

Research Article

Astronomical Tourism in the Sultanate of Oman

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Abstract

Astronomical Tourism is not a widely recognized activity on the global tourism map; however, it is growing rapidly due to the increasing interest of many individuals in visiting unconventional tourist destinations that focus primarily on sky observation, escaping light pollution, and exploring astronomical heritage sites such as ancient observatories. Astronomical tourism initiatives contribute to spreading knowledge and developing human capital among visitors and within the host community. Therefore, it can serve as a potential tool for development, especially considering that the locations attracting this type of tourism are often remote areas, providing economic support and employment opportunities for the local workforce. Nevertheless, astronomical tourism requires a high level of scientific content and advanced technologies to keep pace with developments in the field and meet the expectations of visitors to these destinations. Despite the currently limited utilization of this type of tourism as a key contributor to the national economy and as a vital source of scientific knowledge for universities and research centers, Oman is one of the promising countries in this sector. This paper examines the current state of astronomical tourism in Oman, its prospects, and the opportunities that can be leveraged to develop this sector. It also explores the potential for establishing world-class astronomical observatories to position Oman on the global astronomical tourism map.

Keywords

Astrotourism, Oman, Natural Heritage, Sustainable Tourism, Astronomical Observatories

1. Introduction

Astrotourism, also known as stellar tourism, involves the development of recreational and educational activities related to the cosmos and astronomical phenomena [4], and it is a new phenomenon that is taking hold across the world [8].

Gray's Travel Motivation Theory identifies two reasons why individuals seek natural environments. The first reason is the desire to embark on a journey from the known to the unknown, termed 'wanderlust' in Gray's theory. The second reason is that travelers wish to experience facilities unavailable in their own residence, referred to as 'sun lust' [6]. Thus, astronomical tourism emphasizes these aspects, creating a new meaning for tourism. Traditionally, astrotourism has been a niche

pursuit, centred on scientific exploration and specialised equipment, and targeted at a specific audience of science enthusiast [9].

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 [1], Astro-tourism focuses on astronomy-related activities, such as observing the night sky and astronomical phenomena in natural settings. It contributes to community engagement, empowerment, and participation while also fostering a knowledge-based economy, creating job opportunities, and facilitating the acquisition of diverse knowledge in this field. It's a multifaceted, multidimensional phenomenon situated at

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the crossroads of several types of interactions within societies [5]; it is deeply rooted in people's interest in the night sky and other celestial events. Offering a unique exploration experience intertwined with nature under the mesmerizing night sky, astro-tourism is an innovative tourism segment differentiating itself from traditional tourism types. Recent research shows that astro-tourism only really started to take off in the last decade of the 20th century [11]. This coincided with a growing interest in night sky observation as the academic community, professional astronomers, environmentalists, and “Starlight Reserves” proponents became more engaged. These initiatives were trying to address the growing light pollution problem as urban sprawl and artificial lighting started to encroach on areas that once had dark skies. As the number of places to stargaze decreased, the first steps were taken to protect the night environment by creating certified observation sites and astronomical reserves. Only in recent years have we really started to grasp the scale of this loss – the dimming of the starry night sky – and the urgency to fight light pollution. Astro tourism has evolved into a niche market, offering unique sensory and cognitive experiences. It is now recognized as a form of sustainable tourism that contributes to regional development, environmental conservation, and community empowerment [11]. Location is key when it comes to Astro Tourism as the rationale is for tourists to look deeper into space using a clear dark night sky, and Astro Tourism is regarded as “... tourism in its most natural settings [6]. As a result, mountainous and desert regions are widely regarded as ideal locations for stargazing, offering clear, unobstructed views of the night sky with minimal light pollution. In countries lacking world-class telescopes or major observatories, clear, dark skies represent an asset for the development of astrotourism. Travelers attracted to these destinations—often in organized groups—are typically less concerned with luxury accommodation such as upscale hotels or resorts. Instead, their primary interest lies in proximity to pristine night skies and natural landscapes. This preference for simplicity reduces the need for extensive infrastructure and lowers the barrier to entry for local entrepreneurs and tourism operators. As a result, astro-tourism presents an inclusive and sustainable opportunity for economic development, particularly in rural or underdeveloped regions.

The International Dark Sky Places program, an independent, third-party assessment and certification program, has certified over 200 places worldwide [13].

In this paper, we examine the status of astrotourism in the Sultanate of Oman, its role in enhancing the local economy, and its potential for providing employment opportunities for Omani youth.

2. The Geographical Nature of the Sultanate of Oman

Located in the southeastern extremity of the Arabian Pen-

insula, the Sultanate of Oman spans from 16.40 ° to 26.20 ° north latitude and from 51.50 ° to 59.40 ° east longitude. This positioning grants Oman a uniquely strategic geographical significance. While geography is essentially a question of location, terrain and land or sea borders, it also represents a kind of dialogue between nature, resources and environment and man's response to them – not only in the way he attempts to overcome any difficulties they may pose, but also in the extent of his success in converting them into material assets [14].

3. Geographical Advantages

Oman's diverse topography—ranging from vast deserts to high mountain plateaus—provides optimal stargazing and celestial observation conditions. Many regions of the country, particularly in the interior and southern areas, experience low levels of light pollution due to limited urban development. Locations such as Jabal Shams, Remal Al-Sharqiyah, Rub' al Khali (Empty Quarter), and Al Jebel Al Akhdar are characterized by dark skies and high elevations, contributing to clearer atmospheric conditions and minimal interference from artificial lighting.

Furthermore, Oman's arid climate, particularly in the central and southeastern regions, offers many cloudless nights throughout the year. This makes it possible to conduct astronomical observations and organize night-time tourism activities across multiple seasons with minimal weather disruptions. This diversity contributes to year-round astronomical tourism if the north-south diversity is exploited, enhancing its economic role.



Figure 1. Aurora Borealis observation from Jebel Shams in Oman. [2].

When comparing the principal dark-sky sites suitable for the development of astro-tourism, it becomes clear that they exhibit geographical and atmospheric characteristics comparable to other internationally recognized destinations, such as the Coquimbo region in Chile. Jebel Shams, the highest mountain peak in the Sultanate of Oman, reaches an elevation of approximately 3000 meters and is characterized by an exceptionally low population density (around 3.3 inhabitants/km²). A compelling example of this is the observation of the aurora borealis by astrophotographers from the Oman Society of Astronomy and Space during the peak of solar activity in May 2024. The combination of high elevation, clear skies, and minimal light pollution provided an ideal environment for documenting this phenomenon, which represents the first recorded auroral observation in the Middle East [2] (Figure 1) which results in very limited light pollution. These conditions facilitate high-altitude astronomical observations. In addition, the presence of the Al Hajar Al Gharbi Dark-Sky Reserve and the Star Park—currently being developed by the Oman Society of Astronomy and Space—underscores the potential of the site to serve as a regional center for astro-tourism in Oman. Jebel Samhan within the Dhofar Governorate, with heights in excess of 2,000 meters and an estimated population density less than 2/km², is another under-exploited location with high potential, especially during winter months when skies are most stable. In comparison, Chile's Coquimbo Region—home to world-class observatories like La Silla and Gemini South—is more than 40,000 km² with a population density of about 20 people/km², illustrating the extent to which sparsity of settlement and clarity of the atmosphere have facilitated large-scale astronomical infrastructure development. Such comparisons serve to emphasize Oman's geographical potential for emulating successful dark-sky tourism models within its diverse landscape, with terrain that varies from mountainous highlands to isolated desert expanses.

4. Cultural and Historical Heritage Sites

The Sultanate of Oman has a richer and multidimensional astronomical heritage in tune with its geographical complexion and long-established cultural practices. Of deserts and mountains, coastal plains and valleys, Oman's varied topography has conditioned diverse astronomical practices within its bounds. These—seafaring, agrarian, desert, architectural, and environmental—were complementary in evidence of the traditional ingenuity of Omani society in perceiving, understanding, and applying celestial knowledge in their day-to-day needs.

In the maritime world, Omani seafarers developed advanced methods of star navigation to traverse their voyages on the Indian Ocean. Scholars such as Shihab al-Din Ahmad bin Majid al-Sa'di and Nasir al-Khudhuri composed masterworks—*Al-Fawa'id fi 'Ulum al-Bahr wa al-Qawa'id*, *Al-Nuniyya al-Kubra*, and *Ma'dan al-Asrar*—which de-

scribed navigation by the stars and astronomy-based seafaring practices. These gifts, inscribed by UNESCO's Memory of the World initiative, verify the scientific scale of Oman's maritime history and its distinctness in the Arabian Peninsula.

In Oman's interior, agriculture astronomy played a key role in the regulation of the aflaj irrigation system—an ancient solar-driven water-sharing method. Farmers utilized the shadow of the sun, or *al-lamad*, to share water among themselves. The stars also served as calendars of agriculture, determining critical seasonal shifts in the planting and harvesting cycles [3, 10].

In eastern and southern Oman desert communities, astronomy was a part of the nomadic way of life. Desert skies with minimal cloud cover facilitated the construction of oral star maps and systematized empirical knowledge bases that guided seasonal migration, traveling, and animal husbandry. It is an astronomical tradition grounded in the desert that demonstrates sophisticated accommodation to the natural environment based on generations of observation and memorization.

Moreover, Oman's architectural heritage—its fortresses and castles—presents a subtle reconciliation of astronomy and engineering. Ventilation shafts and loopholes were fitted to trap sunlight or moonlight at particular moments based on celestial calculations. This union of function and form is the reconciliation of cosmological awareness and building ingenuity.

In Jebel Akhdar's mountainous region, agricultural terraces formation and usage also reflect the influence of astronomy. The solar radiation incidence angle varies in various terraces, influencing the selection of crops for an area. Such practice indicates a practical, landscape-oriented application of astronomical information in ancient land use.

Together, these diverse forms of astronomical heritage position Oman in an affluent setting in which to develop astro-tourism. Its clear night skies, low levels of light pollution, and heritage sky traditions embedded within the culture present an enhanced platform on which to construct sustainable forms of celebratory tourism that honor science and heritage. Uncovering and reviving these heritages using facilitated observations, education plans, and values-based tourism planning is not only capable of preserving traditional wisdom but also of stimulating economic and cultural dynamism in the modern world.

5. Current Status of Astronomical Tourism in Oman

The Oman Society of Astronomy and Space is a voluntary, non-profit scientific organization based in the Governorate of Muscat. It was officially established by the ministerial decree on June 7, 2008. Society is dedicated to the promotion of astronomy and space sciences and to bringing together individuals in the Sultanate who are interested in these fields for

knowledge exchange and development. It is also committed to observing and tracking significant astronomical events and raising public awareness. In addition, the society actively encourages the integration of astronomy and space sciences in educational institutions and seeks to foster a deeper appreciation of these sciences within Omani society [15].

The Sultanate of Oman has set itself as an extraordinary model, even a global reference for astronomical activities, space-related initiatives, and international scientific collaboration. This collaboration involved a highly international Mars analog field simulation in Dhofar (AMADEE18) (Figure 2). This initiative showed unique geological features and exceptional terrain characteristics that suited Oman for this kind of mission [7].



Figure 2. Among the most notable space-related scientific experiments conducted in the Sultanate of Oman is the Mars analog mission carried out in the Marmol Desert.

Among the *prima facie* reasons for choosing Oman as a workspace for this project were the existence of landscapes quite similar to Martian environments and the absence of general light pollution, which are very important for the success of extraterrestrial simulation missions. So, the ambient conditions were set to satisfy a controlled and optimal environment for scientific experimentation as well as operational testing.

The strategic exploitation of this site also lays down very critical groundwork for the construction of an integrated project, future-oriented in its handling for serious long-term investment into astrotourism. Thus, Oman, with its natural attributes, stands to become one of the premier destinations for space tourism and research, thereby contributing significantly to the uplift of the local economy as well as diversification of its economic base.

The Oman Society of Astronomy and Space contributed to the scientific and educational role in this event, elevating the Sultanate's position as a noteworthy host of major astronomical gatherings on the global stage. This contribution highlights the potential for developing astronomy-themed tourism projects in regions with favorable observational conditions. Areas characterized by low levels of light pollution offer ideal environments for promoting scientific astronomical tourism, yielding sustainable, knowledge-led developments for this evolving sector.

The traditional camps in regions least contaminated by light such as Dakhiliyah Governorate's Jebel Shams resorts, South Sharqiyah Governorate's Sharqiyah Sands, and Dhofar Governorate's Jebel Samhan—are the most suitable place for astronomical observation and have now become the hub of activities towards the growth of astro-tourism. These locations have clear skies throughout the year and a tranquil natural environment and are thus well suited for astronomy-related tourism infrastructure development and stargazing activities. Their success provides an imitable template for other locations. Seasonal variations also contribute to increased demand, particularly during the winter and autumn months, when the Arabian Peninsula experiences milder weather conditions that are conducive to outdoor astronomical events and tourism.

6. Comparative Analysis: Oman and Global Astro-tourism Models

Astronomical tourism is a multifaceted, multidimensional phenomenon situated at the crossroads of various types of interactions within societies [12]. In December 2020, there was a remarkable annular solar eclipse, and the Sultanate of Oman was well placed to witness this unusual sky phenomenon. Approximately 300 observers from 12 countries came to witness and capture the eclipse as part of a specialized observation camp organized together by the Oman Society of Astronomy and Space, the Ministry of Heritage and Tourism, and the Ministry of Endowments and Religious Affairs at Ras Al Hadd, within the South Al Sharqiyah Governorate.

In addition to this main event, numerous other locations across Oman also witnessed comparable public observation activities, attracting massive turnouts of astronomy enthusiasts, astrophotographers, and international tourists. The intense scientific and media frenzy surrounding the eclipse also indicates an emerging interest in astronomical tourism and is a very strong indicator of the potential for the industry in Oman.

With its geographically and environmentally diversified wealth, Oman is optimally positioned to become one of the leading astro-tourism destinations with well-rounded experiences for the global market. Oman also has the potential not only to further develop this niche industry but also to become a member of and even a leader of the world's best international models of astronomy tourism.

The integration of astronomical heritage—whether maritime, agricultural, or even related to Omani folktales and proverbs associated with astronomy—with astro-tourism can propel tourism in the Sultanate of Oman to rank among the leading countries in this field. This is especially true given that all these distinctive elements are unique to Oman compared to other Gulf countries, in addition to the high level of safety the Sultanate enjoys.

Oman enjoys a favorable environment and a unique geographical location along the Tropic of Cancer at latitude

23°26', a position that offers distinct astronomical advantages such as the overhead passage of the Sun during the summer solstice and clear visibility of seasonal celestial phenomena. Moreover, this location allows for unobstructed views of numerous asteroids and star clusters that cannot be seen from many other places on Earth, in addition to the rarity of cloud cover, particularly in the central and southern regions near the Empty Quarter and in the mountainous highlands such as Jebel Shams, Jebel Akhdar, Jebel Abyad, and Jebel Samhan. These advantages, however, can be further enriched through collaboration with countries that have made significant progress in this field, and by drawing on international experiences such as those in South Africa, Chile, Namibia, Peru, and others. Furthermore, expanding dark-sky reserves and protecting these areas through legislation that safeguards them from light pollution and radio interference, as well as establishing Radio Quiet Zones (RQZs), would greatly enhance the value of astro-tourism and turn it into projects with scientific and social impact in the years to come.

7. Conclusions

Astro-tourism in the Sultanate of Oman holds great promise as a strategic pillar of the tourism sector. Its success depends on the sustainable protection of dark-sky sites and the establishment of radio quiet zones (RQZs) through effective legislation. By integrating Oman's rich astronomical heritage into the tourism framework in line with Oman Vision 2040, the sector can generate substantial economic benefits and increase its contribution to the national budget. This study recommends exploring the feasibility of establishing world-class radio astronomy observatories in Al Wusta and Dhofar Governorates—particularly in Thumrait and Muqshin—as well as utilizing Oman's mountain environments, such as Jebel Shams, Jebel Akhdar, Jebel Abyad, Jebel Samhan, and the Musandam highlands, for the development of international-standard observatories and astronomy-themed resorts. Such initiatives would firmly place Oman on the global astro-tourism map at a time when this field is witnessing rapid worldwide growth.

Abbreviations

RQZs Radio Quiet Zones

Author Contributions

Ishaq Yahya Khalhfan Alshuaili: Conceptualization, Methodology, Project administration, Supervision, Writing – original draft

Ali Amur Qais AlShibani: Conceptualization, Methodology, Writing – review & editing

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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