

# The night sky as a heritage of humanity and Astrotourism as a tourist potential in the rural regions of Rosana/SP

Fábio Luciano Violin<sup>a</sup>  
Vitor Barbato Honorato<sup>b</sup>  
Ana Beatriz Rodrigues Lima<sup>c</sup>

**ABSTRACT:** The present study aimed to present a review of the literature regarding the interconnection between the quality of the night sky and the growing interest in astrotourism. As a basis for data collection, studies of secondary documentary nature were used. It is observed that the subject grows in interest on the part of scholars considering the possibilities of application of the astrotourism activity, due to the distinctive elements of offer in the field of tourism, in addition to appearing as a playful element in the perception of tourists. The study is relevant considering the still small amount of studies in Brazil on the subject and the possibility of incorporating this type of service in the national tourist trade, in addition to being able to appear as a distinctive element of the offer in rural areas, like others countries.

**Keywords:** Night Sky;  
Astrotourism;  
Light Pollution;  
Rural Tourism;  
Heritage.

## Info do artigo:

Aceito 24/Fev/2022  
Publicado 27/Mar/2024

<sup>a</sup>PhD in Environment and Regional Development at Universidade Anhanguera , UNIDERP  
Assistant Professor in the Tourism course at Universidade Estadual Paulista - UNESP  
fabio.violin@unesp.br

<sup>b</sup>Undergraduate in Tourism at Universidade Estadual Paulista - UNESP  
vitor.barbato@outlook.com

<sup>c</sup>Graduating in Tourism at Universidade Estadual Paulista - UNESP  
ana.r.lima@unesp.br

DOI: 10.14210/at.v9i1.20218



## INTRODUCTION

Astrotourism is currently one of the niches with growing interest both from the theoretical field, from the understanding of the potential, forms of offer, capacity of interconnection with attractions, promotion of tourist activity in locations outside the urban axis, among other related aspects understanding of the offer.

In turn, municipal managers, individual entrepreneurs, especially in rural areas, and other people interested in enhancing the offer of this type of service can benefit from this type of tourist arrangement considering the low financial investment and the attractiveness of the theme, which it can be easily linked to direct tourism offers such as events, places, properties, as well as indirectly from complementary services in accommodation or similar facilities.

In this way, it is observed that studies related to Astrotourism are still embryonic and lack of expansion of understanding, particularly considering the low supply in Brazil, however, countries such as Portugal, United States, Chile, Norway, Russia, among others, take advantage of the potential of this type of service and expanded the actions of implantation of places capable of exponentiation this type of experience.

The emergence of expansion of the understanding of the subject is denoted when observing the expansion of this type of offer in several countries where tourism is in effervescence, or even the establishment of delineating landmarks of the offer.

In this sense, the present study discussed in an introductory way the importance of the night sky for the offer of Astrotourism based on tourism in rural areas, based on the assumption of the expansion of this market niche and the possibility of structuring the system of operation of this type supply in the national territory.

## THEORETICAL FRAMEWORK

### Night Sky

The night sky has been observed by humanity since the beginning, in search of answers to the primal questions of its origin and the origin of the universe (Tomanik & Bastos, 2012). Consequently, looking at the sky is part of the actions undertaken both with the naked eye or with amateur equipment by laypeople and from specialized scientific observation centers.

From the technological evolution, the reality of observing the completely dark sky, in most urban regions, is no longer the same. Not infrequently, to enjoy the natural landscapes and to contemplate the night sky, it is necessary to move to regions more favorable to the enjoyment of this type of tourist offer. Thus, the observation of the sky and its celestial bodies together with

the management of tourism allow us to offer a service aimed at recreation and enjoyment of activities at a time when consumers want to travel to places outside their usual residence (Valladares, 2020).

In this way, the interest in the consumption of astronomy has awakened the development of observatories around the world that offer activities such as stargazing, eclipses, visits, among others (Marujo & Fialho, 2021), in addition to several other activities offered in places that have reduced light pollution combined with tourist facilities, generally in rural areas.

However, although the night sky is part of everyday reality and the scientific interest of human beings, at all times, in all societies, it has been suffering the consequences of light pollution (Tomanik & Bastos, 2012) and this impairs the observation of the sky, in animal life and even in human life itself.

### The night sky as heritage

The constant interaction with the sky, throughout the history of human civilizations, configures it as a heritage of humanity, both in its natural and cultural aspects (Tomanik & Bastos, 2012). For this reason, its preservation can be considered as a heritage of humanity, essential for the night sky, in which it is one of the objects of study of this article.

In consideration, it is sought to rescue this interest in observing celestial bodies and marveling at a clear sky in a natural landscape, in a way that promotes the learning of astronomy (Valladares, 2020), in addition to scientific education, studies, and activities in the field that can promote sustainable tourism planning.

In 2021, in Brazil, a Bill 1975/21 was created that authorizes bodies of the National System of Nature Conservation Units (SNUC) to create programs to certify locations with great potential for observing the night sky (Agência Câmara de Notícias, 2021). With this, it will strengthen the implementation of the astrotourism typology in Brazil.

The project has similarities with international certifications, such as the International Dark-Sky Association, with the International Dark-Sky Place (IDSP) program, designed for communities, natural parks and protected areas around the world to preserve and protect the night sky through responsible lighting policies and science education on the topic (IDA, 2021b).

Another project on the subject is the Starlight destinations, places characterized by an excellent quality night sky, where the tourist practice contemplates the desired sky. The improvement in the quality of tourist experiences goes beyond discovering associated scientific, cultural, natural values, but also in the preservation of the sky (Starlight Foundation, 2021).

## Light Pollution

Artificial light at night used by anthropogenic processes is a cause arising from the evolution of a society that, in recent decades, has been accompanied by the industrial pace of development, that is, a recent achievement compared to the history of humanity. Exposure to these light sources at night, where there was none before, occurred mostly after the invention of the arc lamp (Owens et al., 2020).

Light pollution is generated by the use of artificial light when it is carried out excessively or inappropriately (IDA, 2021c), and can affect several components, such as the environment, human health, the economy of a place, science and education, especially of Astronomy (Araújo, 2017).

The opinion of the International Astronomical Union states that light pollution is the incorrect use of artificial lighting abroad, moreover, it divides the modalities of how it presents itself. The diffuse glow of the sky can be seen from long distances, the effect is about sources that emit light directed in a way that ends up dispersing among the particles that are part of the atmosphere, among them, the pollutants. Intrusive light is light that invades unwanted places. Meanwhile, glare is a consequence of excessive brightness, which generates high contrasts at night, and can cause glare (IAU, 2015).

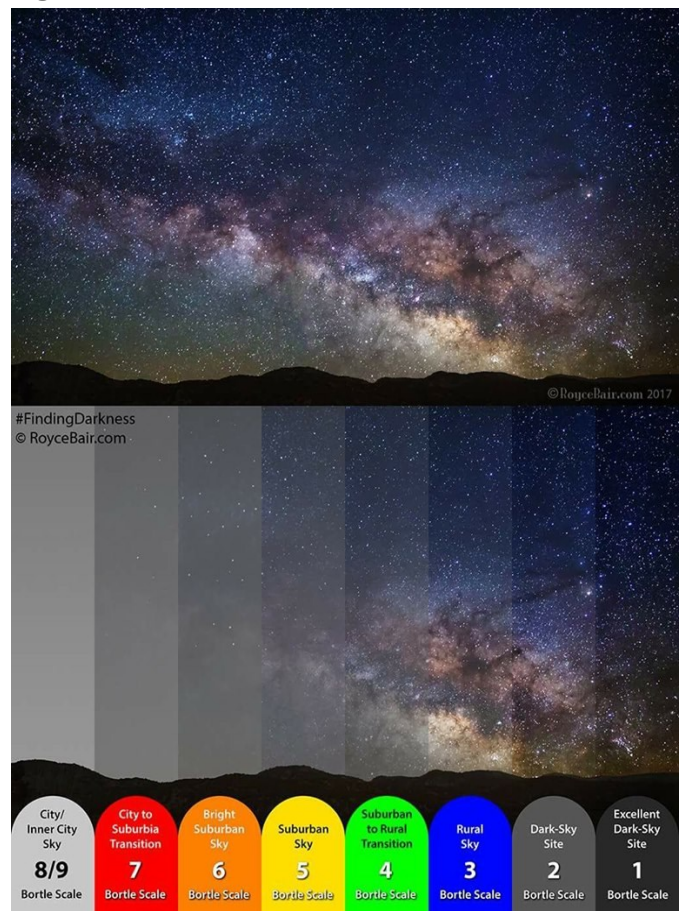
However, the perception of human natural sensors has great difficulty in detecting the effects of this type of pollution, mainly because the damage caused is tendentially noticeable if seen in the long term (Araújo, 2017). Therefore, this can be considered one of the reasons why the reaction to problems does not lead to satisfactory measures to combat light pollution by public bodies.

Generally, to mitigate the consequences caused by light sources, some factors must be considered: their applicability, that is, whether it is necessary to illuminate the object in question, considering the impacts of its use; the protection structure, which directs light only to the planned location; the intensity; and lighting control, preventing its dispersion, as well as additional energy dissipation when not in use. In addition, another point is the ideal color temperature, and it is desirable to limit as much as possible the emission of light that has a low wavelength, close to the color blue (IDA, 2021a).

That said, from the lighting planning, it is sought that the visualization of photons, by an individual, is increased as the quality of a starry sky also depends on the influence of light pollution in the atmosphere of the place where the observation is carried out. The atmosphere is attenuated and contaminated by solid and gaseous pollutants, and by light, that is, the less atmospheric interference by lighting, the greater the contrast between the brightness of the object and the

brightness of the sky (Araújo, 2017). It is also important to demonstrate that the quality of the observation will depend on other factors such as altitude and weather. Although we share the same sky, because of this problem, not everyone can have access to the same nightscape. Therefore, the Bortle Scale was developed as a consistent method for comparing observations of the night sky, divided into 9 classes, so that it is possible to establish the difference between different observation points (Bortle, 2001). As in the diagram below:

Figure 1: Bortle Scale



Source: EXOSS Citizen Science Project

In addition to negatively influencing the visualization of stars, planets, and other stars, studies show that artificial light at night also affects the well-being of plants and animals, among which insects, one of the most affected, and which play an essential role for ecosystem services, and their extinction would have devastating consequences for the planet (Owens et al., 2020).

“Prolonged and uninterrupted exposure to light at night can have negative consequences for living beings, due to the change in the function of the biological clock and the production of melatonin” (Araújo, 2017), considered probably carcinogenic, among the agents of group 2A by the World Health Organization.

## Astrotourism as a Tourist Potential in Rural Areas

Protection of the night sky has many benefits and potential for tourism development and planning. Thus, the concern with the night sky is part of sustainable development, and tourism is evidenced as one of the alternatives for promoting this heritage, as long as it is creative and sustainable (Tomanik & Bastos, 2012). Thus, in protected areas and low-density territories, astronomical tourism has immense potential to satisfy the different curiosities of some tourists or visitors in the area of astronomy (Marujo & Fialho, 2021). Thus, Astrotourism enters as a relevant potential in rural areas due to its low light incidence, which can be considered possible for the implementation of this tourist activity by the rural owners themselves, as it is considered sustainable tourism.

The astronomical observations and appreciation carried out in appropriate places for this purpose, whether in observatories or even outdoors, constitute a form of sustainable tourism and leisure, provided that local carrying capacities are respected, contributing to the preservation of the quality of the night sky (Tomanik & Bastos, 2012). In contrast to the above, tourist service providers in particular do not include astronomical attractions in their tour packages, and therefore there is a lack of supply of products linked to this modality, causing waste of this type of alternatives (Valladares, 2020).

According to Dominici & Rangel (2017), the Ilha Grande archipelago has some tourist activities, such as fishing and the use of scientific research in the environmental area, in which these are being affected by light pollution, caused by the practice of inadequate lighting. The regulation, according to the same authors, would serve to guide companies and residents to maintain good practices in the use of light and would complement actions to protect the recognized natural heritage of the Island.

Internationally, Astrotourism is a well-known term because it benefits from the strategic location of astronomical observatories recognized in this case in neighboring countries such as Chile, Argentina, other places such as Hawaii, Canary Islands in Spain and many more (Valladares, 2020). Thus, in Chile, some types of infrastructure were designed and built precisely for the investigation of the cosmos, and it was presented as a need for other places made possible for the observation of amateurs or simply tourists who want to know a little more about the stars of the Southern Hemisphere of our planet (Sepúlveda; Palacios, 2020).

Thus, the activity of Astrotourism that is practiced sustainably, promotes the preservation of the environment, culture, and the quality of the night sky for the observation of starlight and other objects (Tomanik & Bastos, 2012). In this regard, it is thought about the development of Astrotourism in rural areas and re-

search is carried out for its practice in the countryside of São Paulo, in the municipality of Rosana/SP.

Currently, tourists want genuine and exotic experiences, so astronomical tourism is a type of tourism that can meet the new demands present in some tourists (Marujo & Fialho, 2021). In this way, the rural space becomes one of the most viable places for this practice and one can think of this tourist potential for the municipality of Rosana/SP, as it has natural beauties and attractions, diverse flora and fauna, in addition to have the meeting of the Paraná and Paranapanema Rivers, where São Paulo's ground zero is located.

The objective of Astrotourism is to achieve maximum profitability, but at the same time it must safeguard natural resources and respect the population (Valladares, 2020). From this, astronomical tourism enters as a relevant factor for the development of tourism in the municipality, being able to enjoy the night sky, in which it becomes a natural resource that can be valued by citizens and especially by rural properties. In this way, the quality of the night sky can be a vector for tourism (Tomanik & Bastos, 2012).

After all, Astrotourism is an activity that is emerging as a sustainable option for the socio-economic progress of the territories and a catalyst for the economy of their communities (Araya-Pizarro, 2020) and, after the COVID-19 pandemic, it could become one of the typologies of alternative tourism most sought after by tourists. Therefore, for the same author, the diversification of Astrotourism to occur needs to cover a broad framework of tourist activities that, based on the culture of the sky and the stars, manage to combine to generate a tourist product valued in the communities where it will be implemented.

## METHODOLOGY

The study uses a theoretical basis, which composes the specific themes of the research, to carry out the qualitative analysis of the object of study. Considering this, Lüdke; André (1986, p.257) point out that "the case is always well-defined, and its contours must be defined in the development of the study". In this sense, it will use documentary research sources of a descriptive nature, so that the object has its principles delimited, in this case, Astrotourism.

To obtain a certain precision, the study goes through the fundamental chapters that deal with the interaction between individuals and the night sky, such as its interpretation as an activity, conservation awareness, and light pollution, a determining factor for the quality of star viewing. Thus, conjecturing about its possibility of implementation becomes an object of planning that must be carried out for its consolidation.

In order to analyze the light pollution index in the region, the lightpollutionmap tool was used, a website

that operates from the superposition of layers on a map that displays the light intensity of a region. In this sense, some places of interest were listed to compare their indexes intending to identify the potential of the night sky of the municipality. The data come from the quantification performed by the VIIRS satellite, and also from the study of the World Atlas of Artificial Night Sky Brightness (Falchi, 2016).

## DATA ANALYSIS

Located on the edge of São Paulo, 780 km from the capital, the municipality of Rosana is interspersed between two rivers, the Paraná and the Paranapanema, in which they enhance the municipality for tourist activities. In this way, both nature tourism and rural tourism can be highlighted, where the activity is encouraged in the settlements as an additional source of income. In addition, fishing tourism presents itself as a predominant segment in the region for having a large water extension, in addition to being close to the reservoir of the Rosana Hydroelectric Power Plant.

The city includes the Municipal Bathhouse, which offers points with departure for boats for tourist tours developed on local islands, such as the Paraná River Islands, which list 16 islands located in the proximity of the Bathhouse of Rosana. The Paraná River has the Mirante installed 38 meters above the river bed (Secretaria de Esporte, Turismo e Cultura, 2021).

The points of inference are the analyzed locations based on the light pollution generated in the region and its indicators. Thus, Figure 2 points to the locations of analysis:

Figure 2: Indication of observation locations

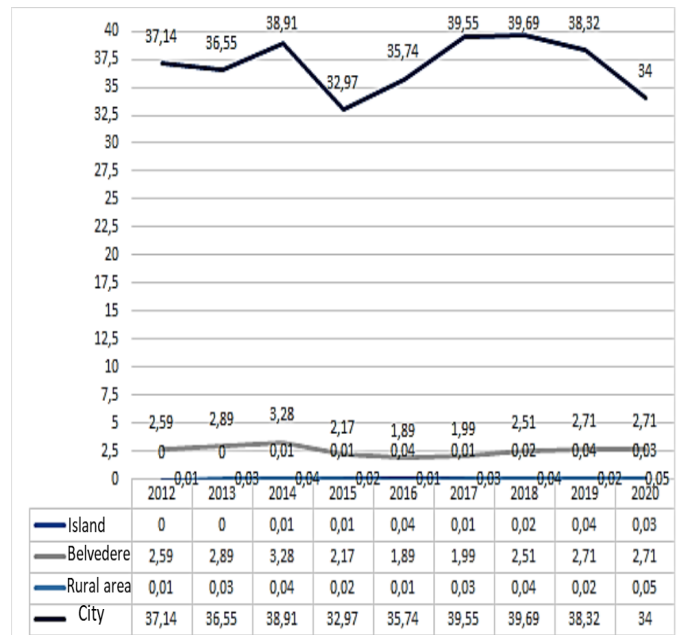


Source: adapted from Light Pollution Map, 2021

It is observed that the most distant places from urban centers present a consistent difference in terms of light

pollution and that the alliance between the natural conditions of the locations, added to the potential of taking advantage of the space for the implementation of the Astrotourism service, could directly or indirectly connect the attractions. Graph 1 shows the rates of light pollution:

Graph 1 : Analysis of the Illuminance Indices of the Chosen Locations



Source: Light Pollution Map, 2021

The data in the graph indicate the possibility of comparing the locations chosen in the municipality of Rosana, and their respective luminosity indices in an area from data collected by the VIIRS satellite, converted into the unit of magnitude of the sky background, at night, by arc second squared by the lightpollutionmap tool.

The result of the analysis showed that the attractions listed have low levels of luminosity, therefore, they have a natural potential, the night sky is protected, a point corroborated by Honorato & Violin (2020). The record of the city's indexes shows that there is still a high incidence of artificial lights impairing the quality of the sky, since, without the nearby areas having adequate lighting, it will cause a noticeable visual interference in the region's sky, which can extend kilometers, harming several locations beyond the urban area.

It is thus indicated that the location has potential for offering Astrotourism, especially considering the possibility of connecting both the attractions facing the rivers of the region, generating income for the populations that live on this type of offer, and for the expansion of the offer aimed at to rural tourism, which have scenic beauty, ease of access and connectivity with the object of analysis of this study.

Finally, it is important to emphasize that the conversion of the data collected by the satellite lacks some specifi-

cations that would help assertiveness in the quantification of the luminance of the night sky brightness. Therefore, an analysis model would be needed to find out how light propagates in the earth's atmosphere, taking into account several factors, such as the air condition, the curvature of the earth.

## FINAL CONSIDERATIONS

The offer of Astrotourism brings indicators of connectivity with other attractions in the municipality and indicates the possibility of increasing the offer considering the possibility of generating in the target audience visiting the municipality or even the residents of the surroundings the ability to access a specific type of experience.

Astrotourism as a tourist offer can, for example, connect with the activities carried out around the rivers that bathe the municipality and already have a developed structure, at the same time that they can be combined with offers linked to rural tourism in the municipality, which already presents actions to boost demand. This type of study contributes to the field of theory by allowing advances in terms of understanding the topic, expanding the scope of analysis and opening up a discussion on forms and types of supply in the field of tourism, with special emphasis on the possibility of understanding regarding the connection between Astrotourism in rural areas and the night sky as an indelible heritage to be contextualized and protected, aiming at the object of study to be used as an interpretive factor for the segment to be used as a tourist enhancer.

The study contributes to the field of understanding by launching the perception of coherence between supply and demand of a niche still unexplored in Brazil, but which has gained relevance in other countries with the adoption of certification programs with the objective allied to the promotion of Astrotourism.

It is observed that from the management point of view, the study brings to light the observation of the possibility of implantation of structures aimed at Astrotourism especially in rural areas or even in structures, as is the example of the locality of analysis, in islands considering the low light and the relatively low values for investment in the activity which can appear as added to attractions such as activities in rural areas or even bird watching, for example, which may have as additional elements related to Astrotourism, or even specialized offers focused exclusively in this type of activity.

The academic contribution of the study focuses on the incorporation of understandings related to the way of surveying luminosity indicators, in addition to the form of triangulation of variables inherent to the understanding of the structuring of this type of niche in the context of the tourist offer, especially in locations where tourism is not presents as a central element of

the local economy.

As an indication of future research, the expansion of the scope of analysis is indicated intending to use case or multi-case studies on the subject in order to broaden the understanding of the permissive elements of offer of Astrotourism in Brazil, since it still it is an unexplored field of research, and with market expansion trends.

The low levels of luminosity in the places demonstrate that there is passive potential to be explored in the municipality. However, the city has high levels, which demonstrates that the application of the segment would have to be accompanied by actions to combat light pollution intending to safeguard the sky landscape and enhance it from the interpretation of the possibilities that Astrotourism offers.

## REFERENCES

- Agência Câmara de notícias (2021). Projeto prevê certificação de localidades de céus escuros para estimular Astroturismo. Available at: <https://www.camara.leg.br/noticias/784462-projeto-preve-certificacao-de-localidades-de-ceus-escuros-para-estimular-Astroturismo>. Acesso em: 27 set. 2021.
- Araújo, J. L. (2017). A poluição luminosa, suas implicações na ciência e na sociedade. São Paulo/SP. Universidade de São Paulo, USP. 160p. Available at: [https://www.iag.usp.br/pos/sites/default/files/d\\_jose\\_l\\_araujo\\_corrigeida.pdf](https://www.iag.usp.br/pos/sites/default/files/d_jose_l_araujo_corrigeida.pdf).
- Araya-Pizarro, S. (2020). Astroturismo como alternativa estratégica de dinamización territorial: el caso de la Región Estrella de Chile. *Economía y Sociedad*, 25 (58), 1-21.
- Bortle, J. E. (2001). Introducing the bortle dark-sky scale. *Sky & Telescope*. 5p. Available at: [https://www.nps.gov/subjects/night skies/upload/BortleDarkSky\\_Scale-2.pdf](https://www.nps.gov/subjects/night skies/upload/BortleDarkSky_Scale-2.pdf). Accessed on: september, 26, 2021.
- Dominici, T.P; Rangel, M.F. (2017). Utilizando conceitos de patrimônio como uma estratégia de proteção do direito à luz das estrelas. *Museologia e Patrimônio*, 10 (1), 32.
- Falchi, F.; Cinzano,P.; Duriscoe, D.; Kyba,C.C.M.; Elvidge, C.D.; Portnov, K.B.A.; Rybnikova, N.A.; and Furgoni, R. (2016). The new world atlas of artificial night sky brightness. *Science Advances*, 2(6), 1-25. American Association for the Advancement of Science (AAAS).
- Honorato, V.B.; Violin, F.L. (2020). Astroturismo: uma análise no Parque Estadual Morro do Diabo, Teodoro Sampaio, São Paulo. *Turismo e Sociedade*, 12 (3).
- IAU (International Astronomical Union) (2018). Light Pollution Brochure. IAU Office for Astronomy Outreach. Available at: <https://www.iau.org/static/archives/images/pdf/light-pollution-brochure.pdf>. Accessed on: september, 26, 2021.
- International Dark-Sky Association. (2021a). Five Principles for Responsible Outdoor Lighting. Available at: <https://www.darksky.org/our-work/lighting/lighting-principles/>. Accessed on: september, 27, 2021.



- International Dark-Sky Association. (2021b). International Dark Sky Places. Available at: <<https://www.darksky.org/our-work/conservation/idsp>>. Accessed on: september, 27, 2021.
- International Dark-Sky Association. (2021c). Light Pollution. Available at: <<https://www.darksky.org/light-pollution/>>. Accessed on: september, 27, 2021.
- Light Pollution Map (2021). Pollution Map. Available at: <<https://www.lightpollutionmap.info>>. Accessed on: october, 5, 2021.
- Marujo, N.; Fialho, L. (2021). Turismo astronómico: o caso do observatório do lago de Alqueva (ola) no Alentejo - Portugal. *Revista Contribuciones a las Ciencias Sociales*, 1(3), 77-86.
- Owens, A.C.S; Cochard, P.; Durrant, J.; Farnworth, B.; Perkin, E.K.; and Seymoure, B. (2020). Light pollution is a driver of insect declines. *Biological Conservation*, 241.
- Secretaria de Esporte, Turismo e Cultura (2021). Prefeitura do Município de Rosana. Atrativos. Available at: <<https://www.rosana.sp.gov.br/turismo/atrativos/>>. Accessed on: october, 5, 2021.
- Sepúlveda, J. L.; Palacios, J. F. R. (2020). Cosmos astrolodge: lodge con Astroturismo. Available at: <<http://repositorio.uchile.cl/handle/2250/178139>>. Accessed on: september, 20, 2021.
- Starlight Foundtion (2021). Starlight Tourist Destinations. Available at: <[https://starlight2007.net/index\\_option\\_com\\_content\\_view\\_article\\_id\\_169\\_touristdestinations\\_catid\\_58\\_starlight-sites\\_itemid\\_158\\_lang\\_en.html](https://starlight2007.net/index_option_com_content_view_article_id_169_touristdestinations_catid_58_starlight-sites_itemid_158_lang_en.html)>. Accessed on: october, 5, 2021.
- Tomanik, G.B.; Bastos, S. R. (2012). Um patrimônio da humanidade ameaçado: o céu noturno. *Anais do IX Seminário da ANPTUR-Turismo e Patrimônio*, 1-13.
- Valladares, S.D. G. (2020). Condiciones de aprovechamiento astroturístico de Quitoloma-Pucará como estrategia de desarrollo económico en la parroquia de Cangahua, cantón Cayambe. *Trabalho de Conclusão de Curso*. Available at: <http://repositorio.utm.edu.ec/handle/123456789/10435>.