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Solid Waste in the Context of Environmental Education, the Mangrove Ecosystem, and Photography

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Abstract: Although mangrove ecosystems are supported by various environmental legislations, they still suffer from improper disposal of solid waste. This study aims to reflect, using photographic images, on the problem of urban solid waste production and its disposal in mangrove areas, with a view to diagnosing necessary environmental education actions for the conservation of ecosystems. The research took place according to the phenomenological method, which seeks to reveal deeper aspects of the context and allowed researchers to have a better understanding of the lived experience. The technique used was the image capture. The concepts studied contributed to the discussion of negative impacts caused in the mangrove by the disposal of some types of waste. It was concluded that photography, as a means of diagnosis, allowed another look at environmental issues.

Keywords: Law 12.305/2010; Solid Waste Management; Mangrove; Environmental Education; Photography.

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Introduction

The contemporary world has been described as full of scientific and technological advances. On the other hand, full of growing ecological aggressions directly related to the social crisis and environmental problems, on the way to a collapse built by contemporary society, as a result of behavioral transformations of excessive consumption and relevant anthropic interventions in ecological systems, such as forests, mangroves, streams, seas, and oceans.

This situation calls for thematic considerations relevant to the environmental issue, particularly with regard to solid waste and its inadequate disposal in ecosystems, which requires taking paths to raise awareness and preserve the environment. According to Foladori (2001), the economic model is not alone the main generator of the crisis, but issues that encompass it, such as financial and technological resources and the resulting solid waste.

Solid waste began to represent a problem for humanity when the advance of non-biodegradable synthetic products, manufactured in large quantities and discharged indiscriminately in nature, resulted in toxic contamination and impacts of significant proportion and magnitude. This behavior continues to be fostered by the high consumption of goods and the inevitable production of waste through inefficient management, which provides negative and restrictive factors for healthier, more equitable, and more sustainable development.

In view of the complexity of how to manage this waste and the management obstacles faced in Brazil for the proper management of solid waste, a valuable regulatory system was created — the National Solid Waste Policy (PNRS)[1] , Law No. 2010. It is considered an advanced regulatory framework, which sets out principles, objectives, and means, as well as guidelines for integrated management of solid waste (BRASIL, 2010), which are factors that can contribute to minimizing impacts on public health and the environment.

Chapter II, Definitions, article 3, item XVI of the PNRS, defines solid waste as:

> Discarded material, substance, object, or good resulting from human activities in society, whose final destination is proceeded, proposed, or obliged to proceed, in solid or semi-solid states, as well as gases contained in containers and liquids whose particularities make it unfeasible its release into the public sewage system or water bodies, or require solutions that are technically or economically unfeasible given the best available technology (BRASIL, 2010, Chap. II).

Law No. 12,305/2010 classifies solid waste according to origin and hazardousness for application of the proposed regulations, aiming to protect public health and quality of life. Since the enactment of this regulatory framework, much progress has been made in the selective collection and industrial recycling in order to minimize the problems that

1 - In Portuguese, Política Nacional de Resíduos Sólidos.

industrial waste causes. Resolution No. 313 of the National Council for the Environment (CONAMA)[2], which provides for the mandatory National Inventory of Industrial Solid Waste, understands industrial waste as all waste resulting from industrial activities and which is in the solid, semi-solid, gaseous and liquid state (BRASIL, 2002), with a potential to cause pollution and contamination.

According to Vieira, Dias and Hanazaki (2011),

> "Solid waste is in a moment of international media projection. Several scientific means of communication expose the problems related to environmental contamination and its final destination." (VIEIRA; DIAS; HANAZAKI, 2011, p. 22).

However, despite the propagation of the harmful effects caused by the incorrect disposal of urban solid waste in the environment, areas intended for the protection and conservation of biotic attributes (fauna and flora), in which mangroves are inserted, are still unprotected from anthropic actions. Such an issue has perverse effects that aggravate the degradation and extinction of species "in several regions of the country, mangroves are seriously threatened, in an advanced process of eradication" (RAMOS, 2002, p. 100).

Despite a broad regulatory framework concerning environmental protection, the mangrove in All Saints Bay (BTS)[3] , located in the surroundings of the Metropolitan Region of Salvador, Bahia, Brazil, has been suffering an increasingly negative impact. It is an Environmental Protection Area (APA)[4] that includes several marine-coastal environments, including mangrove ecosystems that constantly suffer from the drawbacks of inadequate waste disposal by the local population, industries, and port activities in the region. The harmful consequence for this ecosystem is its transformation into a receptor of pollutants from urban, industrial, and agricultural sources, preventing the maintenance and conservation of biodiversity.

That statement can be proven by the research conducted by Nascimento and Pimentel (2018) in mangrove areas of BTS, where they found solid waste from different origins and from a variety of production chains discarded by the population and by companies, such as plastic and glass bottles, rubber tires, construction materials, iron, fishing tackle, and mostly, plastic from a wide range of sources. The authors emphasize that most environmental problems are hardly seen and, for that reason, go unnoticed in the daily lives of individuals, becoming invisible. Ratifying this idea, Tristão and Nogueira (2011, p. 108) state that photography implies capturing something that we do not perceive in everyday life, but that "[...] allows us to see what is before our eyes, being able to reveal the reality we do not see".

From this context, it is worth highlighting that the PNRS acknowledges Environmental Education (EA)[5] as one of its main instruments. Nascimento and Pimentel (2018)

2 - In Portuguese, Conselho Nacional de Meio Ambiente.
3 - In Portuguese, Baía de Todos os Santos.
4 - In Portuguese, Área de Proteção Ambiental.
5 - In Portuguese, Educação Ambiental.

point out the need to stimulate actions in environmental education, which provides the basis for proper management of solid waste (non-generation, reduction, reuse, recycling, collection, treatment, transport, and correct final disposal of tailings). Actions in EA regarding solid waste sensitize subjects to understand environmental problems and to strive for appropriate behavior since EA is a promoter of relationships and leads to a consequent construction of values that promote awareness of the ecosystem mangroves and natural resources preservation.

"It is through sensitization first that man begins to become aware of his practice concerning the environment in which they live" (ANDREOLI, 2009, p. 8). In this statement, the author continues pointing to that relationship, which makes it possible to review behaviors and practices of pollution and anthropic environmental impacts, awakening to change habits "taking into account that natural resources are depletable and that the main responsible for their degradation is the man." (ANDREOLI, 2009, p. 9). However, for that awakening, we need lenses able to approach and increase the perception of these subjects for such problems. That is the purpose of photography as a methodological and educational resource in socio-environmental actions (SILVEIRA; ALVES, 2008).

In view of the scenario presented, this study aims to reflect, using photographic images, on the problem of urban solid waste production and its disposal in mangrove areas, to diagnose necessary EA actions for the care and conservation of ecosystems.

Area of Study and Methodology

All Saints Bay (BTS), given the paradox established in this place, is a suitable region for sampling the negative impacts caused by the incorrect disposal of waste from different sources in the natural environment. On the one hand, BTS has natural attributes of great scenic beauty typical of marine-coastal ecosystems, including the mangrove environment and relevant social, economic, and cultural aspects that constitute the historical context of Bahia. On the other hand, it has a disordered human occupation and intense industrial, nautical, and tourist activities that, independently or associated, promote the degradation of these environments. The study was held in a traditional community located in the District of Mutá, municipality of Jaguaripe, 101 km off Salvador (Bahia). This municipality is part of All Saints Bay Environmental Protection Area, which is predominantly a mangrove ecosystem — a condition that gave it the title of Bahian Pantanal (NASCIMENTO; PIMENTEL, 2018).

When reflecting on the problem of urban solid waste production and its disposal in mangrove areas, using photographic images, we seek to point out the need for EA actions for the care and conservation of these ecological systems of great importance for the maintenance of biodiversity and environmental stability. In this sense, this study is identified as exploratory research with a qualitative approach, which Gil (2011, p. 27) claims: "constitutes the first stage of broader research"; Furthermore, to approximate, clarify and delimit, they can usually involve reference and documentary surveys, non-standard interviews, and case studies. Based on this premise and a study published by Yin (2010), the case study investigates contemporary phenomena within a real-life context, as

proposed in this study: the inadequate disposal of solid waste in the mangrove ecosystem of All Saints Bay, in the state of Bahia, Brazil.

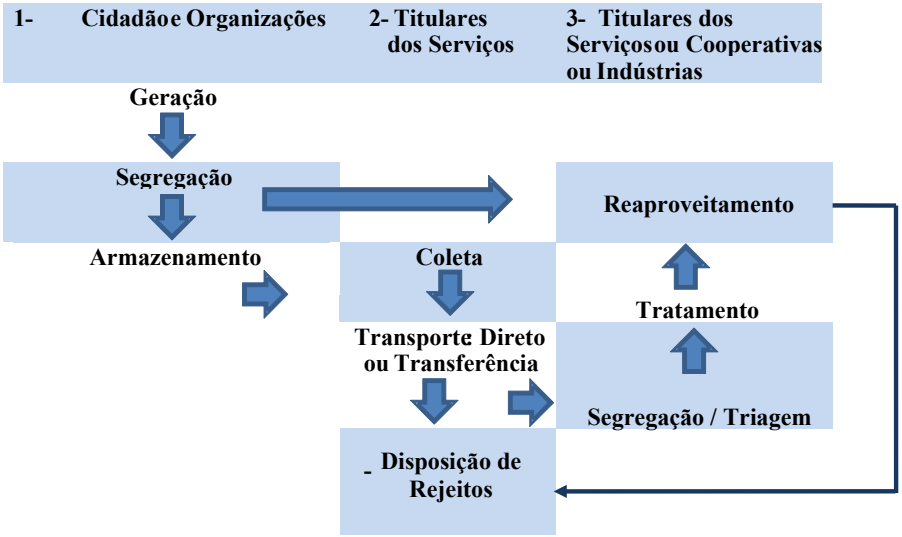
The data collection occurred in two different and complementary moments: the literature review and the empirical research. The literature review resulted from the survey of secondary data obtained from national and international bibliography, focusing on the period between 1995 and 2021. Federal normative instruments referring to the theme, such as versions of sectoral agreements and CONAMA regulations, were also analyzed.

The research followed the phenomenological method, which allows the researcher perception of the phenomenon and its corresponding meaning. This method of analysis and interpretation of occurrences seeks to reveal aspects of the context considering intuition, sensations, and emotions and allows the subject to understand the lived experience and the inherent implications of the situation encountered (ANTHEA, 2015), rescuing the possible meanings attributed by subjects to the object studied (GIL, 2011, p. 15). Therefore, we consider photography a tool to capture aspects of the "experienced experience" intended to raise awareness and awaken interest in the issue of waste in the mangrove. As a result of a photo contest, six out of thirty-five pictures were selected for discussion in the present study, as those gathered elements to raise consciousness and, possibly, transformative behavioral actions.

The Relationship between Solid Waste Management and Environmental Protection

According to the PNRS, solid waste management is a set of actions conducted by the correct handling, carried out directly or indirectly by the service owner, in the stages of segregation, collection, packaging, transport, transshipment, treatment, reuse, and environmentally correct final disposal of tailings (Picture 1).

Picture 1: Responsibility and Solid Waste Management Stages



Source: Brazil (2010). By the authors

This management must be in accordance with the integrated solid waste management of the municipal plan or with the solid waste management plan of public, private, or non-governmental organizations (BRASIL, 2010).

The management concept brought by the PNRS is subject to being applied to states, municipalities, metropolitan regions, and organizations. It is important to highlight that this norm also attributes its observance by the population, as people are responsible for the generation and segregation of household waste. Hence, the responsibility for managing urban solid waste not only falls on the organizations and the State but also affects the users of the services. Everyone is responsible for reduction, generation, correct disposal, segregation, reuse, and co-responsible for improving the sustainability of the place where they live.

The PNRS, art. 30, points to the participation of all when establishing Shared Responsibility for the life cycle of products: a set of attributions in an individualized and chained way, covering manufacturers, importers, distributors and traders, consumers, and holders of public urban cleaning services and solid waste management, to minimize the volume of solid waste and waste generated, as well as to reduce the impacts caused to human health and environmental quality resulting from the life cycle of products (BRASIL, 2010). This Shared Responsibility aims to: a) reconcile interests between economic and social agents and business and market management processes with those of environmental management, developing sustainable strategies; b) promote the use of solid waste, directing it to its production chain or other production chains; c) reduce the generation of solid waste, waste of materials, pollution and environmental damage; d) encourage the use of inputs that are less aggressive to the environment and more sustainable; e) stimulate market development, production, and consumption of products

derived from recycled and recyclable materials; f) enable production activities to achieve efficiency and sustainability; g) encourage good socio-environmental responsibility practices (BRASIL, 2010, Art.30).

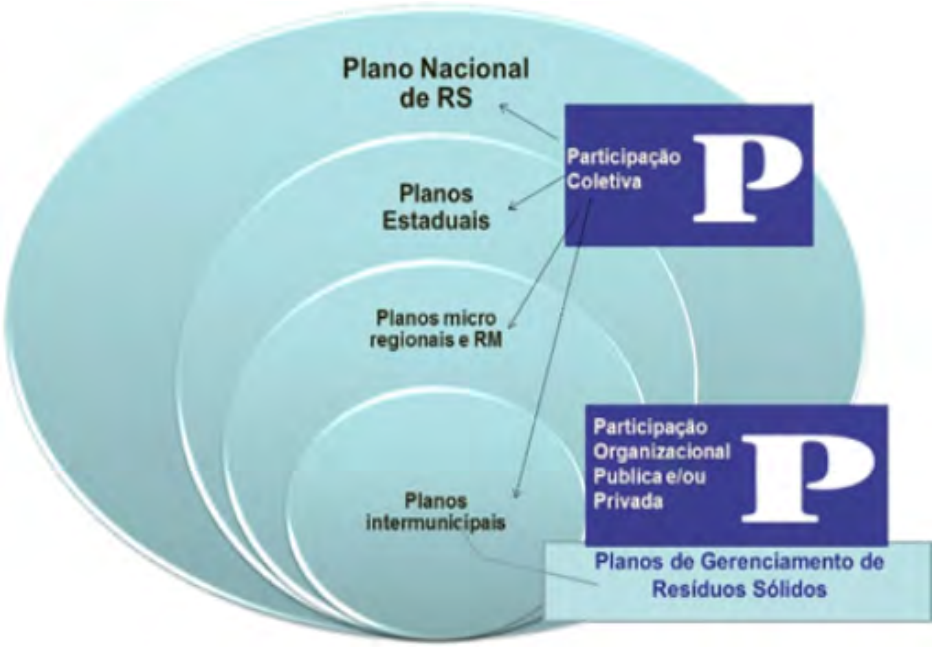
It is undeniable that the holders of public services of urban cleaning and waste management are close to the aggressions suffered in the urban environment brought about by improper disposal, and, in this way, they become more responsible for complying with what the legislation determines. Pereira (2011) points out that the law brings higher duties to the municipalities, as they have the constitutional competence to perform local services, including urban cleaning.

Searching for instruments that support the PNRS, this framework anticipated the development of a National Solid Waste Plan, which has a minimum content for its preparation and validity for an indefinite period in a horizon of 20 years, to be updated every four years. This plan provides guidelines for state and municipal plans. One of the stages of the National Solid Waste Plan is the presentation of the preliminary proposal, in which the contributions from consultations and public hearings must be incorporated for consideration, among others, by the National Council for the Environment, which signals the importance of this plan to contribute to environmental sustainability.

The National Council for the Environment (CONAMA)'s recommendation No. 15, of July 9, 2012, suggests that the Interministerial Committee for the National Solid Waste Policy approve the proposal for the National Solid Waste Plan, with some suggestions, among them the inclusion of a specific chapter for the financing of the plan goals (BRASIL, 2012).

It is possible to infer the need for funding to support proposals that provide for the protection of the environment. Some propositions that even allow the application of sanctions that point to the correct management of waste in the ecosystems are: the creation of Regional, State and Municipal Plans and improving the inspection of institutions that monitor the fulfillment of the plans.

According to Marchi and Silva (2018), the development of the Plans involves several spheres and actors, which must be interconnected (Picture 2)



Sourse: Marchi and Silva (2018, p. 58).

These standards, created to support the responsible management of waste likewise its disposal at appropriate places, can prevent environmental degradation, damage to human health, and protection of mangrove ecosystems (NASCIMENTO; PIMENTEL, 2018).

Another instrument chains that positively interfere in the management of urban solid waste are sectoral agreements, i.e., acts of a contractual nature signed between the government and manufacturers, importers, distributors, or traders, intending to implement shared responsibility in various production (BRASIL, 2010). These agreements aim to ensure the environmentally appropriate final disposal of electronics, general packaging, lubricating oil packaging, and light bulbs, among others. Its configuration is based on an agreement of a contractual nature between the government and manufacturers, importers, distributors, or traders, to implement shared responsibility for the product life cycle.

The tools and objectives included in the PNRS have contributed to minimizing the volume of waste discarded in the environment. It is worth mentioning the responsibility of the consumer, which is not well known or discussed by citizens and does not promote participation and social control with urban solid waste services. Art. 3 of Decree No. 10,936, January 12, 2022, which regulates the PNRS, proclaims that shared responsibility must be implemented in an individualized and chained manner (BRASIL, 2022). The

users' lack of knowledge about the consequences caused by improper disposal, the participation in the management of solid waste, and the society's contribution to implementing public policies in the sector is critical.

From this perspective, attention is drawn to the appreciation of the PNRS on the importance of Environmental Education (EA) and environmental programs and actions. EA can collaborate to raise awareness and correct waste management, as it calls attention to the non-generation, reduction, reuse, and recycling of waste aiming at sustainability and conservation of natural resources (BRASIL, 2010).

As claimed by Andreoli (2009), the contribution and participation of EA actions are essential to raising environmental awareness, in a continuum of the population engagement in the decision-making process, as a way of strengthening their co-responsibility, which may be based on the inspection and control of agents that degrade the environment.

By suggesting EA as a way of sensitizing the various formal and informal social agents, such as NGOs, educational institutions, associations, and the third sector, among others, their participation in the conservation of ecosystems is attributed. The EA instrument, allied to the correct management of waste, can improve the situation of predatory management, boosting citizenship, and awakening the rights and obligations of each individual for environmental public policies.

In accordance with Marchi (2015),

> [...] inadequate sanitation practices encourage environmental deterioration and mobilize the State to implement new technologies, in addition to emphasizing educational actions, aiming to reduce the existing imbalance in the environment and create facilities for the incorporation of new practices, which provide a better quality of life (MARCHI, 2015, p. 92).

The Quest to Preserve the Mangrove Ecosystem

According to Schaeffer-Novelli (1995), the mangrove is a coastal ecosystem with terrestrial and marine environments characteristic of tropical and subtropical regions, subject to the tidal regime. Ramos (2002) warns that mangroves are rich in organic matter and low in oxygen.

Mangrove areas consist of several herbaceous, epiphytic, hemiparasitic, and aquatic species, with a predominance of woody and arboreal vegetation denominated Rhizophora mangle. According to Ramos (2002), BTS forms important predominant mangrove forests classified as white mangrove (Laguncularia racemosa), black mangrove (Avicennia germinans), and red mangrove (Rhizophora mangle).

The mangrove ecosystem is one of the most important and productive on the planet. Unlike other forests, it is not species-rich but shares its space with several distinct populations. These characteristics explain the nickname "animal nursery" for housing endemic species (residents), semi-residents, and visitors, species that occupy the water,

vegetation, and soil of this habitat (SOFFIATI, 2006).

Furthermore, these coastal regions constitute "ideal areas for feeding, reproduction, and protection of several animal species, which are attracted by one of the most efficient systems for turning organic matter into nutrients for the environment" (SOUZA et al., 2018, p. 17). The aspects mentioned in this environment of species of fauna and flora provide relevant importance for coastal communities in their livelihood, developing culture and customs, and, for the planet, in the battle against global warming. It is possible because mangroves and tropical forests are (together) one of the most efficient ecosystems in the war against global warming due to their enormous capacity to sequester carbon, being a natural sink (SOUZA et al., 2018, p. 20).

In accordance with Schaeffer-Novelli (1995), Ramos (2002), and Soffiati (2006), mangroves offer numerous attributions and functions as natural resources for economic extraction, mainly in fishing (source of subsistence for coastal populations), as a biological filter, in the nesting and nursery of species, in carbon sequestration, in the protection of the coastline against erosion, in the production of food for several species, including the man.

In view of the extreme relevance of the mangrove ecosystem to the planet and its economic, social, and cultural importance for coastal communities, the need for EA policies is evident in the expectation of changes to contribute to the conservation of ecosystems and local biodiversity. Accordant with Dias (2004), Environmental Education is a permanent process by which individuals and communities acquire new values and experiences, enabling them to act and resolve present and future problems.

Current and future problems regarding environmental impacts brought about by the inadequate management of solid waste are also of concern to the National Solid Waste Plan. This plan has several instruments for its development. In public consultations, many diagnostic notebooks are made available; among them is the one related to Environmental Education. Amongst the topics discussed is the importance of Education for Consumption within the PNRS, which discusses responsible consumption as,

> [...] the developing process of an educational practice aimed at reflecting on the causes, consequences, implications, and potential of acts (and habits) of consumption is increasingly assuming its own identity, which is the result of a maturation process of a pedagogical proposal that today we can name environmental education for consumption (BRASIL, 2012, p. 48).

Silva (2011) questions whether EA can somehow circulate knowledge and information that produces environmental responsibility for the population. This author believes that

> [...] the qualification discourse of consumption represents a change in the image of consumption in general since, for the subject framed in society as a consumer, there would be the possibility of a choice between products (qualified or not by the environmental discourse). Today, the identification of the consumer as a citizen would depend

> on this choice – and it is in this sense that "education" works out (SILVA, 2011, p. 565).

Thus, responsible consumption is related to the environmental discourse developed and propagated by education, allowing the subject to intervene between the desire for consumption and environment-related conflicts. It is worth noting that the focus of Environmental Education is not limited to raising awareness but promoting continuous learning to change and improve the quality of their habitat

EA, in its various possibilities, makes room for rethinking social practices, such as conscious consumption, and developing the necessary knowledge for individuals to acquire an adequate basis of essential understanding for global and local environment preservation (ANDREOLI, 2009). Therefore, Environmental Education for planetary sustainability is a process of "permanent learning, based on the respect for all forms of life and that affirms values and actions that contribute to socio-environmental transformations" (TOZONI-REIS, 2006, p. 86).

Given the relevance of the ecosystem services provided by the mangrove ecosystem, the conservation of such ecosystems and their biodiversity is paramount, particularly when considering their importance for the environmental, economic, social, and cultural sustainability of peoples and the planet. Faced with so many threats, EA guidelines for the development and promotion of care and preservation in mangrove areas become essential,

Sato and Santos (2003) emphasize that the valuation of ecosystems, especially mangroves through EA, can stimulate the search for actions that favor preservation and improve the quality of life. In contrast, almost two decades after the statement by Sato and Santos (2003), environmental problems in mangroves persist.

Talamoni et al. (2018) warn that seven editions of the Environmental Education National Meeting in Mangrove Areas (ENEAM)[6] have already been held. The VII ENEAM was held in May 2007, on Itaparica Island (BA), located in All Saints Bay. At that time, the Brazilian Association for Environmental Education in Mangrove Areas (EDUMANGUE)[7] was founded. The creators of this network regret the discontinuity of such a project, although they consider it very important for the population and conservation of mangroves.

Bento et al. (2018) discuss Environmental Education publications linked to the mangrove ecosystem. The authors clarify that there are few publications available for this ecosystem, usually booklets that bring individual activities, citing:

> 1) "Experience in the Mangrove: Activity Handbook for Teachers"— developed by Pires & Carriéri-Bruno (2003), through the Education Department of the Municipality of Praia Grande Beach Resort[8] , comprising 24 activities (word searches, crosswords, etc.); and 2) "Gú & Gui e o Caranguejo-Uçá"— by Pinheiro (2006), which shows

6 - In Portuguese, Encontro Nacional de EA em Áreas de Manguezal.

7 - In Portuguese, Associação Brasileira para Educação Ambiental em Áreas de Manguezal.

8 - In Portuguese, Secretaria de Educação da Prefeitura Municipal da Estância Balneária de Praia Grande.

> a comic book and nine activities (connect dots, origami, coloring pages, among others), about the mangrove ecosystem and its biota (BENTO et al., 2018, p. 101).

Thus, it is clear that despite all the importance mangroves have, discussions on ways to conduct EA in this ecosystem are still far from analyzes and publications in the academic field.

(Re)discovering the Mangrove Environment through Photography

Bento et al. (2018) postulate that awareness-raising activities on Environmental Education should be applied in the initial phase of the activities, aiming to facilitate the contact of participants with the ecosystem. This sort of activity aims to show participants the interrelationship between living beings belonging to the ecosystem in focus, as well as the consequences of anthropic impacts.

Sato (1997, p. 86) indicates that environmental education — from the perspective of imagination and invention — "must articulate different axes, demanding a multipurpose competence capable of destroying the Cartesian model " and establishing a new paradigm that takes the citizen's perspectives to their habitat understanding, guiding them to a behavior that favors the emphasis on protection and conservation.

Buchanan; Pressick-Kilborn and Maher's study (2019) discusses formal and informal learning transformative practices related to environmental education in elementary school. Despite some limitations, the authors consider digital technologies as innovative tools that arouse interest, favor project-based learning, and provide opportunities for virtual interaction with nature or its representations. Despite encouraging their use in pedagogical projects, they warn that existing and emerging technologies can serve as bridges or barriers to the training of environmentally responsible youth. Photography is one of the digital technologies focused on by the authors.

The seriousness of the complex environmental situation in the contemporary world requires, according to Justo (2003, p. 181), "discussing the potential of photography for educational work, exercising a more attentive look at what surrounds us." Photography drives the individual, through his sight, to more accurate observation and reproduces reality with different interpretations and perspectives. This statement implies capturing something we do not perceive in everyday life but allows us to see what is before our eyes, which may reveal something concrete that we do not see (TRISTÃO; NOGUEIRA, 2011, p. 108).

Borges et al. (2010) analyze nature photography as a tool for environmental education. The authors state that the sense of sight is one of the most evolved in human beings, as it allows learning about the outer world, besides receiving impulses that generate optical images and, consequently, the visual sensation itself. The authors warn that there is, in general, a lack of resources for the effectiveness of EA in schools and claim that it is photography,

> [...] an excellent option, as with the beauty of its components, raises awareness and teaches through self-contained information or that we can extract from its content. [...] Photography is an instrument of relevant pedagogical importance and is often essential for different teaching areas. As a non-verbal language contributes decisively to the realization of theoretical research, artistic-cultural manifestations and is efficient support in numerous scientific-technological discoveries. (BORGES et al., 2010, p. 150-151).

These researchers describe how nature photographs provoke emotions in observers and exemplify the delicacy and curiosity that photos generate, such as the visualization of a picture of "an Icterus jamacaii[9] holding a feather in one of its paw" (BORGES et al., 2010, p. 151). It causes different perceptions in individuals, recollecting what has already happened or bringing new perspectives and feelings.

Photography is not only a means of information and visual documentation - as it usually occurs with the use of such a language - but also provides an opportunity to apply these images as a way of changing behaviors and attitudes concerning environmental and ecological problems (BORGES et al., 2010, p. 152).

Ardoin et al. (2014) revealed in their study that pedagogical support tools, such as photography, captured aspects of the experience carried out in field research in environmental education programs and aroused or further supported students' interest in the environment and the natural world. In that regard,

> [...] the belief that because of their reflective nature embodied and oriented towards the participant, digital photography and journaling can be efficient assessment tools that would provide subtle indicators of interest development in environmental education-based settings. (ARDOIN et al. 2014).

Borges et al. (2010) postulate that, in literature, Environmental Education projects that use photographs are rare. Thus, it is inferred that the EA approach, using photography, can be characterized as a mechanism that arouses feelings of curiosity, action, and awareness through images and causes in the subject, perceptions, and narratives about their reality. That is because photography makes it possible to diagnose the environment in which one is inserted, through captured images, with inter and intratextual movement, as well as stimulating our senses of learning, creation, and protection with new points of view (SATO; PASSOS, 2009).

When photography is used in the EA process, diagnosing the lived environment, it presents an investigative methodology named "Photodiagnosis." In this article, Photodiagnosis is considered as a methodological tool that allows another view of environmental issues with the perspective of raising awareness and, possibly, creating actions of behavioral change for the conservation of ecosystems and natural resources.

9 - In Portuguese, Currupião

The ideas exposed above remind us of the importance of "seeing" the mangrove ecosystem also through "illustrations" created by a vehicle considered, in modern times, as fundamental for communication: the cell phone. This process of capturing the "real and tangible" world can act as a foundation for the promotion of diagnoses within the scope of EA. Through this diagnosis, with photography or photodiagnosis, the subject can awake to what has been happening with solid waste improperly discarded in mangroves, which negatively impacts the ecosystem. Although there are adequate regulations and sectoral agreements already signed between the Ministry of the Environment and Brazilian production chains, a large amount of waste still impacts the mangrove areas, as is the case, among others, of plastic materials, tires, and remains from construction and demolition (RCD)[10]

Technology and art can be used as a methodological resource aimed at Environmental Education and, through photography, awaken perceptions and reflections on environmental problems. Photography in the educational process can make the perception of the captured image express much more than just its aesthetics. Photography allows leading the subject to new languages, including the political dimension of the represented phenomena (SILVEIRA; ALVES, 2008).

The photographic records presented below fully highlighted the impact caused by the disposal of solid waste in the mangrove ecosystem of Mutá (Bahia, Brazil) in 2016. Plastic material waste, the remains of packaging bags, and PET bottles hinder the passage of crustaceans and mollusks to their burrows. When trying to clear the way, they are exposed to plastic waste, which causes entanglement or suffocation of crabs, and oysters, among others, leading to death (Picture 3).

Picture 3: Plastic waste from the production chain poses risks to the District of Mutá Mangrove, Jaguaripe – BTS

Sourse: Authors' collection, 2016.

Another grave consequence occurs when plastic fragments are entangled in the aerial roots of the mangrove (pneumatophores), hindering plants from breathing, suffocating them, and even leading to the extinction of the entire mangrove. It is crucial

10 - In Portuguese, Resíduos da Construção e Demolição.

to highlight that the problem persists despite the signing of the Sector Agreement for the Implementation of the Reverse Logistics System for General Packaging in November 2015 by representatives of the sector and the federal government. This agreement aims to ensure the proper final destination of packaging, which can be made up of various elements such as paper and cardboard, plastic, aluminum, steel, and glass (BRASIL, 2015). All these materials improperly discarded in mangroves cause pollution and destruction of fauna and flora.

As emphasized by Borges et al. (2010), photography raises questions and promotes solutions in the search for results. The photos highlighted above may spark curiosity about an environmental education program, encouraging the observer to reflect on the reasons for the behavior of "littering" near mangrove areas and how this dirty matter influences the dynamics of nature. After that, rethink behaviors, and seek further information as well as the means (knowledge, behavior, and attitudes) and techniques to avoid environmental damage, particularly to the fauna and flora of such an ecosystem.

Other problems in mangroves are caused by the automotive production chain, which consists of two segments: car manufacturers and auto parts. Tires are produced by companies that are part of the auto parts segment, and the disposal of this material is regulated by CONAMA Resolution No. 416 of September 30, 2009, which features the liability of importing companies and national manufacturers regarding worn-out tires and their aggressive effects on the environment (BRASIL, 2009). Visual pollution and degradation of marine flora and fauna, breeding grounds for disease-transmitting insects, negative impact on the soil, and obstruction of tidal waves, which bring crucial nutrients to the ecosystem balance, are some of the damages caused by improper disposal of tires in the mangrove (Picture 4).

Picture 4: Waste from the automotive production chain poses risks to the of the District of Mutá Mangrove areas, Jaguaripe – BTS

Source: Authors' collection, 2016.

It is worth noting that this type of waste is also commonly found in rivers and beaches of BTS. This fact represents a serious risk because it is a material with a long period of decomposition, besides containing highly toxic substances, degrading the quality of soil, air, and water.

The ability to unravel a situation as "it is indeed" makes photography a valuable tool for socio-environmental training and scientific research. ARDOIN et al. (2014) postulate that photography used in field research in environmental education awakens greater understanding among those involved and emphasizes social aspects of learning, particularly those that occur in informal circumstances.

In this perspective, photographic images facilitate understanding the implications of reckless disposal of tires on beaches. The records of such aggression on beaches, places commonly associated with leisure and sociability, can cause a stronger feeling of loss of connection among people and well-being with nature, which facilitates the formation of subjects committed to the socio-environmental educational process.

As customary as they are impactful, waste from the construction sector causes irreversible damage to the mangrove environment, especially in terms of soil quality, since large volumes of rubbish are dumped into nature without any treatment. The consequences of the inadequate action of waste disposal on the coast of Bahia are countless and perhaps immeasurable. According to Marques Neto (2005), the productive sector of civil construction is responsible for 50 to 70% of urban solid waste generation and uses 75% of the natural resources from the planet, causing a huge environmental impact, mainly in urban centers, where 85% of the Brazilian population. The coastal area of BTS faces the same problem as hundreds of cubic meters of civil construction debris impact the mangrove (Picture 5).

Picture 5: Waste from the civil construction sector impacts the Mangrove area of BTS

Source: Authors' collection, 2016.

Civil construction residues cause fillings in mangroves and the disappearance of large extensions in these areas, provoking the extinction of fauna and compromising the soil, rich in organic matter. Another commonplace fact (seen in Picture 5) is the combination of debris with improperly discarded fishing material. The latter, entangled with debris, harm all groups of vertebrate or invertebrate animals that are affected by enmeshment or ingestion of fishing net lines, among others, causing mutilation and death of species that live in or use the mangrove environment.

Facing the problem of civil construction waste disposal demands a broader view of sanitation, environmental and urban development policies, and regulations. The critical analysis of experiences recorded in images of attitudes and practices frequent in the improper disposal of remains of "construction works" in cities and nature reveals the concerning damage to daily life and ecosystems.

A large part of this type of waste is not reintegrated into the cycles of nature and the revelation of these photographs, as a methodology for education, enhances projects that form conscious subjects in their relationship with the place, customs, and environmental issues.

> Photography enters not only as a means of information and visual documentation - as is usually the case with this language, but also provides an opportunity to apply these images as a path of changing behaviors and attitudes concerning environmental and ecological problems (BORGES et al., 2010, p. 152).

To achieve a better relationship between man and mangrove ecosystems must start by understanding the consequences of inappropriate disposal of solid waste to marine species and the inhabitants of surrounding areas; such understanding can be made possible through images. The study by Gonzalez, Rocha, and Rego (2017) supports the ecological importance and biodiversity relevance of mangrove ecosystems. The authors proclaim that even the inhabitants of nearby areas are often unaware of this value. They emphasize alternative educational mechanisms, such as using photographs, represent an expansion of knowledge about the harmful effects of the interaction between the physical environment and living beings, stimulating the conservation of the remnants of the marine-coastal environment. In the authors' opinion,

> The use of photography is not only a means of information and visual documentation but also provides opportunities for the application of these images as a path to changing behaviors and attitudes concerning environmental and ecological problems (GONZALEZ; ROCHA; REGO, 2017, p. 3).

Thus, photographs can become an important mechanism to dialogue with environmental issues and enable significant behavioral changes.

Final considerations

The analysis of the inadequate solid waste disposal issue in mangrove ecosystems has direct repercussions on the environmental, social, economic, and cultural sustainability of these environments and how policies and norms that regulate this theme point to the need to implement innovative practices of Environmental education. Those practices, such as the ones using images reproduced employing photographic cameras, allow subjects to have an approximate and expanded look at every day and almost always an invisible question, envisioning other ways of intervening in the environment.

The experience through the stimulus, development of perception (senses), or the re-signification of how to see things through the photograph, in addition to allowing reflection on the impact of the solid waste issue in mangroves, can facilitate introspection and, consequently, the change of harmful practices to ecosystems, besides serving as a methodological procedure for diagnoses in these environments.

The concept here denominated photodiagnosis is considered an expository, powerful, and vital tool to assess, investigate, and discuss environmental impacts in mangroves or any other Brazilian ecosystems threatened by anthropic actions.

The provocation objectified in this study, to reflect, using photographic images, upon the production and disposal of the solid waste issue for the care and conservation of mangroves, allowed a multidimensional reflection of the themes, not summarized nor restricted to a mere analysis of environmental education and awareness of the proper disposal of solid waste. It is a stimulus to similar studies that may result in innovative methodologies with relevant findings for the environmental area.

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SciELO

OS RESÍDUOS SÓLIDOS NO CONTEXTO DA EDUCAÇÃO AMBIENTAL, DO ECOSSISTEMA MANGUEZAL E DA FOTOGRAFIA

Cristina Maria Dacach Fernandez Marchi
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Resumo: Apesar dos ecossistemas de manguezais serem amparados por diversas legislações ambientais, ainda sofrem com os impactos do descarte inadequado dos resíduos sólidos. Este estudo tem como objetivo refletir, utilizando imagens fotográficas, acerca da problemática da produção de resíduos sólidos urbanos e do seu descarte em áreas de manguezais, tendo em vista diagnosticar ações necessárias de Educação Ambiental para o cuidado e a conservação de ecossistemas. A pesquisa transcorreu segundo o método fenomenológico, que busca desvelar aspectos mais profundos do contexto e que possibilitou aos pesquisadores terem uma melhor compreensão sobre a experiência vivenciada. A técnica utilizada para tal foi a captura de imagens. Os conceitos pesquisados contribuíram para a discussão sobre impactos negativos provocados pelo descarte de alguns tipos de resíduos ocorridos no manguezal. Conclui-se que a fotografia, como meio de diagnóstico, possibilitou outro olhar para as questões ambientais.

Palavras-chave: Lei nº 12.305/2010; Gerenciamento de Resíduos Sólidos; Ecossistema de Manguezal; Educação Ambiental; Fotografia.

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LOS RESIDUOS SÓLIDOS EN EL CONTEXTO DE LA EDUCACIÓN AMBIENTAL, DEL ECOSISTEMA MANGLARES Y DE LA FOTOGRAFÍA

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Resumen: Los ecosistemas de manglares están respaldados por diversas legislaciones ambientales, pero sufren por la eliminación inadecuada de desechos sólidos. Este estudio tiene como objetivo reflexionar, a través de imágenes fotográficas, sobre la problemática de la producción de residuos sólidos urbanos y su disposición en áreas de manglares, con miras a diagnosticar acciones de Educación Ambiental necesarias para el cuidado y conservación de los ecosistemas. La investigación se llevó a cabo de acuerdo con el método fenomenológico, que busca revelar aspectos más profundos del contexto y permitió a los investigadores tener una mejor comprensión de la experiencia vivida. La técnica utilizada fue la captura de imágenes. Los conceptos estudiados contribuyeron a la discusión de los impactos negativos causados en el manglar por la disposición de algunos tipos de desechos. Se concluye que la fotografía, como medio de diagnóstico, permitió otra mirada a la problemática ambiental.

Palabras-clave: Ley 12.305 / 2010; Gestión de Residuos Sólidos; Ecosistema de Manglares; Educación Ambiental; Fotografia.

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