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PECULIARITIES OF ASTRO – TOURISM

Abstract. *Dark sky tourism or astro-tourism is a journey of tourists in order to obtain astronomical knowledge and outdoor activities. The article will give a definition of astro-tourism, components of astro-tourism, the main aspects of astro-tourism and how to use them and the article will talk about the place of astro-tourism in the Republic of Kazakhstan and offer prospects for its development. This article deals with the essence, components, aspects and peculiarities of dark sky tourism, stargazers and dark sky tourism as an existing type of tourism, history and economic impact of dark sky tourism. Also, it points out a guide for a night sky and celestial objects as indicators of the road for tourists, some features of International dark sky locations and perspectives of dark sky tourism in Kazakhstan.*

Keywords: *dark sky tourism, astro-tourism, astronomy, tourism, celestial bodies, space objects, traveling*

Introduction

In the modern world, tourism acts as an effective process of mass accessibility of scientific, cultural and natural values, a way of understanding the heritage of human civilization. In the 21st century, the interdependence of science, education, culture and tourism is increasing. Cognitive and scientific tourism contributes to the intellectual development of an individual and society as a whole.

Dark sky tourism or astro-tourism is a journey of tourists in order to obtain astronomical knowledge and outdoor activities. Nowadays, it is impossible to observe the starry sky in cities due to the pollution of the climate and the abundance of city lights (light pollution), that's why astronomy fanatics deliberately look for places that are too dark. It is not possible to see the stars from the window unless you have a single house on a mountain or island far from city lights.

The purpose of this research is to give a deeper look at the phenomenon of astro-tourism, consider the necessary conditions under which this tourism becomes possible and compare these conditions with the conditions of the Republic of Kazakhstan.

Astro-tourism is unusual type of tourism. The night sky has always fascinated everyone. It is delightful: billions of stars like diamonds, the Moon, planets, comets, meteors, the Milky Way, polar lights. The stars inspired scientists to discoveries, wayfarers to travel. This type of tourism has become popular in the last few years and being a new trend for those who want to combine education and recreation [1].

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According to statistics, the number of people in the world who have not seen the Milky Way or the dark sky is increasing, the reason for this is "light pollution" or artificial lighting, which is increasing day by day. In the city, in cloudless weather, the stars are not visible even with a professional telescope. That is why astro-tourism is a new direction.

Light pollution causes great damage to observatories. Excess light obscures the faint light of smaller objects, making astronomical observations difficult. However, in addition to visible sky glare, there is an even more annoying problem caused by external light sources. This is clearly seen in the spectrograms that astronomers use to study the chemical composition, temperature, and velocity of matter. Lamps, especially mercury lamps, produce very bright bands in all parts of the optical spectrum from infrared to ultraviolet. The brightness of these bands is much higher than the brightness of the bands of astronomical objects, and this light cannot be filtered out.

Astronomers founded the International Dark Sky Association (IDA) in 1988 as a non-profit organization. The organization has compiled a list of places suitable for stargazing, and updates this list every year. The main goal of the organization is to combat excessive illumination and pollution in the sky. The IDA organizes forums for amateur astronomers [2].

To draw attention to the problem of light pollution, Globe at Night has created a special map where users mark the measured brightness of the night sky using applications installed on mobile devices. The International Dark Sky Association (IDA) has created a map of Dark Sky Program locations to conserve and protect areas of dark night.

Atmospheric and meteorological conditions are very important for tourists and organizers of astro-tourism. Variable natural factors play a large role in astronomical observations. The following conditions must be taken into account here [3]:

- visibility, index - measures the degree of blurring of astronomical objects such as stars due to turbulence in the earth's atmosphere and flicker caused by air. Visibility is usually poor if there are large fluctuations in temperature in the atmosphere.

- transparency, when light passes through the atmosphere, it scattered and absorbed by gases and other particles. The transparency value determines how much light is lost.

- cloudiness

- chance of precipitation

- the phase of the moon.

Planetarium is a scientific and educational institution in which the celestial sphere with stars, planets and satellites, comets and meteors is shown; also, solar and lunar eclipses, panoramas of the Moon, Mars, Venus. Usually, the demonstration is accompanied by lectures on astronomy, astronautics and earth sciences. The utilitarian value of planetariums is to help in astronomical education and in the popularization of space research. With the manufacture of new audio-visual devices, the possibilities of planetariums have expanded [4].

The first and so far, the only stationary planetarium in Kazakhstan was opened in Aktobe in 1967. The highlight of the Aktobe planetarium is the device, with the help of which guides reproduce on the dome of one of the halls a complete model of the starry sky, visible from the surface of the Earth. About 7,000 transparencies and slides are stored in the organization's funds, which depict real astronomical phenomena. Since 2008, the Aktobe planetarium has been a member of the Euro-Asian Commonwealth of Planetariums.

Observatory, a specialized scientific institution equipped for astronomical, physical, meteorological, etc. research. The emergence of astronomical observatories dates back to ancient times and is associated with the practical needs of mankind in ways of calculating time, orientation

on land and at sea. The remains of ancient structures for astronomical purposes are found on the territory of the CIS countries (Armenia, Uzbekistan), the Middle East (Babylon), Mexico, Peru, Great Britain and other places. As we see in this graphical element, astro-tourism has two main directions (figure 1):

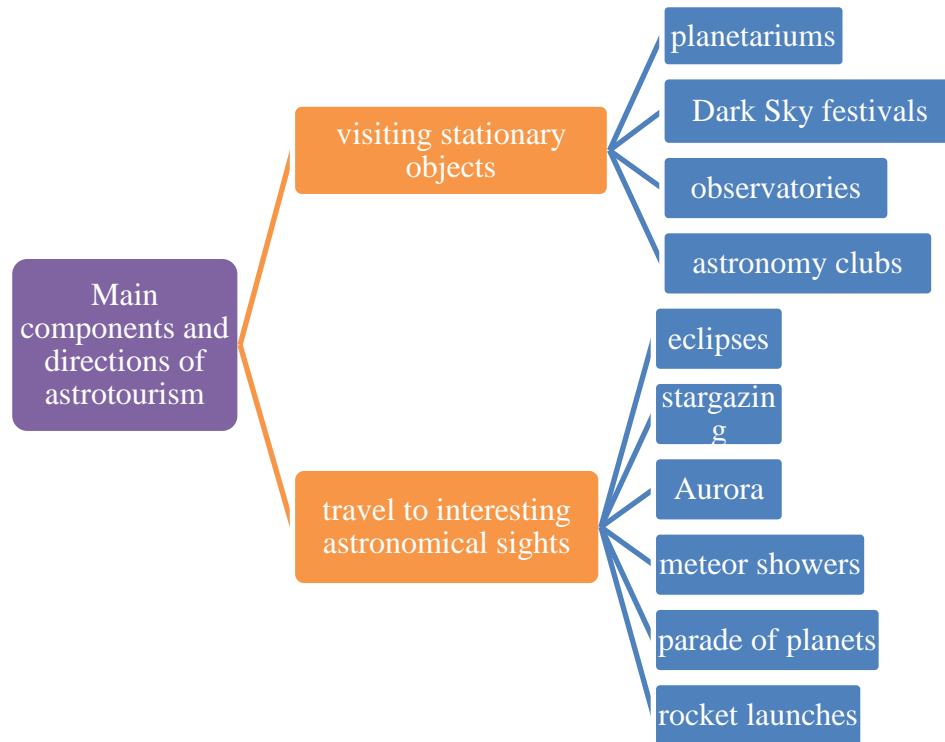


Figure 1 – The main components and directions of astro-tourism

Astronomical observatories of the modern type began to appear in Europe at the beginning of the 17th century. After the invention of the spotting scope, which Galileo turned into a telescope. After the construction of a number of observatories by astronomers Tycho Brahe, J. Hevelius, V. Herschel, and others, state observatories began to be created, primarily for the development of methods for marine astronavigation. Such are the Paris (1667), Greenwich (1675) and other observatories. Currently, there are more than 500 observatories in the world, most of them in the northern hemisphere of the Earth. Usually, they are installed outside the cities and often in the mountains, at high altitudes above sea level [5].

Currently, Kazakhstan is not a leading country in terms of astronomy. However, there are many places in mountainous regions with clear skies that are perfect for stargazing. Our Astrophysical Institute named after V.G. Fesenkov has 3 observation bases, that is, there are currently the main 3 observatories in Kazakhstan.

The Tien-Shan Astronomical Observatory is located near Almaty in the Northern Tien-Shan Mountains at an altitude of about 3000 m and is one of the highest observatories in the world above sea level. Opened in 1957, it was for many years known as the Sternberg State Astronomical Institute. By contacting the institution's administration in advance, you can also book a hotel room, a tour of the mountain and, of course, stargazing.

Asy-Turgen observatory was built on a flat land on a ridge 2700 meters above sea level at the confluence of Asy and Turgen rivers in Ile Alatau. It is located 100 km south-east of Almaty. A 1-meter mirror diameter reflector is installed in the inner center of the dome tower made in Germany. It studies the Moon, large and small planets and meteorites in the Lunar System, artificial

celestial bodies, the structure and dynamics of galaxies, the interstellar medium, bright and dark diffuse nebulae, and associated stars and other objects.

"Kamenskoe plateau" observatory is one of the three observatories in Almaty. In addition, it is the oldest, the decision to build it was made in 1941. In 1945, the project of the observatory building was prepared, and its construction was completed 4 years later. As planned, the facility was an exact copy of the Pulkovo Observatory in Moscow, only slightly more modest in size.

One of the special aspects of astro-tourism is observing the flight of a rocket from the surface of the earth. In general, this direction of astro-tourism has great prospects in the territory of Kazakhstan, because one of the largest cosmodromes in the world known to us, Baikonur, is located on Kazakh land. However, Baikonur is currently leased to the Russian Federation, but it does not prevent organizing a tour to Baikonur to watch rockets fly.

An interesting direction for astro-tourism is meteor showers. The Earth experiences meteor showers at about the same time every year. More than a hundred such showers have been recorded at the Meteor Data Center, but there are strong and weak ones among them. Meteor showers can be observed at any time of the year. Among them, it is worth highlighting meteor showers: Quadrantids (January), Lyrids (April), Aquarids.(May), Perseids (August), Orionids (October), Leonids(November), Gemini and Ursids (December).Summer is the best time to watch meteor showers due to cloudless weather, and August is the most convenient month for stargazing, the Perseid meteor shower falls on the new moon phase, when you can see up to 100 meteors per hour (table 1).

Table 1 – Major meteor showers

Meteor shower names	Active periods	Active days	A nearby bright star
Quadrantids	January 1-4	January 3	ι Dragonis
Lyrids	April 19-24	April 22	α Lyrae
Aquarids of May	May 1-8	May 3	α Aquarii
Cassiopeides	July 17-August 15	July 28	β and γ Cassiopeiae
Delta Aquarids	July 15-August 18	July 27	δ Aquarii
Perseids	July 25-August 17	August 13	α Persei
Draconids	October 8-10	October 9	β and γ Dragonis
Orionids	October 18-26	October 21	γ Geminorum
Leonidas	November 14-20	November 18	γ Leonis
Geminids	December 7-15	December 14	α Geminorum
Ursids	December 17-24	December 22	β and γ Ursae Majoris

Solar and lunar eclipses are among the most important events for humanity. The ancients gave the solar eclipse a sacred meaning, considering it a harbinger of trouble or change. Of course, now progress has advanced much further and we know that this is a cosmic phenomenon, but even in our culture and imagination it is still something mysterious and beautiful. There are 2 to 5 solar and 2 to 4 lunar eclipses on Earth every year, however, the viewing areas can vary, and this is a great reason for astronomy lovers to travel to see a 2-3-second event [6].

One of the phenomena that people always admire is the Aurora Borealis. It has several names, it is usually called the Northern Lights. The reason for this phenomenon, which occurs in the magnetic belts of the Earth, is the high-energy charged particles coming from space. (electrons

and protons) interaction with atoms and molecules (at an altitude of 90 — 1000 km). However, we cannot observe the Aurora Borealis from anywhere in the world, where the sky is clear, as we observe the stars. The northern lights can be observed in regions and countries such as Russia, Finland, Norway, Sweden, USA (Alaska), Svalbard. Since the northern regions are far from us not everyone can afford this astro-tourism route. It is more difficult to organize a tour to the northern regions to see the Aurora Borealis than to organize other tours.

During astrotours, tourists can engage in the following activities [7]:

1. Visual observations including learning

- pointing the telescope at the object (manually and using the Go To system);
- orientation in the sky;
- use of astronomical maps, atlases, calendars;
- techniques for observing the moon, planets, stars and nebulae.

2. Astronomical photography, i.e. use the camera for astronomical photography, take pictures through filters, add and process photographs.

3. Scientific observations of known asteroids, comets, planets, stars with the possible discovery of new celestial bodies.

Astro-tourism is considered to be a tourism destination that brings a lot of income to the economy. A simple example is that some reputable travel companies carefully monitor astronomical events and organize trips to those regions of the world where some astronomical event is expected. It can be said that the total solar eclipse in Shanghai, China attracted more than 200,000 tourists, and in Australia, 70,000 people bought 30-minute stargazing tours. And due to a misinterpretation of the Aztec calendar, trips to greet the "end of the world" attributed to December 2012 have inspired more than 500,000 people to travel. Some went to the place indicated on the calendar, while others went to Southeast Asia to be the first to meet this terrible day [8].

TravelQuest, one of the world's most famous astrotravel companies, also develops programs and itineraries with popular science magazine Sky & Telescope. Travelers are accompanied by professional astronomers as guides. The agency developed and successfully implemented a travel program to the North Pole, where tourists could see the solar eclipse that occurred on August 1, 2008. A chartered plane tracked the shadow of the moon for several hours - it is impossible to observe an eclipse from Earth for such a long time. Despite the high cost of the tour, tickets were sold out almost a year before the event. Business class airfare sold for \$13,380 for economy class, which ranged from \$4,440 to \$8,880.

Currently, the countries where astro-tourism is developed can be counted on a finger. But this does not mean that people were not interested in observing celestial bodies before this type of tourism appeared. Astro-tourism is just forming its history, but the history of astronomy in Kazakhstan is deep. It is known to us that the Kazakh people were a nomadic people, and our wise people used to observe and know the time and weather from the celestial bodies in the distant times away from technology and civilization.

The Kazakhs, whose life is closely connected with the horse, imagined the North Star as an iron stake driven into the navel of the sky, and the rest of the stars as horses with ropes around their necks. This is how the Kazakh people connect these two constellations, which the Greeks called Ursa Minor and Ursa Major, with a legend.

There are many amateur astronomers and ordinary tourists who want to get acquainted with this interesting type of vacation go to observatories of many countries. The public, the press, and tourist companies are interested in the possibilities and availability of this type of tourism. Taking

into account the growing interest in this field of human activity, Forbes has selected the seven best observatories open to the public in different parts of the world.

Rock de los Muchachos is one of the most important modern scientific observatories. 2400 meters high on the island of La Palme (Canary Islands). For those interested in astronomy as a science, not just stargazing, Roque de los Muchachos is a must-see. Since the Canary Islands are one of the three best places on the planet for astronomical observations, in addition to Roque de los Muchachos, the archipelago has a large Teide Observatory, which is equal to that of Tenerife, and private hobby complexes. Some travel agencies even offer special astrotours to the Canary Islands, placing their clients at the most convenient points for independent observation of the islands and organizing group excursions to Roque de los Muchachos and Teide.

The observatory near the Lithuanian city of Moletai began its work in 1969. The place was chosen for it on the two hundred meter hill of Kaldiniai. A few years ago, an ethnocosmological museum appeared near the Moletai observatory. Its building is made of glass and metal and looks like a spaceship where the museum has landed against the local forest landscape. Space artifacts, fragments of meteorites and many other interesting relics can be seen there. Night sky observations are organized in the museum: the telescope is installed on a 45-meter tower in a special dome. But daytime observations are available both at the museum and at the observatory. Moletai is located 60 kilometers north of Vilnius.

San Pedro Valley in Benson, Arizona, USA is not just a private observatory, but a whole astronomy center for enthusiasts. They are ready to arrange stargazing for the charm of a private observatory 24 hours a day and at any time of the year, when there are no strict conditions for visiting. The owners have devised many educational and entertainment programs for their customers. But the most important entertainment in the San Pedro Valley is astrophotography, which is accessible to everyone. The cost of the program starts at \$130. The observatory in Givatayim is the oldest and most important in Israel. It was built on top of the hill in 1967, and today the staff of the institution conducts continuous educational activities at various levels - from programs for students studying astronomy to clubs for children.

According to the site lightpollutionmap.info, the territories of the whole of Kazakhstan, except for cities, are the least affected by light pollution (Table 2, Figure 2) [9].

Table 2 – The statistics of light pollution in Kazakhstan last few years

Year	Pixel count	Sum	Rad. / 1000 pop.	Mean
1	2	3	4	5
2012	19,057,669	737,745	39.8	0.0581
2013	19,057,669	748,560	40.4	0.0589
2014	19,057,669	793,178	42.8	0.0624
2015	19,057,669	680,447	36.8	0.0536
2016	19,057,669	612,623	33.1	0.0482
2017	19,057,669	676,657	36.5	0.0533
2018	19,057,669	600,627	32.4	0.0473
2019	19,057,669	630,352	34.0	0.0496
2020	19,057,669	576,974	31.2	0.0454
2021	19,057,669	696,929	37.6	0.0549

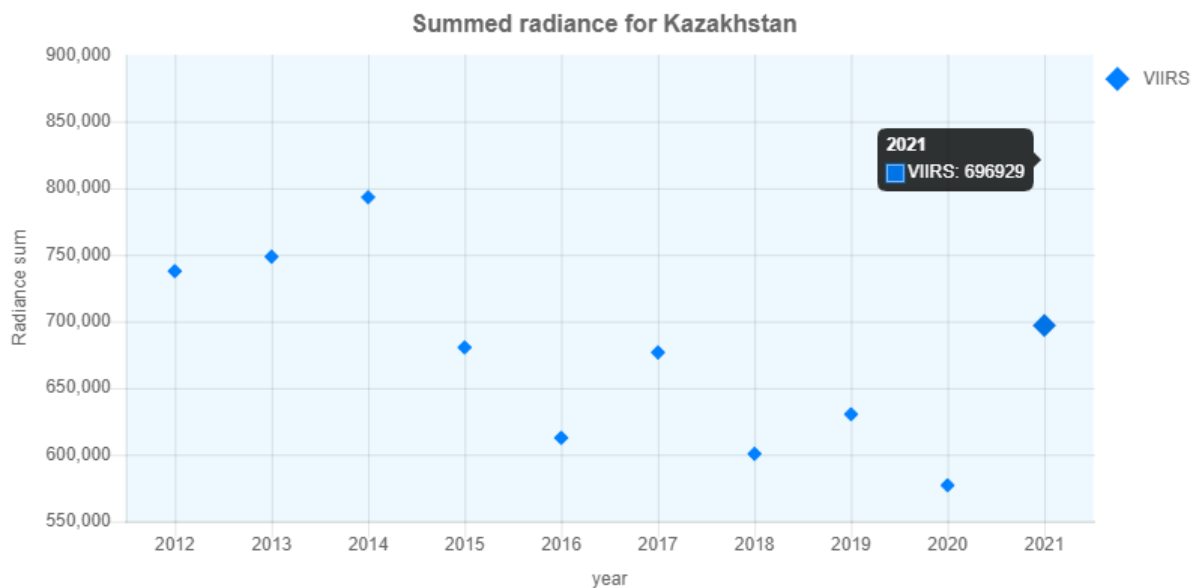


Figure 2 – VIIRS Country statistics in Kazakhstan

The sharply continental climate of Kazakhstan, low air humidity creates good conditions for the transparency of the atmosphere, this is especially noticeable in the summer period, which is characterized by the largest number of clear days. In addition, in the summer months, the lowest wind speed is observed in zones like semi-desert, desert, which has a positive effect on visibility, as light pollution is at a minimum in these regions. All this together creates favorable conditions for astronomical observations and the development of astro-tourism in general in our region.

Currently, there are several observatories and glamping sites in the territory of Kazakhstan. However, most of them are located only in the city of Almaty and its mountainous regions. In the territory of Kazakhstan, the central, eastern and western regions are well protected from light pollution. And it gives us great opportunities to develop dark sky tourism in our country.

Rural settlements in the region of the Turkestan region are also suitable for the construction of glamping sites. According to the site the climate of the Turkestan region is very suitable for glamping, and also, compared to other regions, the Turkestan region is known for its hot weather, which means that the sky completely open and it also gives tourists a great chance to hike and not worry about cold weather [10].

Nowadays, tourism has become an important economic activity. Many cities and even states have become strongly, even significantly dependent on tourism. The cost of astro-tourism is minimal; its very idea involves traveling to remote, untouched places, because all that is needed is a sky with a low level of light pollution, which is always available to us. Another advantage of this type of tourism is that it helps to preserve the original appearance of nature. Unfortunately, the number of places providing such an opportunity is becoming less and less. The countryside in this case looks the most favorable. Moreover, astro-tourism can have a positive impact on the local economy and infrastructure development, especially in remote communities suffering from a lack of sustainable development alternatives.

Summing up, we can say that astro-tourism as a direction of scientific and educational tourism has a great future and reliably gathers its audience. Within the framework of international tours, attention should be paid to increasing the opportunities for expanding the geography of Kazakhstani destinations, it is necessary to start organizing astro-tours within the country.

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АСТРОТУРИЗМНІҢ ЕРЕКШЕЛІКТЕРІ

Аңдатпа. Қараңғы аспан туризмі немесе астротуризм – туристердің астрономиялық білім алу және белсенді демалыс мақсатындағы саяхаты. Мақалада астротуризмнің анықтамасы, астротуризмнің құрамдас бөліктері, оларды қолданудың негізгі аспектілері мен әдістері берілген, сонымен қатар Қазақстан Республикасындағы астротуризмнің рөлі мен орны анықталып, оның даму перспективалары ұсынылған. Бұл мақаланың авторлары қараңғы аспан туризмінің мәнін, ерекшеліктерін және жұлдызды аспанды саяхат кезінде навигациялық бағыт алудың негізгі объектісі ретінде қарастырылады. Қараңғы аспан туризмінің тарихы мен экономикалық мәнін қарастырып, халықаралық астротуризм дамыған елдер және олардың дамыту әдістері қарастырылды.

Кілт сөздер: қараңғы аспан туризмі, астротуризм, астрономия, туризм, аспан денелері, ғарыш объектілері, саяхат.

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ОСОБЕННОСТИ АСТРОТУРИЗМА

Аннотация. Туризм темного неба или астротуризм - это путешествие туристов с целью получения астрономических знаний и активного отдыха. В статье приводится определение астротуризма, составляющие компоненты астротуризма, основные аспекты и способы их использования, а также раскрывается роль и место астротуризма в Республике Казахстан и предлагаются перспективы его развития. Авторами данной статьи рассматривается сущность, характеристика и особенности туризма темного неба, звездочетов как одного из главных черт ориентации во время путешествия, история и экономическое значение туризма темного неба. Кроме того раскрывается роль гида по ночному небу и небесным объектам как одним из указателей пути для туристов, некоторые особенности международных локаций темного неба и перспективы астротуризма в Республике Казахстан.

Ключевые слова: туризм темного неба, астротуризм, астрономия, небесные светила, путешествие.