, such as light levels appropriate for the building areas and no dispersion of light rays on the beaches of the region in order to ensure adequate light levels to the sea turtles' life cycles.

In this phase the implementation of the projected structures and the adequacy of lighting regarding the aspect of environmental photopollution were verified. This follow-up *in situ* was realized through periodic visits according to gradual work advances (off-shore and Retro Area - Logistics Support 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 LLX / Minas Rio maintenance team.

Based in the established criteria of Brazilian environmental legislation (IBAMA Edict nº 11/1995) for the remaining areas of sea turtle reproduction, complementary visits were realized, always during the night and during the phase of the new moon. It is the most adequate period to observe and measure eventual contributions of photopollution to the environment and to relate them to the area of direct influence for the enterprise.

Starting from the beach line, the eventual light contributions (direct and indirect light focuses, light halo and reflections) that originated from the provisional structures of the work, whether they are movable or fixed, as well as the definitive structures that are being constructed, were systematically observed.

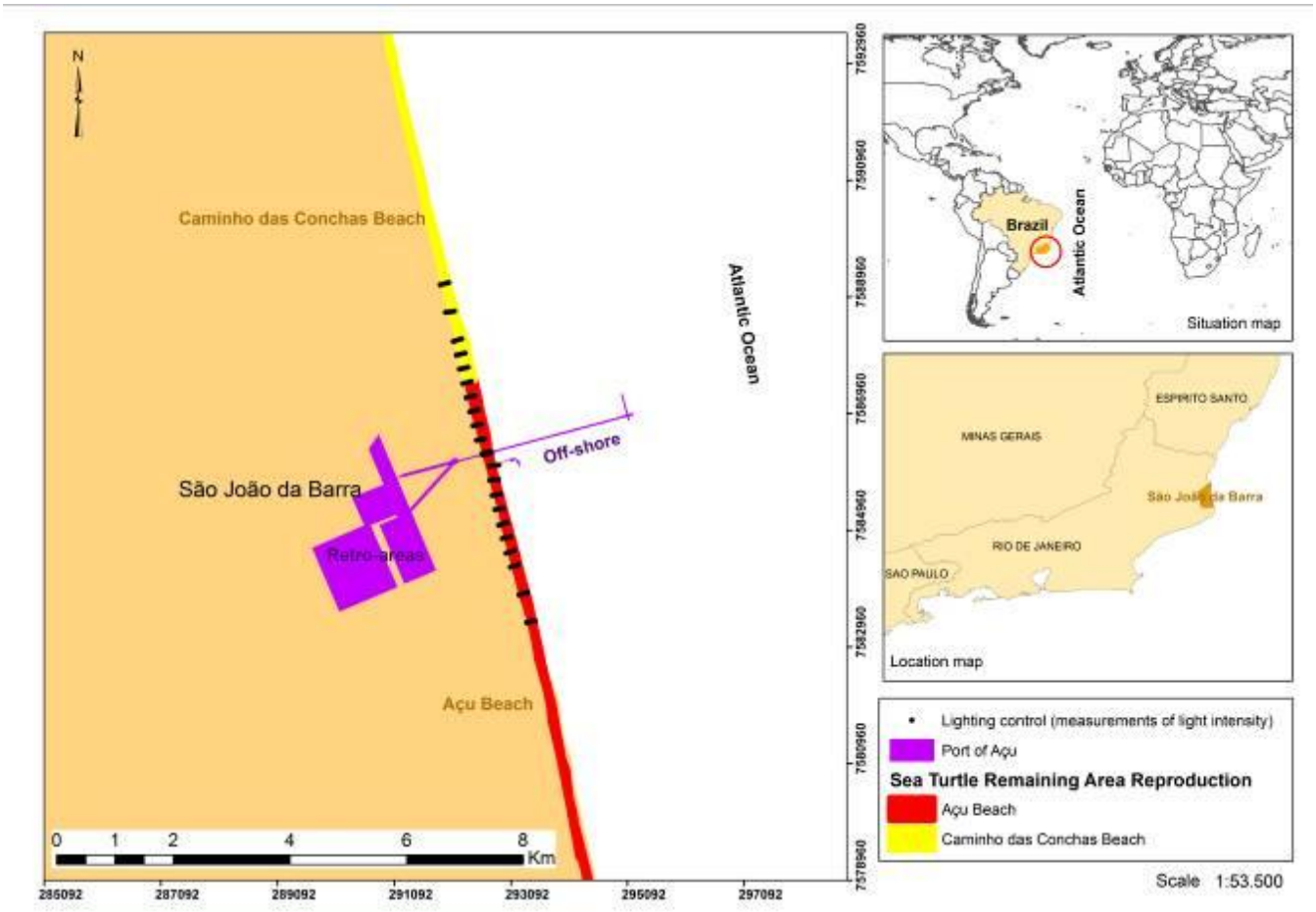
Periodic reports were presented to the environmental managers describing the field observations, and in the case of non-conformities they appointed practical and effective solutions to mitigate the environmental pollution.

With this information, through the LLX / Minas Rio Environmental Unity, several meetings were held with those responsible (collaborators in the area of engineering, security, executing companies of infrastructure work) with the objective of mitigating the foci of photopollution, such as:

a) In some cases, principally in the definitive pier of Porto do Açu where the presence of wind is frequent, it was necessary to experimentally determine the geometry of the screen and from there confine the light flow of the lighting of the bridge over the surface, eliminating the dispersion beyond that, which would fatally reach the beach and/or ocean, creating a photopollution spot;

b) Sometimes the use of complementary operational processes were suggested to establish criteria to restrict the artificial light in the different fronts of work, restricting them to only when it is necessary, that is, when there is activity.

Concurrently, the areas with sea turtle nests are monitored regularly from the start of the infrastructure work by the LLX / Minas Rio Environmental Unity. The rate of spawning versus the mitigation of light pollution has been evaluated. In this way, periodic monitoring is realized every 60 days for the light control on the Direct Influence Area (DIA): a stretch of 6 kilometers of beach located in front of the work location (3 km to the north and 3 km to the south of the Pier of Porto do Açu), complementing the program that controls appearances of sea turtles (Figure 1).



For the lighting control, measurements of light intensity were performed with a digital luxmeter (with a resolution of 0.01 lux) directly on the beach line in the band of greatest environmental sensitivity, in accordance with Brazilian environmental legislation (Edict nº 11/95-IBAMA).

5 – RESULTS

Data from the LLX Minas Rio registered that in the Indirect Influence Area (IIA) – beach stretch (62 km) - the occurrence of 960 nests during the Nesting Season 2010/2011 and of 914 nests, during the Nesting Season 2011/2012. In the Direct Influence Area (DIA) - beach stretch (6 km) – the data registered 53 and 41 occurrence of nests. The levels of observed light Intensity during the 2011/2012 season were satisfactory, without any identification of disorientation of newborns on the stretch of a monitored beach (DIA). - Table 1.

Table 1 - Port of Açu - Program Controls Ocurrence of Sea Turtles.

	Beach/Stretch (kilometers)	Nesting Season 2010/2011 Number of nests	Nesting Season 2011/2012 Number of nests	Average Illumination Intensity
Indirect Influence Area (IIA)	62 km	960	914	*
Direct Influence Area (DIA)	6 km	53	41	0,35 / 0,79 Lux

*Started in Nesting Season 2011/2012

6 - FINAL CONSIDERATIONS

With the beginning of the operations of Porto do Açu, scheduled for the end of 2013 and the beginning of 2014, an expansion of the lighting systems is predicted. From the understanding acquired during the implementation phase of Porto do Açu, the regular environmental photopollution control processes should be continued, providing solutions and proposing the development of norms and standards for lighting in the immediate surroundings, in this way guaranteeing the conservation of the environmental characteristics of the protected sea turtle areas.

7- REFERENCES

Dow, Wendy, Karen Eckert, Michael Palmer and Philip Kramer. 2007. An Atlas of Sea Turtle Nesting Habitat for the Wider Caribbean Region. The Wider Caribbean Sea Turtle Conservation Network and The Nature Conservancy. WIDECAST Technical Report No. 6. Beaufort, North Carolina. 267 pages, plus electronic Appendices. Available: http://seamap.env.duke.edu/seamap2.5/widecast/references/Dow_et_al_2007.pdf . Accessed: March, 26 2012.

Patiri, Victor J.A. and Palmeira, Augusto M.D. - Light Pollution Mitigation – A Proposal Methodology – 32ND Annual Conference International Association for Impact Assessment – IAIA, Porto, Portugal, 2012, *In Press*.