ENVIRONMENTAL IMPACT ASSESSMENT OF UAKARI FLOATING LODGE USING INTERACTION MATRIXES.

AVALIAÇÃO DE IMPACTO AMBIENTAL DA POUSADA FLUTUANTE UACARI UTILIZANDO MATRIZES DE INTERAÇÃO.

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KEY WORDS:

Uakari Floating Lodge;

Environmental Impact Assessment;

Environmental Aspect;

Interaction Matrix;

Leopold Matrix.

ABSTRACT

Tourism impacts the environment. Therefore, the knowledge of mechanisms that allow doing an Environmental Impact Assessment (EIA) is critical. Among other methods we emphasize the Leopold Matrix, a kind of interaction matrix that allows clear visualization of the potential impact of a venture or project. This article aims to show the potential environmental impact of Uakari Floating Lodge, through an adaptation of the Leopold Matrix, evaluating the Magnitude and Importance of their environmental impacts. We found 28 environmental aspects in Uakari Lodge, being "generation of domestic wastewater" and "accumulation of used batteries" the most significant internal aspects, and "utilization of lubricating oil and fuel in motor boats rides" and "generation of gases from fuel combustion in boat rides" the most significant external aspects. All of them were identified as environmental aspects with potential for Direct (84.6%), Reversible (76.9%), Insignificant (46.2%) or Moderated (53.8%), and Local (100%) impacts. The results indicate the environmental aspects raised have low impact to the natural environment, considering the enterprise scale. However, we should find ways to mitigate their effects, once the Uakari Floating Lodge is located in a Protected area (Area).

PALAVRAS - CHAVE:

Pousada Flutuante Uacari;

Avaliação de Impacto Ambiental;

Aspecto Ambiental;

Matriz de Interação;

Matriz de Leopold.

RESUMO

O turismo é impactante ao ambiente. Por isso, é fundamental o conhecimento de mecanismos que permitem realizar uma Avaliação de Impacto Ambiental (AIA). Entre outros métodos, destaca-se a Matriz de Leopold, um tipo de matriz de interação que permite visualizar de forma clara o potencial de impacto de empreendimento/projeto em estudo. Este artigo teve por objetivo demonstrar o potencial de impacto ambiental da Pousada Flutuante Uacari, através da adaptação da Matriz de Leopold, com valoração de Magnitude e Importância de seus aspectos ambientais. No total, foram levantados 27 aspectos ambientais, sendo "geração de efluentes domésticos" e "acúmulo de baterias e pilhas usadas" os aspectos internos mais significativos, e "Utilização de óleos lubrificantes e combustível nos motores dos botes de passeio" e "geração de gases provenientes queima de combustíveis nos botes de passeio" os aspectos externos mais importantes. Todos eles foram identificados como aspectos ambientais com potencial de impacto Direto (84.6%), Reversíveis (76.9%), Insignificantes (46.2%) ou Moderados (53.8%), e Local (100%). Os resultados apontam que os aspectos ambientais levantados são pouco impactantes ao ambiente natural, visto a escala do empreendimento. Entretanto, deve-se buscar meios para mitigar seus efeitos, uma vez que a Pousada Uacari está localizada em uma Unidade de Conservação.

INTRODUCTION

Tourism, as any other economic activity, impacts the environment. The high consumption of fuels, electricity, food and water, the generation of solid waste and the emission of pollutants confirm tourism as an activity of potential environmental impact (PIRES, 2010).

The bibliography that approaches the environmental impacts involved in tourism is quite strong. In the survey carried out by Carr and Higham (2001) hundreds of studies can be found in this scope. Booth and Mackay (2007) present about 80 articles related to the environmental impacts of tourism. In the bibliographical surveys carried out by Twynam (1998), Sun and Walsh (1998); Baysan (2001); Pires et al., (2009); Buckley (1999) and Browns (2004) interesting reference about tourism and its impacts can be found.

Among the most common negative environmental impacts observed are:

- Relocation of population due to the disordered development of tourism, social conflict between locals and tourists during high season, increased competition in the local economy since tourism employs workers of other economic activities such as agriculture and fishing;
- Loss or degradation of habitat and natural landscapes, historical locations and monuments of cultural interest.
- Loss or imbalance of fauna and flora biodiversity, including areas of ecological interest.
- Reduction or shortage of quality water from public supplies to meet the demands of turistic enterprises.
- Sanitary problems due to the production of solid waste and the problematic of its disposal, and also the generation of residuary water (effluents), especially in protected areas.
- Increase of air and noise pollution due to crowded touristic facilities; increase of air and land traffic (emission of harmful atmospheric gases);
- Increased probability of fire occurrences caused by disorganized touristic activities; and
- Overload of services and infrastructure caused by an elevated number of tourists (ROWE, 2002; WOOD, 2002; KUSLER, 2006; BLACKSMITH, 2009).

As observed, tourism related impacts are numerous and pose as a threat to the natural environment when not controlled. Therefore, the creation of mechanisms capable of estimating the potential environmental impact caused by touristic activities becomes very important.

In this scope, the Environmental Impact Assessment (EIA) poses as a widely spread tool, potentially efficient in the prevention of environmental damage and in the promotion of sustainable development (SÁNCHEZ, 2006), with possible applications in tourism. The EIA is defined by RAMSAR CONVENTION SECRETARIAT (2007) as "a process of evaluation of the possible environmental impacts of a project or activity, considering socioeconomic, cultural and public health related impacts, whether they are advantageous or adverse".

The EIA presents many benefits: higher protection for human health, sustainable use of natural

resources, reductions in cost and wasting of resources, reduction in risk of environmental disasters, improvement of the responsibility of leaderships, better project localizations, greater responsibility and transparency during the development process, better integration of projects in both social and environmental areas, reduction of environmental damages, more efficient projects in terms of understanding their financial and socioeconomic objectives, contribution to reach sustainability (ABAZA et al., 2004; CANADIAN ENVIRONMENTAL ASSESSMENT AGENCY, 2011).

There are several methods of assessing environmental impact. Authors Lohani (1997), Keys et al. (2005), There Rovere (2001), Sanches (2006), and Almeida and Lins (2009) present the following:

- Spontaneous methodologies (Ad hoc), which are based on the empirical knowledge of a specific area;
- Check-list, which consists in the identification and enumeration of impacts based on a diagnose, carried out by specialists in physics, biotics and socioeconomic fields;
- Interaction matrixes, which are bidimensional techniques that relate action with environmental factors, consisting basically of identification methods;
- Interaction networks, which establish a sequence of environmental impacts based on a determined intervention, using a graphical method. It has the objective of relating enterprise activities with the consequent impacts;
- Quantitative methodologies, which associate costs to the qualitative considerations that might be formulated in the impact assessment of a project. This method uses indicators of environmental quality expressed by graphics relating the conditions of certain environmental aspects to a condition of quality;
- Simulation models, which are mathematical models that represent the behavior of environmental parameters or the relations and interactions between causes and effects of determined actions;
- Overlay mapping, which consists in the production of thematic letters of environmental aspect, and once overlayed the maps can guide the studies and synthesize the environmental situation of a geographic area.

Among the presented methods, the interaction matrix is more easily interpreted, allowing greater understanding of the results. It presents qualitative and quantitative data at the same time, and supplies clear orientation on the environmental situation of a determined activity.

The Matrix of Leopold used in this paper provides a format for a comprehensive analysis to venture the investigator of the variety of interactions that can be involved in an activity, assisting in the identification of alternatives that can reduce impacts (LEOPOLD, 1971; HOWELLS; EDWARDS-JONES; MORGAN, 1998; DARBRA et al., 2005).

The intention of this article is to demonstrate the potential impacts to the natural environment in which the Uakari Floating Lodge (UFL) is located, by collecting and crossing its aspects and associated environmental impacts using the interaction matrix.

METHODOLOGY

Bibliographical material approaching tourism related environmental impacts, EIA methodologies and others have been consulted.

The object of study in this research is the Uakari Floating Lodge, located in the Mamirauá Sustainable Development Reserve (MSDR), considered to be Brazil's biggest protected area in flooded areas, and the only one completely inserted in an amazonian várzea flooded forest ecosystem (INSTITUTE..., 2010, p. 30). The activities in the Uakari Lodge are founded by Brazilian government's Community Based Tourism program, generating socioeconomical benefits for the MSDR inhabitants, distributing the generated revenue between the service providing communities. Moreover, it contributes for the conservation of natural resources, with minimum impact activities, considering that it is located in a preservation area (BORGES PEDRO, 2011).

To reach the proposed objective, matrixes were created based on the Leopold Matrix (LEOPOLD, 1971). As explained by Chaves (2005), the principle of this method consists in labeling all possible interactions between activities (environmental aspects) and environmental factors, and then establishing a scale (from 1 to 10) to measure the magnitude and the importance of each impact, and to identify it as positive or negative.

In this paper, Magnitude is comprehended as presented by Leopold (1971), who defines it as "the gravity, extension, or scale of an impact", in more general, wide and theoretical terms. For Importance the definition by the same author has been adopted, as being "the balance of the degree of importance of a particular activity on the environmental factor in a specific situation of analysis".

The values labeled in the matrixes represent the impacts of the studied object (in this case, ecotourism), provoked by the activities and/or actions that are taken into consideration during the analysis (PIRES, 2009). The environmental characteristics marked in grey are considered to be more significant, in accordance with PIACA I. The environmental aspects in grey were considered more significant in accordance with PICCA I. The highlighted cells represent a possibility of interaction between the environmental characteristics and aspects. The weights established in the tables concern the magnitude and importance of each environmental aspect, defined through local observations and interviews with local enterprise managers. (Figure 1).

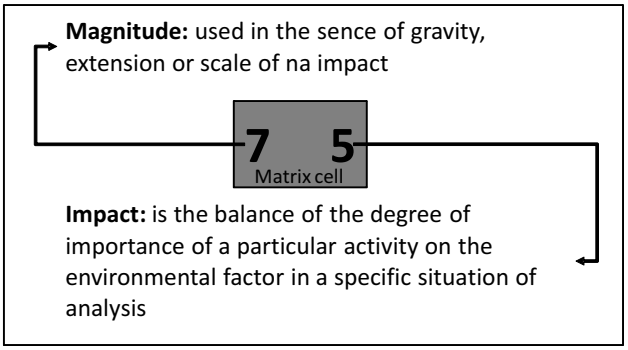

Figure 1 - Magnitude and Importance in the cells of the impact matrixes.

Before establishing assessment grades, it was necessary to select the most relevant environmental aspects. To achieve that, the average of internal and external interactions percentage was calculated and those which presented an above average value were selected.

The matrixes weights were established by 17 specialists who evaluated the environmental aspects and its impact potential in the different environmental characteristics considered to be more relevant, as follows: Two researchers evaluated "Water Quality of the Hydric Body", five researchers evaluated the "Native Fauna", four evaluated the "Landscape Resources", three evaluated "Health and Security", and three the "Air Quality" (Table 1). The final weight shown in the matrix represents the average balances made by the collaborating researchers.

In this paper only the environmental impacts of adverse nature were studied.

Table 1 - Specialties of the evaluating researchers in significant environmental characteristics.

Evaluated environmental characteristics	Specialty of the evaluating researchers
Water quality in the hydric body	Environmental Engineering
Native fauna	Zoology Ecology Biological Sciences
Landscape resources	Ecotourism and Environmental Management Biological Sciences
Health and Security	Environmental Engineering Biological Sciences Sociology Parasitology
Air quality	Civil and Electric Engineering Ecology Biological Sciences

RESULTS

Information regarding the internal environmental aspects of the Uakari Floating Lodge are presented in Table 2. In total, twenty-one aspects were collected and classified into 8 categories: A - effluent, B - solid waste, C - noise, D - oil and greases, E - chemical products, F - generation of energy, G - consumable water, and H - harmful synanthropic fauna.

In regards to internal and external aspects, there are 10 environmental characteristics with potential risks of being affected in any way by the following aspects: a. water quality in the hydric body; b. outflow of the water body; c. hydric availability; d. quality of the air; e. ground permeability; f. ground quality; g. native fauna; h; terrestrial flora; i. landscape resources; j. health and security.

The environmental characteristics affected by a bigger number of environmental aspects are: a. water quality in the hydric body, g. native fauna, i. landscape resources and j. health and security, presenting the index of Interaction Percentage of Aspects with Internal Environmental Characteristics (PIACA I) of 51%, 76%, 70% and 76%, respectively. The last three are affected by all categories of aspects. Although these are the mostly compromised characteristics, they are directly related to *water quality in the hydric body*, that presents a smaller index.

Amongst the environmental characteristics that present the smallest PIACA I levels are b. outflow of the water body (10%), c. hydric availability (14%), and e. ground permeability (10%). These characteristics are little influenced by the activities of the lodge, and therefore they do not demand action of short term mitigation of impacts. The

same applies to the characteristics related to the ground (e. and *f. characteristics*), for they are not expressive when compared to the others.

Among all environmental aspects mentioned, ten present high Percentage of Interaction of Environmental Characteristics with Internal Aspects (PICAA I), this means they interact with a higher number of environmental characteristics. Among them, the following stand out: 1. generation of domestic effluents, 2. Sludge production in the septic tank, 5. generation of recyclable solid waste, and 6. generation of organic solid waste, with PICAA I of 60%, 70%, 70% and 60%, respectively.

Of the less significant aspects, 21 present PICAA below its general average. Among them, 5 have PICCAI of 20% (aspects 3, 4, 9, 18 and 21). The smaller rate is related to aspect 17. Inadequate electric installations, with PICCA I of 10%. For the selection of more impacting aspects, this last item can be disregarded.

The matrix of External Environmental Aspects of the Uakari Lodge is shown in Table 3. In the survey, 7 environmental aspects were identified and classified in three categories. Amongst these aspects, three of them present significant Percentage of Interaction of Environmental Characteristics with External Aspects (PICCA E): 22. use of lubricant oils and fuel in the boats engines, 22. generation of gases proceeding from the fuel burning in the boats, and 25. tourist hikes, with PICCA E rates of 40%, 40% and 60% respectively.

The four environmental characteristics mostly affected by different aspects are: a. water quality in the hydric body, d. quality of the air, g. native fauna, and i. landscape resources, with rates of Percentage of Interaction of Aspects with External Environmental Characteristics (PIACA E) in 43%, 57%, 100% and 86%, respectively. Amongst these, two characteristics stand out: "g", which is potentially affected by all external aspects, and "i", which comprehends all categories. These characteristics are also expressive in the internal aspects, and therefore deserve special attention.

Characteristics b. outflow of the water body and c. hydric availability are not impacted by any of the external environmental aspects (PIACA I = 0% for both). Thus, the necessity of further evaluation is disregarded.

Comparing the more significant environmental aspects, ten of them are from internal environment, and only three from external environment. That means the majority of environmental aspects of the Uakari Lodge is regarding its own infrastructure and/or activities.

Table 4 was generated from the selection of the significant internal aspects, which means only those that presented a PICCA I rate higher than the general average (37.1%). After the selection, were established weights of magnitude and importance for the internal aspects in accordance with the potentially affected environmental characteristic.

In the process of selection of aspects, categories "C - Noise" and "H - Harmful Synanthropic Fauna" were eliminated for not presenting aspects with PICCA I rates higher than the average, showing its impacts demand minor attention.

Table 2 - Matrix of internal environmental aspects regarding the structure of the UaKari Lodge.

CATEGORY OF INTERNAL ENVIRONMENTAL ASPECTS	Environmental characteristics / Environmental aspects	a. Water quality in the hydric body	b. Outflow of the water body	c. Hydric availability	d. Quality of the air	e. Ground permeability	f. Ground quality	g. Native fauna	h. Terrestrial flora	i. Landscape resources	j. Health and Security	PICAA I - Percentage of Interaction of Environmental Characteristics with Internal Aspects (%)
A - Effluents	1. Generation of domestic effluents	■	■	■				■		■	■	60
	2. Sludge production in the septic tank	■				■	■	■	■	■	■	70
	3. Odors of the Sewage System				■					■		20
	4. Generation of gases such as CO_2 and methane by anaerobic decomposition of the sewer				■					■		20
B - Solid waste	5. Generation of recyclable solid waste	■				■	■	■	■	■	■	70
	6. Generation of organic solid waste	■					■	■	■	■	■	60
	7. Generation of solid rejects (toilet, dust, remaining portions of construction sites such as wood, nails, etc...)	■					■			■		30).
	8. Accumulation of used batteries	■					■	■	■		■	50
C - Noise	9. Generation of noise by the energy generator				■			■				20
	10. Generation of noise in construction sights				■			■		■		30
D - Oils and greases	11. Generation of oil and greases in the retainer boxes	■						■		■	■	40
E - Chemical products	12. Use of chemicals for cleaning	■						■			■	30
	13. Use of chemicals for laundry	■						■		■	■	40
	14. Use of poison for pest control	■						■			■	30
F - Generation of Energy	15. Use of lubricant oils and fuels in the energy generator	■			■			■		■	■	50
	16. Generation of gases from the fuel burning in the generators				■			■		■	■	40
	17. Inadequate electric installations										■	10
G - Water for Consumption	18. Rain water collecting for consume and food production			■							■	20
	19. River water use		■	■				■			■	40
H - Harmful synanthropic fauna	20. Attraction of bats							■		■	■	30
	21. Attraction of undesirable insects such as roaches and flies							■			■	20
PIACA I - Percentage of Interaction of Aspects with Environmental Characteristics (%)		52	10	14	29	10	24	76	19	62	76	

Table 3 - Matrix for external environmental aspects related to the natural environment.

CATEGORY OF EXTERNAL ENVIRONMENTAL ASPECTS	Environmental characteristics / Environmental aspects	a. Water quality in the hydric body	b. Outflow of the water body	c. Hydric availability	d. Air quality	e. Soil permeability	f. Soil quality	g. Native fauna	h. Terrestrial flora	i. Landscape resources	j. Health and Security	PICAA E - Rate of Interaction of Environmental Characteristics by Aspect (%)
I - Fluvial transportation	1. Use of lubricant oils and fuel in the boats engines											40
	2. Generation of gases from the burning of fuel in the boats											40
	3. Boat traffic											10
J - Recreation in Natural Environment	4. Tourist hiking											60
	5. Tourist boat rides in the lake											30
K - Noise	6. Generation of noises by the boats											30
	7. Generation of noise by the tourists in the forest											30
PIACA E - Rate of Interaction of Aspects by Environmental Characteristics (%)		43	0	0	57	14	14	100	14	86	29	

Table 4 (matrix of internal environmental aspects) shows that the environmental aspects which present higher magnitude average rates are those: "1", "8" and "19" (7.8, 7.2 and 7.2 respectively). It is evident that the first two are more significant and match their average importance rates which are also the most elevated (4 and 4,6 respectively). From these results it is safe to conclude that these two aspects are the ones that present a higher potential of impact to the environmental characteristics, thus the necessity of establishing measures for environmental control.

Observing the average importance rates of the environmental characteristics, the most elevated are "i" and "j" (3,2 and 5,4), where the last one stands out. It is clear that almost every aspect related to characteristic "j" has above average rates. Therefore, we can point out this environmental characteristic as the most impacted, which demands mitigating effort.

Each environmental characteristic is more or less affected by different aspects. Characteristic "a" is more influenced by aspects "11", "13" and "15" than by others (Importance of 4,3, 4, and

4 respectively). It is important to highlight that aspect "1" (Generation of domestic effluents) is not among the most impacting aspects for characteristic "a" (Water quality of the hydric body). The aspects that less affect the quality of water are "16" and "19" having evaluation grades of 1,5 for both. Furthermore, environmental aspect "19" (Use of river water) can be considered as the less significant or impacting to the environment of the Lodge, since its evaluation grades and average of importance are the lowest in the matrix.

It is clear that characteristic "j" is peculiar. Its grade in evaluation of importance is the highest when compared to the rest of the matrix. Aspects "1", "6", "8" and "11" are far more impacting for "j" than for any other environmental characteristic. In aspect "8", the grade reaches 8,7, which represents high potential of impact, since no other grade in the matrix is so elevated.

To assess the potential impact of the external environmental aspects in the Uakari Lodge, a new matrix was structured and represented in Table 5.

Table 4 - Matrix of selected internal environmental aspects, with weights.

CATEGORY OF INTERNAL ENVIRONMENTAL ASPECTS	Environmental characteristics / Environmental aspects	a. Water quality in the hydric body		g. Native fauna		i. Landscape resources		j. Health and Security		Average	
		M	I	M	I	M	I	M	I	**M**	**I**
A - Effluents	1. Generation of domestic effluents	9	3	6,6	3,6	7	2,8	8,7	6,7	**7,8**	**4**
	2. Sludge production in the septic tank	8	3	4,2	1,8	4,5	1,8	7,7	5,3	**6,1**	**3**
B - Solid waste	5. Generation of recyclable solid waste	7,5	2.	4,5	2,4	6,3	3,5	5,3	3,7	**6,1**	**2,9**
	6. Generation of organic solid waste	7,5	2	5	2	6,8	3,5	9,3	5,7	**7,1**	**3,3**
	8. Accumulation of used batteries	9	3	5,2	2,4	5,8	4,3	9	8,7	**7,2**	**4,6**
D - Oils and greases	11. Generation of oil and greases in the retainer boxes	8,8	4,3	5,2	2,8	6,8	3,3	7,7	5,7	**7,1**	**4**
E - Chemical products	13. Use of chemicals for laundry	8	4	6	2,6	5,5	3,3	6,7	4	**6,5**	**3,5**
F - Generation of Energy	15. Use of lubricant oils and fuels in the energy generator	7,5	4	5,6	2,8	7	4	7,3	4,3	**6,9**	**3,8**
	16. Generation of gases from the fuel burning in the generators	4,5	1,5	6,4	2,6	7,3	4	7,3	4,3	**6,4**	**3,1**
G - Water for Consumption	19. River water use	10	1,5	5,2	1,6	5,5	1,5	8	5,3	**7,2**	**2,5**
	Average	**8**	**2,8**	**5,5**	**2,5**	**6,2**	**3,2**	**7,7**	**5,4**		

Legend: M - Magnitude; I - Importance

Of the seven existing environmental aspects listed in Table 3, only three were considered significant for they represent PICCA E rates higher than the average (34,3%). They are the following: 22. Use of lubricant oils and fuel in the boats engines (PICCA E = 40%); 23. Generation of gases from the burning of fuel in the boats Tourist hikes (PICCA E = 60%).

Amongst the three categories of external environmental aspects, "K - Noise" was eliminated, since none of its aspects presented PICCA E are greater than average. The same occured with this category in the assessment of Internal aspects. Therefore, this category is not considered a significant potential impact.

Category "I - Fluvial Transport" stands out for presenting the highest importance rate average. Aspect "22" has an importance rate average of 4,3, which makes it the most elevated.

Concerning the environmental characteristics, "d - Air quality" is more potentially impacted because it presents the highest importance rate (5.1), rate influenced by aspects "22" and "23", with evaluation grades of 6.3 and 7.0 respectively. The last is the most elevated grade of importance in the matrix and, therefore, requires special attention for control measures and impact mitigation.

In the initial survey of the environmental characteristics, "b. Outflow of the water body" and "c. Hydric availability" presented PIACA E = 0 (Table 3). Which means these elements are not affected by any of the identified environmental aspects.

Environmental aspect "25. Tourist hikes" presented the lowest importance rate average (2.2), pointing its low potential of environmental impact. Evaluating the environmental characteristics, "a. Water quality of the hydric body" presents reduced importance rate average (2.2), indicating that the external environmental aspects have little influence in this element, despite being affected by "22" with a grade of importance of 4.

Table 6 shows the nature of the possible impacts of the Uakari Lodge. The following magnitudes are assessed: Impact Order; Reversibility; Degree of Permanence; Degree of Importance; e Amplitude.

Table 5 - Matrix of selected external environmental aspects, with weights.

CATEGORY OF EXTERNAL ENVIRONMENTAL ASPECTS	Environmental caracteristics / Environmental aspects	a. Water quality in the hydric body		d. Air quality		g. Native fauna		i. Landscape resources		Average	
		M	I	M	I	M	I	M	I	**M**	**I**
I - Fluvial transportation	22. Use of lubricant oils and fuel in the boats engines	8,5	4	6,3	6,3	5,2	2,6	5,8	4,3	**6,4**	**4,3**
	23. Generation of gases from the burning of fuel in the boats	4	1,5	6,7	7	5,4	2,6	6,3	4	**5,6**	**3,8**
J - Recreation in Natural Environment	25. Tourist hiking	1	1	1,7	2.	5,8	3,4	4,8	2,5	**3,3**	**2,2**
Average		**4,5**	**2,2**	**4,9**	**5,1**	**5,5**	**2,9**	**5,6**	**3,6**		

Legend: M - Magnitude; I - Importance

Table 6 - Identification of the nature of the environmental impact, related to its aspects.

ASPECT		IMPACT ORDER		REVERSIBILITY		PERMANENCE DEGREE		IMPORTANCE DEGREE			AMPLITUDE		
		I	D	R	IR	T	P	IS	M	S	L	R	G
Internal	1. Generation of domestic effluents		■	■		■			■		■		
	2. Sludge production in the septic tank	■		■		■			■		■		
	5. Generation of recyclable solid waste		■	■		■		■			■		
	6. Generation of organic solid waste		■	■		■		■			■		
	8. Accumulation of used batteries	■		■			■		■		■		
	11. Generation of oil and greases in the retainer boxes		■	■		■			■		■		
	13. Use of chemicals for laundry		■		■	■			■		■		
	15. Use of lubricant oils and fuels in the energy generator		■	■		■			■		■		
	16. Generation of gases from the fuel burning in the generators		■		■	■		■			■		
	19. River water use		■	■		■		■			■		
External	22. Use of lubricant oils and fuel in the boats engines		■	■		■			■		■		
	23. Generation of gases from the burning of fuel in the boats		■		■	■		■			■		
	25. Tourist hiking		■	■		■		■			■		
	Representativity (%)	15,4	84,6	76,9	23,1	92,3	7,7	46,2	53,8	0	100	0	0

Legend:
I Indirect **D** Direct **R** Reversible **IR** Irreversible **T** Temporary **P** Permanent **IS** Insignificant **M** Moderate **S** Severe **R** Regional **L** Local **G** Global

An analysis of the order of impact shows that the majority of aspects have Direct impact potential (84,6%). Which means in case the possible impact comes about it would have direct action upon the related environmental characteristic. In case the domestic effluents were directly thrown in the hydric body receptor, for example, the quality of natural water would be directly altered.

Regarding Reversibility, 23,1% of the impacts related to the aspects are Irreversible, in contrast with the majority of them (76,9%) which are Reversible.

Only aspect "8. Accumulation of used batteries" has Permanent potential of impact, representing 7,7%. Both in the assessment matrix (Table 4) and in the impact nature (Table 6) this aspect stands out for its potential of impact.

None of the aspects have Severe potential. They are either Insignificant (46,2%) or Moderate (53,8%). It becomes clear that the activities in the Uakari Lodge have little negative influence in its surroundings, since the majority of aspects (92.3%) represent impacts with *Temporary* Degree of Permanence.

Another property is Amplitude, meaning its radius of action. They can be Local, Regional, or Global. In all the aspects (100% of them) the possible environmental impact is of Local scale. Whatever are the impacts caused by the daily activities in the Uakari Lodge, their reach will not surpass the surroundings or neighbooring areas.

CONCLUSION

Analyzing the data presented in this work, the following conclusions are clear:

- The adaptation of the Leopold Matrix presented in this study is a useful tool for touristic enterprises. It allows clear detailing of potential environmental impacts. Besides providing support in the realization of an environmental impact study, the matrix also contributes to the elaboration of an Environmental Management System.
- The results of importance show that the potential for environmental impact of the enterprise is low, since in most cases the environmental aspects raised present low importance rate average. Therefore, it is clear that the Uakari Lodge has a small scale of influence in terms of environmental impacts.
- The aspects that were not selected for being considered less significant (they did not present an above average percentage of interaction) should not be neglected. The enterprise managers must take the necessary steps into reducing or eliminating the effects of these aspects because the enterprise is located within a protected area, and regardless of the magnitude of the impacts, they must be considered as an important matter.
- Priority should be given to the aspects and respective impacts which are considered more significant in order to reduce its negative effects more quickly.

Once the potential of environmental impacts of each aspect is identified, the Uakari Lodge must search solutions with qualified professionals so that more possible significant impacts are minimized.

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LITERATURE CITED

ABAZA, H.; BISSET, R; SADLER, B. **Environmental impact assessment and strategic environmental assessment:** Towards an Integrated Approach, UNEP, Geneva. 2004.

ALMEIDA, J. R.; LINS, G. A. Impactos ambientais. In: TOCCHETTO, D. (Org.). **Tratado de perícias criminalísticas**. Porto Alegre: Millenium Editora, , 2009. p. 183 - 211.

BAYSAN, S. Perceptions of the Environmental Impacts of Tourism: A Comparative Study of the Attitudes of German, Russian and Turkish Tourists in Kemer, Antalya. Tour. **Tourism Geographies**, v. 3, n. 2, p. 218 - 235, 2001.

BOOTH, K.; MACKAY, M. **Tourism and recreation in New Zealand's Natural Environment:** a Bibliography and Research Synthesis. Wellington, New Zealand: Ministry of Tourism, 2007.

BORGES PEDRO, J. P. Otimização do tratamento de despejos domésticos na Pousada Uacari. In: SEMINÁRIO ANUAL DE PESQUISA, 8, 2011, Tefé, AM. **Poster**. Tefé, AM: IDSM, 2011.

BROWN, D. M. **Rural tourism**: an annotated bibliography. Washington: Economic Research Service, US Department of Agriculture. 2004.

BUCKLEY, R. C. Tourism and biodiversity: land-use, planning and impact assessment. **Journal of Tourism Studies**, v. 10, n. 2, p. 47 - 56, 1999.

CANADIAN ENVIRONMENTAL ASSESSMENT AGENCY. **Basics of environmental assessment**. Disponível em: http://www.ceaa.gc.ca/default.asp?lang=En&n=B053F859-1#4. Acesso em: 03/ago/2011.

CARR, A. M.; HIGHAM, J. E. S. **Ecotourism**: a research bibliography. Dunedin. New Zealand: Department of Tourism, University of Otago, 2001.

CHAVES, P. S. V.; OLIVEIRA, F. C.; COSTA, M. V. **Uso das metodologias de avaliação de impacto ambiental em estudos realizados na Ceará**. In: SIMPÓSIO DE GESTÃO E ESTRATÉGIA EM NEGÓCIOS DA UFRURAL, 2. 2005. Rio de Janeiro. **Anais**. 2005.

DARBRA, R. M.; RONZA, A; STOJANOVIC, T. A; WOOLDRIDGE, C.; CASAL, J. A procedure for identifying significant environmental aspects in sea ports**. Marine Pollution Bulletin**, v. 50, n. 8, p. 866 - 74, ago. 2005.

FERREIRA, Luís. Impactos do turismo nos destinos turísticos. **Percursos & Ideias**, v. 2, n. 1, p.105 - 116, 2009.

HOWELLS, O.; EDWARDS-JONES, G.; MORGAN, O. Ecozone II: a decision support system for aiding environmental impact assessments in agriculture and rural development projects in developing countries. **Computers and Electronics in Agriculture**, v. 20, n. 2, p. 145 - 164, jul 1998.

INSTITUTO DE DESENVOLVIMENTO SUSTENTÀVEL MAMIRAUÁ. **Plano de gestão Reserva de Desenvolvimento Sustentável Mamirauá - IDSM**: diagnóstico. Tefé, AM: IDSM, 2010. v. 1, il.

KUSLER, J. **Common questions**: Wetlands and Ecotourism. Association of State Wetland Managers, Inc. 2006.

LA ROVERE, E. L. **Instrumentos de planejamento e gestão ambiental para a Amazônia, cerrado e pantanal**: demandas e propostas: metodologia de avaliação de impacto ambiental. Brasília: IBAMA, 2001.

LEOPOLD, L. B. **A Procedure for evaluating environmental impact**. Washington. D.C.: Geological Survey, (Circular 645). 1971.

LOHANI, B.; EVANS, J. W.; LUDWIG, H.; EVERITT, R. R.; CARPENTER, R. A.; TU, S. L. **Environmental impact assessment for developing countries in Asia**. Volume 1 - Overview. 356 p. 1997.

PIRES, P. S. Turismo e Meio Ambiente: relação de interdependência. In: PHILIPPI JR., A.; Ruschmann, D. M. (Org.). **Gestão ambiental e sustentabilidade no turismo**. São Paulo: Manole, 2010, p. 3 - 29.

PIRES, P.; ANJOS, F.; SILVA, Y.; OLIVEIRA, J. Estruturação de Matriz de Impactos do Turismo: o caso do Agroturismo do Município de Santa Rosa de Lima/SC. **RBTur**, v. 3, n. 1, 2009.

RAMSAR CONVENTION SECRETARIAT. **Impact assessment**: guidelines for incorporating biodiversity-related issues into environmental impact assessment legislation and/or processes and in strategic environmental assessment. Ramsar handbooks for the wise use of wetlands, Gland, Switzerland: Ramsar Convention Secretariat, 2007. vol. 13.

ROWE, A.; SMITH, J. D.; BOREIN, F. **Career award – travel and tourism - standard level**. Cambridge: Cambridge University Press, 2002. 22 p.

SÁNCHEZ, L. H. **Avaliação de impacto ambiental**: conceitos e métodos. São Paulo: Oficina de Tectos, 2006.495 p.

SUN, D.; WALSH, D. Review of Studies on Environmental Impacts of Recreation and Tourism in Australia. **Journal of Environmental Management**, v. 53, p. 323 - 338. 1998.

TWYNAM, D.; JOHNSTON, M.; PAYNE, B.; KINGSTON, S. **Ecotourism and sustainable tourism guidelines:** an annotated bibliography. North Bennington, Vermont: The Ecotourism Society, 1998.

WOOD, M. E. **Ecotourism:** principles, practices & policies for sustainability. United Nations Publication, 2002.

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