

翻訳

Exploring the astro-tourism space: A review of the English literature to build a research framework in Japan

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Abstract :

In recent years, astro-tourism has started to attract an increasing number of tourists, both internationally and domestically in Japan. Astro-tourism is defined as an activity where people travel from their place of residence with a purpose to watch beautiful starry sky and celestial bodies. Despite its growing popularity in Japan, however, academic studies on astro-tourism are limited. The purpose of this paper is therefore to conduct a review of the English language research on astro-tourism and build a framework for future research for this field of research in Japan. As a result of the analysis, four key areas of research were identified: (i) astro-tourism research has been indirectly mentioned by astronomers since the 2000s; (ii) case studies of astro-tourism research tend to be studies in sites where there are international observatories or are certificated by the International Dark-sky Association (IDA); (iii) astro-tourism research has been gradually increasing in the international tourism literature since 2010; and (iv) the subject of astro-tourism research occupies dark place. Based on this review, we argue it is necessary to begin astro-tourism research from the perspective of tourism studies in Japan.

I. Introduction

Astro-tourism can be broadly defined as “an activity where people travel from their place of residence in order to look up at beautiful starry sky and celestial bodies” (Sawada & Okyudo, 2020a, p. 23). In recent years, this novel form of tourism has become significantly popular worldwide, including in Japan. In the US, an estimated seven million people traveled across the country to observe the total solar eclipse on August 21, 2017 (Lonely Planet, 2019b).

In 2019, Lonely Planet, an internationally renowned travel guide publisher, published *Dark Skies: A Practical Guide to Astrotourism*, which provided information about 35 dark places on the planet, comets, eclipses, or the best countries to see the Northern Lights. The fact that the guidebook, exclusively on astro-tourism, was published indicates the global popularity of this form of tourism.¹

In Japan, meteorological events have become a popular tourism attraction. For example, some 13,000 people visited Amami-Oshima Island to experience the total solar eclipse on July 22, 2009. This number was surprising, especially because

the island had a maximum accommodation capacity of 6,800 tourists (Okyudo et al., 2010). The “Star Party in Kimino,” held in Kimino Town, Wakayama Prefecture, attracted almost 5,000 participants, mainly from the Kansai area. Since 2016, the event, which organizes viewing opportunities for the Perseid meteor shower in August and the Geminids meteor shower in December, has been a hit among tourists and celestial enthusiasts (Okyudo, 2018).

Beyond these developments, some local communities are exploiting the tourism potential of their clear, starry skies for regional development. For example, Achi Village in Nagano Prefecture is home to a Hirugami hot spring. However, following the decline in public interest in hot springs, the village is now reviving its status as a tourism destination by marketing its clear, stars-studded skies, attracting nearly 100,000 annual visitors (Nagai, 2016; Sakamoto et al., 2020). Similarly, Yoron Island, Kagoshima Prefecture, signed a partnership agreement with the Faculty of Tourism at Wakayama University to develop tourism based on the starry sky. The island is now eagerly implementing measures

to transform itself a leading astro-tourism destination in Japan, completed with training courses for astro-guides and specifically-designed activities for light-pollution prevention (Sawada & Okyudo, 2020a; Sawada & Okyudo, 2020b).

Astro-tourism-related trends are now seen in some public sectors and public organizations as well, in addition to the private sector. The International Dark-Sky Association (IDA), founded for dark sky protection and to highlight light pollution issues, conducts the International Dark Sky Places (IDSP) program, "a system to certify the darkness of the night sky (Ochi, 2016). In Japan, IDSP (*Hoshizora Hogoku*)², has been implemented in the Iriomote-Ishigaki National Park (Uda & Isono, 2019; Miyaji, 2020, pp. 80–81) and Kozushima Island (Kozushima Village, 2020), used for community development based on the certification system. The "GSTC Destination Criteria", a set of criteria established by the Global Sustainable Tourism Council (GSTC) to promote a common understanding of sustainable tourism, included a "light and noise pollution" criterion to minimize light pollution in tourist destinations (Global Sustainable Tourism Council, 2019). The inclusion of a standard on astro-tourism as part of sustainable tourism criteria emphasizes its importance.³ In Japan, "Sora Tourism", a collaborative network of public, private, and academic organizations around Japan which promotes the "sky, space & universe" as tourism resources, has been selected as the "Project on Tourist's Invitation Using a Specific Resource" under the Japan Tourism Agency. The "Sora Tourism Promotion Council" is actively promoting astro-tourism in Japan by conducting marketing research, organizing astro-guide training courses, and disseminating information on Sora Tourism (Arai, 2018; Agata, 2019b, pp. 118–120).

As seen above, astro-tourism is becoming progressively popular worldwide, including in Japan. However, Japanese researchers have paid little attention to this innovative form of tourism. A Google Scholar search (as of November 7, 2020) for articles on "asutoro turizumu (astro-tourism)" or "tenmon kanko (astronomical tourism)" revealed just one entry respectively: the former by Uda & Isono (2019); the latter by Okyudo (2018).⁴ Globally, astro-tourism research is gradually increasing, but its comprehensive and systematic review has not yet been conducted, although Soleimani et al. (2017) and Ma et al. (2020) have briefly reviewed astro-tourism. Therefore, this article aims to establish a framework for the future study of astro-tourism in Japan through a systematic review of international astro-tourism research. By doing so, it also aims to provide an overview of astro-tourism research from the perspective of tourism studies in Japan.⁵

II. Research Method

1. Tourism Research and Review Article

In general, research reviews can be divided into two types: systematic reviews and narrative reviews (Yamada, 2012, p. 1).⁶ The former is a statistical review, that is, a synthesis of the results of multiple studies on the same topic using statistical methods, which is also called "meta-analysis" (Yamada, 2012, p. 1). This review method was developed in the context of psychology and pedagogy to overcome the shortcomings of narrative reviews, which are susceptible to the author's subjectivity. Systematic review is less affected by subjective judgments because it aims to collect relevant articles comprehensively (Onodera, 2018, p. 2).

In general tourism research in Japan, the number of studies based on narrative reviews is larger than that of systematic reviews (e.g., Suzuki, 2005; Okamoto, 2011; Ohashi, 2019a; Takeda, 2019). This may be attributed to the fact that tourism research in Japan is mostly dominated by theoretical and qualitative studies based on existing disciplines in the humanities and social sciences (Yamada, 2016, p. 23), since systematic reviews, by nature, are not suited to theoretical and qualitative studies (Yamada, 2012, p. 17). It is, thus, assumed that narrative reviews dominate in Japanese tourism research. For the purpose of this paper, however, to systematically review astro-tourism research outside Japan, data cannot be collected through narrative reviews.

There are a few systematic reviews in the context of Japanese tourism research (e.g., Take, 2010; Ito & Hinch, 2017; Yamaguchi et al., 2018; Sano, 2018). These studies are classified as systematic reviews because the sampling method, targeted journals, and eligibility criteria are specified. For example, Sano (2018) reviewed research trends in the journal *Tourism Management* and specifies "sampling methods (using EndNote X7 and Nvivo 11 plus)," "cultural and linguistic scope (English)," "time scale (2017)," and "type of publication (a total of 202 articles published in *Tourism Management*)" in her review. Considering the purpose of our article, a systematic review is used to comprehensively sample articles.

Ito & Hinch (2017) is referred to for the sampling, who conducted a review of sports tourism research in Japan. While their review is a typical systematic review, as the sampling procedure and analytical framework were specified, they also adopted the narrative review method in their discussion. In other words, a systematic review was used in literature search, and the collected literature was discussed using the narrative review method.⁷ Such combined method was also used in the context of tourism studies outside Japan. Yang et al. (2017)

reviewed the correlation between gender and travel risk, and Li et al. (2018) explored the relationship between tourism and big data, using systematic review to explore the literature and narrative reviews in their discussion. Thus, it can be expected that the combined method has a certain advantage.⁸ In any case, it is important to clarify the review procedure to provide a basis for reaching an independent conclusion (Slavin, 1986, p. 7). Our article also used systematic review to ensure the transparency, objectivity, and repeatability of the literature collection process and used the narrative review method in the discussion.

2. Research Procedures

This review was conducted for the astro-tourism research articles published up to May 2020.⁹ Three online databases were used, namely “Web of Science” by Thomson Reuters; “Scopus” by Elsevier; and “Google Scholar” by Google Inc, covering a wide range of scientific literature (Falagas et al., 2008). In previous literature search, articles were obtained by directly contacting the authors through e-mail, telephone, or letter. However, today owing to the widespread use of electronic articles, online databases search becomes the main method (Sun, 2012, pp. 51–52). Only online databases were used here, excluding the “gray literature” that are not available online (Ito & Hinch, 2017, p. 776).

In order to search astro-tourism literature, we used three keywords search; “astrotourism,” “astro-tourism,” and “astronomical tourism.” Although according to Metodijeski et al. (2018, p. 238), the meanings of “astro-tourism” and “astronomical tourism” are different, for the purposes of this study, the three terms were considered synonymous, and unless otherwise indicated, the term “astro-tourism” was used in this article. As a result, three articles on “astrotourism,” five on ‘astro-tourism,’ and two on “astronomical tourism” were found in the Web of Science; in Scopus, five articles on “astrotourism,” six on ‘astro-tourism,’ and three on “astronomical tourism” ; and in Google Scholar, 191 articles on “astrotourism,” 130 on “astro-tourism,” and 100 on “astronomical tourism.” After excluding duplicate papers, 171 articles on “astro tourism,” 109 on “astro-tourism,” and 78 on “astronomical tourism”¹⁰ were deemed valid for this analysis.

In a systematic review, it is important to define the “eligibility criteria” in advance to ensure transparency, objectivity, and repeatability of the literature search process (Inoue, 2012, p. 39). In this review, the following eligibility criteria were adopted:

- (i) The full paper must be available on the Internet (e.g., Yamaguchi et al., 2018, p. 16).
- (ii) The text must be in English (e.g., Peng et al., 2014, p. 615).
- (iii) The type of publication includes full paper, proceedings, or conference papers (e.g., Martin & Assenov, 2012, p. 259).
- (iv) The title, abstract, keywords, or text (excluding references) includes search phrases (cf., Froneman, 2014).

Based on the above criteria, 58 articles on “astrotourism,” 23 on “astro-tourism,” and 15 on “astronomical tourism” were eligible. In step (ii), we excluded 29 articles of dissertations, 19 articles of only abstracts in conference proceedings (e.g., Tomasz et al., 2012), 11 book chapters, five newsletters, three book reviews, three technical reports, three front covers only, two research notes, one review article, and one data source.

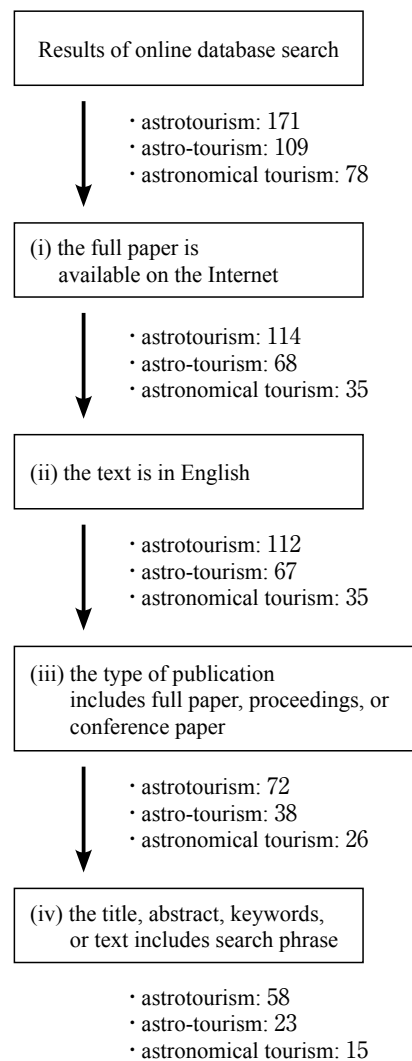


Figure 1 Research Procedure (made by authors)

The review procedure was illustrated in Figure 1.

Finally, 96 original articles were selected for this review, and coded using the following four attributes as analytical frameworks:

- (i) Trends in the number of articles and publication year (e.g., Ito & Hinch, 2017, p. 776).
- (ii) Targeted country (e.g., Ito & Hinch, 2017, p. 776).
- (iii) The author's research area (in case of co-authorship, the first author's research area was considered) (e.g., Yasumura, 1998, pp. 13–14).
- (iv) Research topic (Ito & Hinch, 2017, p. 776).

Microsoft Excel was used for coding.

The following points were considered when employing the above coding: “Targeted country” in (ii) is framed for the purpose of discussing geographical characteristics of the region where astro-tourism was discussed. If an article dealt with more than one country, all of them were included in the coding. This is because some national parks and quasi-national parks are located near national borders or across several countries. “The author's research area” in (iii) referred to the disciplines whose approach was used for astro-tourism research. Tourism research is generally conducted using a multidisciplinary approach (Yasumura, 1998, p. 12). However, the researcher's discipline is often unclear, because tourism phenomena are complex. This is particularly the case with the tourism research within humanities and social sciences. For example, it has been pointed out that tourism anthropologists often discuss theories from other disciplines, depending on the author's research topic (Nash & Smith, 1991, p. 13).¹¹ In this review, the following three methods were employed to identify the author's field.¹²

- (i) When the author's specialization was mentioned in the article, we referred to it (e.g., Kristijan, 2016).
- (ii) If (i) was not available, the author's field was looked up on their university website (e.g., Soleimani et al., 2017).
- (iii) If neither (i) nor (ii) was available, the author's field was specified through “ResearchGate” or “Google Scholar” —social network services for researchers (e.g., Metodijeski et al., 2018).

“Research topic” in (iv) is a classification of the main astro-tourism research areas in seven categories: “dark places,” “observatories,” “meteor showers,” “aurora,” “solar eclipses,” and “rocket launches,” as listed in *Dark Skies* (Lonely Planet, 2019a), and “space,” which is our original category. The purpose of this study is to construct a framework and provide

a perspective for astro-tourism research in Japan based on the global trends in astro-tourism research. Therefore, the above four analytical frameworks were deemed as appropriate for providing an overview of the current state of astro-tourism research.

III. Results and Discussion

1. Trends in the Number of Articles and Publication Year

This section provides an overview of astro-tourism research's development based on the trends of the number of articles in astro-tourism research and their publication year. The results are shown in Figure 2.

The analysis shows that astro-tourism research first appeared in 2001, and the number of articles has continued to increase from 2007 to the present. In 2019, 21 articles were published —almost three-times as many as in 2017.¹³ The number of studies in this field is expected to increase in future, both internationally and domestically in Japan.

Astro-tourism was first mentioned by Smith (2001), an astronomer himself, whose article focused on the activities of the AURA Observatory in Chile, in which he was then the director. He argued that light-pollution prevention activities have created a new tourism resource: the “dark sky.” He also pointed out that the activity would support Chile's growing tourism industry and generate economic benefits for the entire country. In fact, the Cerro Mamalluca Observatory in Chile employed a slogan, “come to the darkest, clearest skies in the world” , which attracted so many tourists and the revenue funded new telescopes without government subsidies.

While astro-tourism research has been gradually increasing, the number of articles written from the perspective of tourism research remains small. Of the 96 articles selected for this review, only 4 (4%) were published in major international journals for tourism research (as of August 7, 2020),¹⁴ which

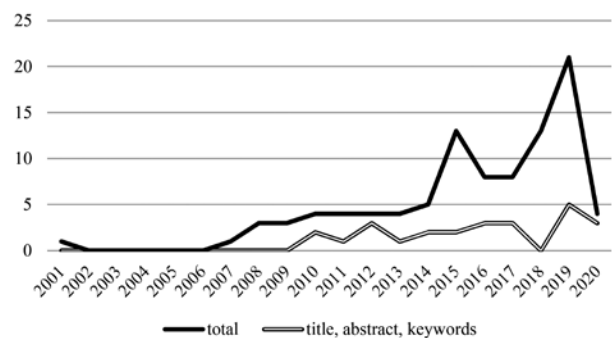


Figure 2 Trends in the Number of Articles and Publication Year (Authors' original work)

suggests that astro-tourism research has not yet widely discussed in the context of tourism research. Additionally, academic research on astro-tourism is scarce. The double-line in Figure 2 shows the number of articles that used the keywords search terms in the title, abstract, or keywords.^{15,16} This line indicates that the articles written before 2010 only indirectly mention astro-tourism; that is, astro-tourism was not its main focus. Although, the number of articles focusing on astro-tourism has been increasing since 2010, the total number is still small. This shows that even as a global trend, astro-tourism research within tourism research has only begun.

Additionally, a broad look at the history of tourism research reveals the novelty of astro-tourism research. It can be said that “ecotourism” was first discussed at the Stockholm Conference in 1972 and the World Conservation Strategy published in 1980 by the IUCN, WWF, and UNEP (Kaizu & Maita, 1999, p. 18). Additionally, “sports tourism,” defined as “travel away from the loving area for a certain period that includes elements of sport, characterized by unique rules, competition based on superior physical ability, and play and frolicking,” has also been attracting academic attention since the mid- to late-1990s (Ito & Hinch, 2017, p. 775). In other words, tourism phenomena based on special tourist interests, that is, branching out of tourism, from “mass tourism” to “alternative tourism” and “sustainable tourism”, have been recognized since the 1980s and 1990s. According to Yasumura (2001, pp. 144–145), these changes in tourism forms indicate a mutuality between the transition from “advanced modernization” and “post-modernization” international society. Kanda (2015) asserted that the current tourism research has been influenced by a “cultural turn” and a “spatial turn” since the 1980s. Since the 1990s, the number of tourism studies on cultural and spatial theories has been increasing. Thus, astro-tourism, with its 2010 or post-2010 origin, is a new research topic, given that tourism forms and tourism research have been shifting in new directions since the 1980s and the 1990s.

Furthermore, astro-tourism research has the potential to provide a new perspective on existing tourism studies. Sustainable tourism is a concept based on the reflection on mass tourism, which in many cases caused environmental destruction and economic disparity (Shimakawa, 2002, pp. 47–48). The Brundtland Report, which introduced the concept of sustainable tourism was published over 30 years ago, and it is now time to update the definition of sustainable tourism. In fact, in tourism research, the “trans-modern” theory, a sublimation of the post-modernity theory, has been gradually attracting attention. Ohashi (2019b, p. 10) argued for the

necessity of focusing on trans-modernity as a new concept to replace post-modernity, arguing that global tourism research trends cannot be discussed without considering the trans-modernity theory. Based on his perspective, astro-tourism is a typical tourism form that exists exactly at the turning point in contemporary tourism research. Therefore, astro-tourism research has a potential to contribute to provide a holistic framework of tourism research in future. Although it is beyond the scope of this study to discuss this point in detail, it is conceivable that astro-tourism research, which is “little narratives,” leads to “grand narratives” of tourism research as a whole, given the beginning of the period of astro-tourism research.

2. Targeted Countries

Case studies are the pre-eminent research method in social sciences (Yazan, 2015) and are considered effective in complex and non-repetitive cases because they can identify phenomena unidentifiable through statistical analysis. Thus, they are often used to verify existing, and build new, theories (Sawabe, Cooper, & Morgan, 2008). According to Robinson & Novelli (2005, pp. 8–9), case studies are useful for a comprehensive discussion on niche tourism research. Based on this perspective, this section discusses the geographical characteristics of the countries selected as case studies in astro-tourism research. The results are shown in Figure 3.¹⁷

The Republic of South Africa (RSA) tops the list with 15 articles (17%), followed by Chile (seven articles [7%]), the US (six articles [6%]), and Portugal (five articles [5%]). The geographical characteristics of these results converge on the following two points: first, the presence of international observatories in the country. In Chile—the setting of the film *Nostalgia de la luz*—there is the Gemini South telescope, operated by the Association of Universities for Research in Astronomy (AURA), and the Cerro Tololo Inter-American Observatory (CTIO), operated by the National Optical Astronomy Observatory (NOAO) (Smith et al., 2015b). Additionally, the Antofagasta region houses the Atacama Large Millimeter/submillimeter Array (ALMA) Observatory and the Atacama Submillimeter Telescope Experiment (ASTE) telescope (National Astronomical Observatory of Japan (NAOJ), 2020). Regions with international observatories attract local people’s interest in astronomy; thus, we identified some articles on science communication (e.g., Vernal, 2014; Vernal, 2015) and reports of outreach activities by astronomers (eg., Smith, 2001; Smith et al., 2015b). The second point is that the country has been or is to be certified under the IDSP program

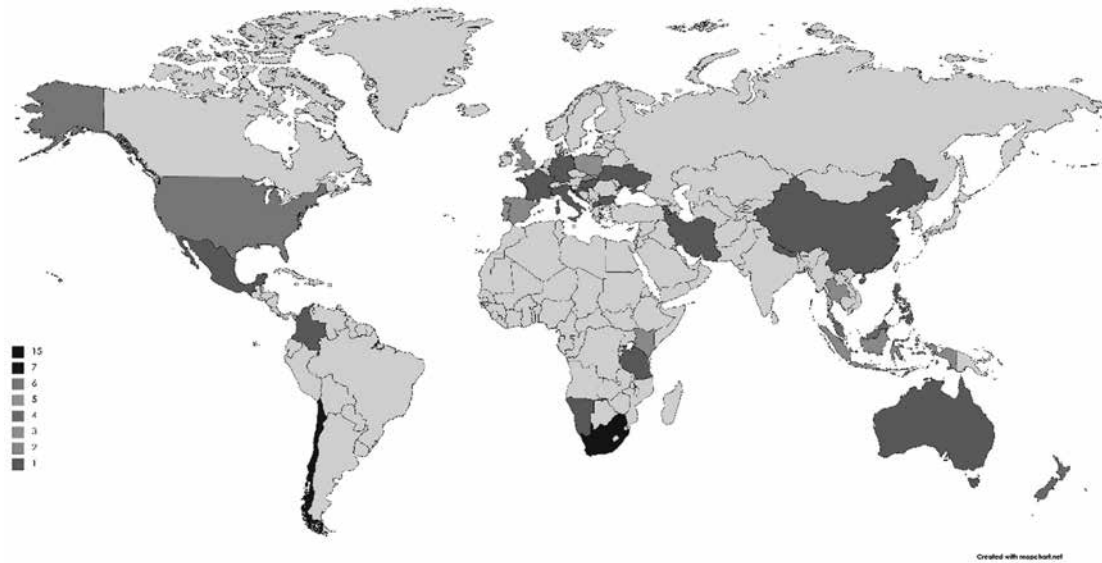


Figure. 3 Targeted Countries (Authors' original work)

of the IDA. This program has the following five categories: international dark sky community, international dark sky parks, international dark sky reserves, international dark sky sanctuaries, and urban night sky places (Ochi, 2016, p. 18). However, the majority of the accredited destinations were in the US (International Dark-sky Association, 2020). Hence, there were some articles on the trends and activities of accredited national parks in the United States. For example, Collison (2012) conducted a secondary study on astro-tourist trends in the IDSP-certified Bryce Canyon National Park. Similarly, an article was about the Hungarian IDSP-certified Hortobágy National Park (Gyarmathy, 2017). A few articles showed that the Alqueva region in Portugal is being considered as an international dark sky reserve (e.g., Rodrigues et al., 2015), where astro-based tourism development is centered on “Dark Sky Alqueva” —a cooperative organization of private tourism-related businesses and astronomical professionals (Dias-Sardinha et al., 2014). It is attracting tourists by marketing itself as the world’s first “starlight tourism destination” (Dark Alqueva, 2020). The following section provides an overview of research trends in the RSA.

(1) Astro-tourism in the Republic of South Africa

This section provides an overview of the current situation of astro-tourism research in the RSA, which has a long history of astronomy. The French astronomer Nicolas-Louis de Lacaille stayed in Cape Town in 1751–52 to observe southern hemisphere objects (Twidle, 2019, pp. 4–5). John Herschel also observed them in Cape Town during 1834–38 to complement the work of his father, William Herschel (Ingle, 2010, p. 92). The RSA has undergone significant astronomical development

in recent years, with the installation of the South African Large Telescope (SALT)—an international observatory, the Square Kilometer Array (SKA), and the Karoo Array Telescopes (MeerKAT) among a group of radio telescopes. According to Ingle (2010, p. 93), the RSA became a “space destination” .

A case of the Karoo region of the RSA, is given here, as one of the leading astro-tourism destinations in the country. In 2007, the region was designated as a suitable area for astro-tourism development through the “Geographic Advantage Act,” which related to the realization of optical and radio astronomy observations (Govender, 2009, p. 578). However, there are various issues associated with astro-tourism development in the region.¹⁸ The issues are discussed below, and be extended to Japanese tourism research.

Ingle (2010) examined the spatial transformation of the Karoo region: from a once desolate space to an astro-tourism destination, using the concept of “sublime.” According to him, astro-tourism developments in Karoo have two general effects: first, the promotion of science education in the RSA. In 1990s, the country’s education system was “stuck,” but following the SALT and SKA programs, science literacy has spread in the country (Ingle, 2010, pp. 95–96). In fact, “the SALT Collateral Benefits Program (SCBP)” listed the dissemination of science education as one of its goals. Manoxoyi (2016, p. 36) listed the following three effects of the SCBP: providing opportunities for astronomical education to local children; strengthening cooperation with domestic and foreign universities; and conducting courses on astronomy for schoolteachers in the RSA. According to Ingle (2010, p. 101), astronomical developments in the Sutherland region around the SALT have led to a rapid increase in the number of tourism-

related facilities, including restaurants and hotels. Additionally, the number of names of tourism facilities related to astronomy increased; Jupiter Restaurant; Southern Cross B & B etc. Manoxoyi pointed out that the number of annual visitors in Karoo increased from less than 250 before the installation of the SALT, to 13,000 in the succeeding period (Manoxoyi, 2016, p. 35). He noted that the tourism effect has stabilized employment in the region, and the migration —especially of intellectuals— to the place has increased (Ingle, 2013, pp. 66–67).

As mentioned above, Karoo has gained both educational and socio-economic benefits from astronomical and astro-tourism development initiatives. Some researchers, however, doubt their effectiveness. Atkinson (2016) focused on the issues related to the construction of the SKA, arguing that development by the RSA’s government and international astronomers occurred without sharing information with the local community, which caused misunderstandings. The SKA also caused problems within the local community. For example, locals cannot freely use electronic devices because the SKA is a radio telescope. Additionally, the jackal and lynx population increased owing to the government’s monopolistic purchase of land, which caused considerable damage to sheep farms. In view of the current situation in Karoo, where these problems were obvious, she was suspicious of the media and researchers, including astronomers, who were touting the benefits of the SKA. She vehemently denounced the policy, asserting that the economic and social losses to the region are greater than the tourism benefits derived from the SKA.

Although the problems caused by the development of the SKA are specific to the RSA as a developing country, it is possible to connect Atkinson’s argument with the discussion of *kanko machizukuri* (tourism and urban planning), which is among the main topics of tourism research in Japan. At first glance, the development of the SKA and astro-tourism, which

disregard the interests of locals, are consistent with what Ishimori (2001, p. 21) calls “exogenous tourism development.” However, as Sudo (2008, pp. 34–35) highlighted, the dichotomy of “endogenous/exogenous” is an extremely simplistic argument while considering recent tourism development in Japan. In fact, there were a few positive aspects of tourism development in the Sutherland area around the SALT. Therefore, “exogenous tourism development” is not necessarily bad. The key point in the discussion of *kanko machizukuri* refers to the consideration of locals’ opinions as much as possible to win their support (Yasumura, 2006, p. 129). In the case of the SKA, the biggest problem was the lack of such a perspective.¹⁹ Astro-tourism destinations are usually discovered spontaneously by amateur astronomers, regardless of the intervention of local residents (Fayos-Solá et al., 2014, p. 667). However, astro-tourism development must be based on local’s interests and aspirations. It is, therefore, important to discuss astro-tourism development from the perspective of *kanko machizukuri*, which has a more dynamic meaning beyond the dichotomy of “endogenous/exogenous.” Additionally, while most of the articles analyzed in this review emphasized the positive aspects of astro-tourism promotion and astronomical development, Atkinson’s perspective is remarkable because of the criticism of these trends. It should also be noted that in order to bring astro-tourism within the ambit of tourism research, a critical perspective from tourism researchers is necessary.

3. The Author’s Research Area

This section provides an overview of the specialized disciplines of astro-tourism researchers and how it may be discussed in the context of tourism research. The results are shown in Figure 4.

The analysis shows that the largest number of astro-tourism

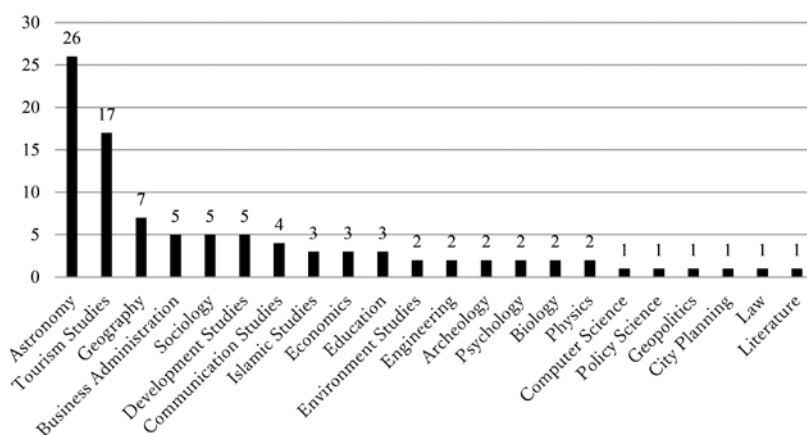


Figure 4 The Author’s Research Area (Authors’ original work)

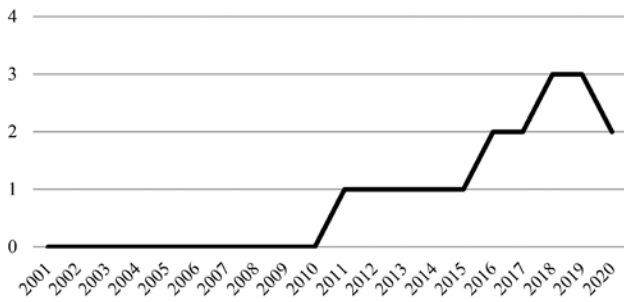


Figure 5 The Number of Articles by Tourism Researcher (Authors' original work)

research was published by astronomers (29%), followed by tourism researchers (20%) and geographers (5%). From this result, it is clear that astronomers were conducting most of the astro-tourism research in the current situation. Though Yamada (2016, p. 23) pointed out that humanities and social sciences play a major part in tourism research in developed countries, in the case of astro-tourism research, astronomers—they belong to the domain of natural sciences—have a strong influence. However, studies on astro-tourism by tourism researchers have been steadily increasing since Weaver's (2011) article (Figure 5). Additionally, while astro-tourism research has been actively conducted from the perspectives of humanities/social sciences subjects, such as business administration, sociology, and economics, there have also been a few attempts from the perspectives of natural sciences, such as engineering, physics, and biology. It is well studied that, tourism produces numerous socio-economic effects on a place. Therefore, it is necessary to construct a synthetic concept that combines both humanities/social sciences and natural sciences to study tourism phenomena (Hayasaki, 2002, p. 111). Yasumura (2015) stated the importance of promoting interdisciplinary research for tourism studies to establish it as a "practical discipline" —in practice, however, a dialog between humanities/social sciences and natural sciences is difficult. Current astro-tourism research is multi-disciplinary rather than interdisciplinary and it is not yet fully established. However, astro-tourism research was first proposed by astronomers and natural sciences researchers, and humanities/social science researchers followed suit. Therefore, interdisciplinary research lowering the boundaries between humanities/social sciences and natural sciences is expected, as astro-tourism research, lead by natural science, has developed in a different manner compared to other types of tourism research. In the following section, articles by Weaver (2011) and Fayos-Solá et al. (2014) are reviewed, as the main authors of tourism research literature, who provided the concept and guidelines of astro-tourism research.

(1). Weaver's Discussion

The first to discuss astro-tourism from the perspective of tourism research was an Australian tourism researcher, David Weaver. Weaver (2011, p. 39) called it "celestial ecotourism," that is, "ecotourism, where the interest of visitors is focused on the observation and appreciation of naturally occurring celestial phenomena," and positioned astro-tourism as an advanced "speciation" of ecotourism. Weaver argued that tourism attractions in "captive," such as planetariums, are not included in celestial ecotourism, even if they indirectly support the tourism sector. In his concept, three types of celestial ecotourism were identified, based on the time of observation of astronomical phenomena: "nocturnal," "diurnal," and "crepuscular." He categorized starry skies, the moon, meteor showers, and the aurora borealis as examples of "nocturnal;" rainbows, solar/lunar eclipses, and sun dogs as examples of "diurnal;" sunrises, sunsets, and midnight sun as examples of "crepuscular." Additionally, he classified two types of observations: naked-eye observation and "assisted" or "aided eye" observation enabled by telescopes and other optical devices (Weaver, 2011, p. 39).

Here, we critically analyzed Weaver's work on two points: first is, Weaver's definition of celestial ecotourism. As mentioned above, Weaver excluded planetarium visit from his definition. This is most likely because he was an ecotourism researcher. In other words, he believed that observing starry skies in nature is "real" whereas their observation in artificial places, such as planetariums, is a "copy." However, in Japan, planetariums have played —and continue to play— an important role in the development of astro-tourism. In fact, when Japanese astro-tourists admire a starry sky, most of them exclaim: "Wow, it's just like the stars in a planetarium!"²⁰ Therefore, Japan is home to a unique phenomenon where the planetarium experience, which Weaver considered a "copy," has authenticity for Japanese astro-tourists. This is because Japan is a "big country of planetarium" (Okyudo, 2019) where some planetariums project the stars of the 6th magnitude or higher, invisible to naked eyes, such as "megastars" (Ohira, 2016). Astro-tourism in Japan transcends the dichotomy between open stargazing and planetariums. Therefore, it cannot be discussed based on the "real/copy" dichotomy proposed by Weaver (Sawada, 2020). A theoretical discussion based on this perspective is a subject for another study, but we believe that this cannot be fully discussed with Weaver's concept.

Second is, Weaver's critical view toward astro-tourism. According to him, "celestial ecotourism" does not directly impact tourism attractions because of the physical distance

between the tourists and the object, that is, the sky, but he stressed the importance of “ecological and sociocultural sustainability” in astro-tourism (Weaver, 2011, p. 42). Specifically, he cited the issues of “visual pollution” associated with observatory construction, the accumulation of spatial footprints from stargazing and aurora viewing, and the high energy consumption from traveling (Weaver, 2011, p. 42). Although his criticism was more about tourism than astro-tourism, it seems that he attempted to understand the full picture of the tourism phenomenon through astro-tourism.

Weaver’s article was a conceptual discussion, not an empirical research, of astro-tourism, which is why some researchers criticized his article. Soleimani et al. (2019, p. 2309) made three arguments; Weaver’s definition of “celestial ecotourism” cannot be discussed in the context of special-interest tourism (SIT); the nomenclature is unfamiliar to the public; and celestial ecotourism was defined without discussing with astronomers and tourism operators. Thus, according to Soleimani et al. (2019), Weaver’s article is not significant enough for future research, although the article, the first to provide guidelines for astro-tourism research, could be regarded as an important part of the literature. His attempt to understand astro-tourism from the perspective of ecotourism was also unique and full of challenges, based on which astro-tourism research will continue to grow.

(2) Fayos-Solá et al.’s Discussion

Eduardo Fayos-Solá is a Spanish tourism researcher in the tourism education department at the World Tourism Organization (UNWTO) (Perdo, 2019, p. 466). Fayos-Solá et al. discussed astro-tourism research from the perspective of tourism policy and governance, defining astro-tourism as “an activity based on astronomical and scientific knowledge, carefully conserved, as a natural resource” (2014, p. 663). They highlighted the growth of astro-tourism since the turn of the 21st century, which in turn was based on public interest in astronomy since the 1950s, when space exploration technologies were developed. However, looking at the supply side (the host side), they stated that, due to increasing demand, spaces never considered as tourism destinations could suddenly develop into astro-tourism sites. Therefore, systematic tourism policies and governance are important for sustainable development of astro-tourism (Fayos-Solá et al., 2014, p. 667). Additionally, they proposed that astro-tourism is not only about enjoying the night sky but should include astronomical culture and heritage as tourism resources. Therefore, astro-tourism policy must encompass “archeoastrotourism,” which combines

astro-tourism with archeological heritage (Fayos-Solá et al., 2014, p. 666).

Thus, they capture astro-tourism as a concept included in “scientific tourism.”²¹ According to their article, astro-tourists want to experience a night sky free from light pollution, as well as acquire a wealth of knowledge related to astronomy (Fayos-Solá et al., 2014, p. 669). In some other articles analyzed in this review, a few authors have discussed astro-tourism as scientific tourism (e.g., Jacobs et al., 2019b). These perspectives seem to be related to the characteristics of astro-tourism research in Japan. Thus, it is questionable whether Japanese astro-tourists intend to acquire scientific knowledge as well. Nakakushi (2009, p. 205) observed that although astronomy attracts more public interest than other disciplines, Japan is also grappling with “science-phobia”. Hashimoto (1999, pp. 14–15) argued that the enjoyment of tourism lies in “acquiring a little knowledge that is different from studying,” and tourism nothing but “bunches of a little enjoyment”. The Japanese are losing interest in science, and if tourism is defined as a different kind of enjoyment from studying, it is questionable whether astro-tourism can be considered as scientific tourism. However, this is a conceptual discussion, and there is no empirical research on astro-tourists in Japan. Whether astro-tourism in Japan should be established as scientific tourism is open to debate.

The discussion by Weaver’s and Fayos-Solá et al. are conceptual, not empirical. Nonetheless, their articles should be valued as the foundation. Future research may employ empirical approaches actively to implement this theoretical foundation, which is pointed out in this paper.

4. Research Topic

This section provides an overview of the research topics covered by astro-tourism research. Ito & Hinch (2017) also provided a coding for an overview of the main topics in Japanese sports tourism research. They classified the topics based on the three elements of “society and culture,” “economy,” and “environment” based on the “triple bottom-line theory” in sustainable tourism. However, the three categories are not mutually exclusive, and they overlap. The findings were therefore difficult to objectively categorize into coding, the following seven categories were employed; “dark place,” “observatory,” “comet,” “aurora,” “solar eclipse,” “rocket launch,” and “space.” However, even in this coding process, some articles were difficult to categorize appropriately. Weaver (2011), for example, refers extensively to “dark places,” “observatories,” “comets,” “auroras,” and “solar

eclipse.” Wherever appropriate categorization was difficult, we classified as “other.”

As a result of the analysis, 54 articles (56%) were classified as “dark places;” 12 (13%) as “observatories;” four (4%) as “space;” one (1%) as “solar eclipse;” three (3%) as “other;” and 22 (23%) were “not applicable.” The current astro-tourism research is mainly focused on “dark places” because this research was mostly conducted by astronomers, who believe that protection of dark skies promotes astro-tourism (e.g., Walker et al., 2012, p. 760).²² In particular, the “certification system” plays a major role in dark-sky protection. These systems include the IDSP program by the IDA, the Royal Astronomical Society of Canada (RASC)’s Dark-Sky Site program, and the Starlight Foundation’s certification program in Spain (Barentine, 2019). The United Nations Educational, Scientific, and Cultural Organization (UNESCO) is also considering an “Astronomical Heritage” program (UNESCO, 2018). Although this program has not yet been implemented, but UNESCO’s focus on a heritage system related to astronomy is remarkable. These certification systems are linked to the “International Year of Astronomy 2009” implemented by the International Astronomical Union (IAU), for which a specific definition was established in the “Kazan Resolution” in 2009 (Rodrigues et al., 2015, p. 216). In Japan, the Ministry of the Environment (MOE) ran *Zenkoku Hoshizora Keizoku Kansatsu* (MOE, 2013) until 2013, and its successor, *Hoshizora Kansatsu* (MOE, 2020), which are not certification systems, but the biannual results of stargazing observations. Achi Village in Nagano Prefecture—a leading astro-tourism destination in Japan—invites astro-tourists using a slogan that ranked first in Japan in 2006 in *Zenkoku Hoshizora Keizoku Kansatsu* (Sakamoto et al., 2020, p. 46). Thus, there is a growing international momentum for the protection of dark skies through certifications—the IDA being the most recognized worldwide. In Japan, the Iriomote Ishigaki National Park received the IDSP certification in 2018, followed by Kozushima Village in Tokyo Prefecture in December 2020 (Kozushima Village, 2020). Additionally, Ibara City (former Bisei Town) in Okayama Prefecture (Ochi, 2020) and Ono City in Fukui Prefecture (Ono City, 2020) are also aiming for this certification.

From the perspective of tourism policy, these certification systems facilitate destination differentiation. An IDA certification guarantees the “authenticity” of dark skies (Uda & Isono, 2019, p. 144). Fayos-Solá et al. (2014, p. 666) indicated that most astro-tourists visit from metropolitan areas affected by light pollution, and are overwhelmed by

the stars-strewn skies—a rare visual spectacle for them. In other words, the beauty criteria of the night sky are defined by the space in which astro-tourists live; thus, it is difficult to create a difference in visual impressions between astro-tourism destinations. In fact, when comparing the results of “Globe at Night,” there was no significant difference between the results for Achi Village, Nagano Prefecture, and Yoron Town, Kagoshima Prefecture (Sawada & Okyudo, 2020a). Hence, astro-tourists’ behavior is induced by the “authenticity” guaranteed by the certification system. Therefore, in the context of tourism research, the issue of tourism promotion by certification systems, especially UNESCO’s World Heritage Site registration, is frequently discussed (for example, Saitsu (2006); Ono (2008)). Collison & Poe (2013, p. 12) remarked that the IDA certification attracts astro-tourists in the short-term, but its medium- to long-term impact is unclear. Therefore, in order for astro-tourism destinations to develop sustainably, it is necessary to establish a new tourism policy from a different angle, rather than a certification system. It is hoped that research based on the perspective of tourism research is conducted to determine the appropriate relationship between certification systems and astro-tourism. Additionally, aurora tourism and solar-eclipse tourism are popular in Japan (Weaver, 2011, p. 41), but research on these forms of tourism is scarce (Okyudo et al., 2009; Amano, 2010; Okyudo et al., 2010). Thus, in the context of Japanese astro-tourism research, academic focus must be laid on dark places, aurora tourism, and solar-eclipse tourism.

IV. Conclusion

In this study, a systematic review of English astro-tourism research was conducted in the larger context of tourism research in Japan, given the current scarcity of the astro-tourism research in Japan. The following four points were identified:

- (i) Astro-tourism research outside Japan has been indirectly discussed by astronomers since the 2000s, and from the perspective of tourism research, since the 2010s.
- (ii) Those countries were mainly selected for astro-tourism research case studies that have international observatories, such as the RSA and Chile, and those certified or about to be certified by the IDA, such as the US and Portugal.
- (iii) Currently astro-tourism research was mostly conducted by astronomers, but the number of articles by tourism researchers is gradually increasing.
- (iv) Currently, the most popular research topic in astro-

tourism studies was dark places.

A major research focus today is on “sustainable tourism development” based on the “triple bottom line theory” (Ohashi, 2019a, pp. 49–50). Astro-tourism ensures sustainable development from the standpoint of both tourism operators and tourism researchers (Sawada & Okyudo, 2020b). This form of tourism is particularly useful for creating a night-time economy, hitherto not explored well in Japan (Uda & Isono, 2019, pp. 277–278). The creation of suitable astro-tourism destinations necessitates light-pollution prevention, which requires a dark-sky protection movement on the host side (Weaver, 2011, p. 43). It will also show that the effects of light-pollution control include the conservation of plants and animals affected by artificial light, and reduction of human health issues, such as sleep disturbance (Manning et al., 2015, p. 1). Thus, astro-tourism promotion will contribute to the protection of dark skies, with cascading positive effects on biological systems. In the US, more than 99% of the population lives under some form of light pollution, and two-thirds of them cannot see the Milky Way from their homes (Cinzano et al., 2001, p. 701). If the Milky Way view is restored to the night sky, we could recall the “star lore” forgotten in our modern life (Fayos-Solá et al., 2014, p. 666). Thus, astro-tourism is gaining attention worldwide, including in Japan, as a tourism option where “economy,” “environment,” “society,” and “culture” are not in conflict. However, value of such development needs to be discussed, especially by tourism researchers, who can provide critical perspective on astronomical developments, as did Weaver (2011) and Atkinson (2016). Such a critical perspective is important in establishing astro-tourism as a systematic field of tourism research.

Tourism is a mirror that reflects the society. According to Urry (1990), tourism is a product based on the dichotomy between the ordinary and extraordinary life; thus, an examination of the typical objects of “tourist gaze” leads to a grasp of the basic structure of a society. In other words, we can understand the social potentials of astro-tourism by studying the recent development trajectory of tourism. Astro-tourism is a new field of research, attracting global attention since 2010, and academic interest in this space is expected to increase in the future.

V. Limitations

Finally, some limitations of this study remain. First, a “keyword search” was conducted using “astro tourism,” “astro-tourism,” and “astronomical tourism;” but, there are

other similar terms. If astro-tourism is an “activity where people travel from their place of residence in order to look up at beautiful starry sky and celestial bodies,” then “dark sky tourism,” discussed by Mitchell & Gallaway (2019) can be included in this category. The “dark sky tourism” keyword search on Google Scholar extracted 38 articles. We excluded this term from this review as we anticipated these articles to be classified as “dark place” in the coding of “research topics,” section III -4. However, it is necessary to include such similar terms in subsequent reviews. The second limitation relates to the measure regarding the omission of irrelevant articles. Pulido-Fernández et al. (2019, p. 3) conducted a review on olive-oil tourism (OOT), and in their review procedure, there was an eligibility criterion to exclude articles in which the relevant term was used only once or twice. In fact, in our review, there were a number of articles in which the term was used only a few times. We did not set the above eligibility criteria because we aimed to extract a wide range of articles on astro-tourism, but it is important to apply such criteria to extract more relevant articles in the future. Third, this study did not set eligibility criteria related to peer review, as did Yamaguchi et al. (2018, p. 16), because, as mentioned above, we aimed to select a wide range of articles. Additionally, it was not clear in case of a few studies whether they were peer-reviewed or not. Moreover, owing to article-length limitation, we could not fully discuss this point in Chapter III. We will resolve these issues in future empirical studies. Despite these limitations, to the best of our knowledge, it is the first attempt to analyze astro-tourism research extensively, both domestic and foreign, using a systematic review, which we expect to contribute to the development of astro-tourism research.

Footnotes

- 1) A Japanese version of the guidebook of astro-tourism is available in Agata, H (Ed.) (2019a), “*Nippon no Hoshizora Turizumu: Mikata, Ikikata, Tanoshimikata*,” Hara Shobo.
- 2) “Hoshizora Hogoku” is the Japanese translation of International Dark-Sky Places program and includes all five categories of the program. This term was registered as a trademark by the IDA Tokyo Branch (2018) and is now owned by the Dark-Sky Promotion Agency (2020).
- 3) In *Japan Sustainable Tourism Standard for Destination (JSTS-D)*, “light pollution and noise” were listed separately, and it was stated that “it needs to considerate lighting in the surrounding areas where astronomical observations.” This suggests that the Japanese standard is clearly designed with astro-tourism in mind (Japan Tourism Agency, 2020).
- 4) In the case of the CiNii search, the former was not applicable, and the latter was only applicable to Okyudo (2018). Google Scholar search of *asutro turizumu* and *tenmon kanko*, excluding double quotation marks, yielded eight results for the former and 1,630 results for the latter (as of

- August 7, 2020). As both were not related to either tourism or astronomy, this review did not deal with them in detail.
- 5) We briefly explain the articles written by Okyudo (2018) and Uda & Isono (2019), which were extracted by CiNii and Google Scholar searches. Okyudo, an astronomer, discussed the astro-tourism development process in Japan, comparing the history of planetariums and public observatories. His definition of astro-tourism (*tenmon kanko*) is in contrast to “space tourism,” and based on his other studies (Okyudo, 2017; Okyudo et al., 2017). Uda & Isono (2019), who are geographers, discussed stargazing as a tourism resource in Ishigaki Island, Okinawa Prefecture. They argued that astro-tourism can help create a night-time economy. Their foresight studies will be reflected in future discussions of astro-tourism research in Japan.
 - 6) Weed (2006a) lists three types of review methods as conflicting narrative review: systematic reviews, meta-analyses, and meta-interpretations. In this study, however, we were not particularly concerned with the differences between these three types of review and use the term “systematic review.”
 - 7) In systematic reviews, it is usual to perform effect size measurements (Yamada, 2012), which Ito & Hinch (2017) did not perform. This is the rationale for considering their study as a combination of systematic and narrative reviews.
 - 8) Slavin (1986) advocated the “best-evidence synthesis,” which combines the advantages of both systematic and narrative (traditional) reviews, on the basis that systematic reviews (meta-analyses) have a variety of problems. Best-evidence synthesis combines the advantages of systematic reviews, which allow for quantification and systematic literature searches, with those of narrative reviews, which allow for a clear and detailed discussion. It should also be noted that this review relies on Slavin’s (1986) discussion.
 - 9) Weed (2006b) and Martin & Assenov (2012) set the year of publication as an eligibility criterion for systematic reviews. However, we reviewed a wide range of astro-tourism studies, thus, did not set this eligibility criterion.
 - 10) While searching Google Scholar, multiple versions (e.g., in the publisher’s electronic journal, in institutional repositories, or in private ownership) of the same article may be extracted (Sun, 2012, p. 68). Truly duplicated articles were excluded from this study.
 - 11) Azuma, H, the author of *Kanko Kyaku no Tetsugaku*, called himself a critic, not a tourism researcher (Azuma, 2017, pp. 6, 17). Thus, even those who discuss tourism phenomena do not identify themselves as tourism researchers.
 - 12) Zhao & Ritchie (2007) categorized the specialized disciplines of tourism researchers. They categorized tourism researchers by focusing on the author’s final degree. According to them, only a small number of researchers have a final degree in tourism studies, with geography and leisure studies accounting for the majority (Zhao & Ritchie, 2007, p. 482). However, researchers who are influential in current tourism studies tend to belong to departments or centers that offer tourism-related doctoral programs, even if they do not have a degree in tourism studies (Zhao & Ritchie, 2007, p. 487). Considering their opinions, we set the eligibility criterion for their current specialization rather than focusing on their final degrees.
 - 13) It should be noted that the records for 2020 were the results of searches up to May.
 - 14) Zhang et al. (2014, p. 217) discussed the correlation between tourism destination image and loyalty in tourists through a meta-analysis. They identified 16 tourism research journals as targets of their analysis. In this study, we categorized the articles based on their measures.
 - 15) We defined “the title, abstract, or keywords” as eligibility criteria. However, Yamaguchi et al. (2018, p. 16) defined “the inclusion of the search phrase in abstract, title” as an eligibility criterion for their systematic review dealing with sports events studies. This criterion is considered to extract more relevant samples.
 - 16) As a result of this analysis, it was found that the study first appeared as two editions by Cater (2010) and Ingle (2010). Cater (2010) discussed astro-tourism in the context of space tourism and categorized three forms of astro-tourism: “astrotourism” including travel to the Moon, Mars, and sub-orbital flights; “atmospheric space tourism” including high altitude jet flights and weightless flights; and “terrestrial space tourism” including visit to space shuttle launch sites and virtual experiences of space travel. He also argued that tourism forms could shift from the lower concept of “terrestrial space tourism” to the more difficult form, that is, “space tourism,” based on Peace’s (1982) travel career ladder approach.
 - 17) The samples were not shown in Figure 3 include space tourism for four articles, and 22 were not applicable. Two of the UK samples were about the Pitcairn Islands, an overseas territory of the country.
 - 18) A special issue of the *Journal of Southern Africa Studies*, 33(2) was devoted to the issues of astronomical development in the Karoo region.
 - 19) There are also some issues with astronomical development in other countries. The TMT (Thirty Meter Telescope) project, in which the NAOJ participates, is being developed on Mauna Kea on Hawaii island, a sacred place for indigenous people, thus facing increasing opposition from local residents (Kahabanoku et al., 2020).
 - 20) A few tourists uttered these words when the first author conducted a field study on Ishigaki Island, Okinawa Prefecture, between March 17 and 20, 2020.
 - 21) To the best of our knowledge, there are two kinds of “scientific tourism” in tourism studies: researchers as tourists, and tourists seeking scientific knowledge. Cynarski & Ďuriček (2014, p. 40) defined the former as researchers’ visits to academic conferences, especially abroad, and the accompanying city walks and cultural heritage visits. The latter was defined by Kitamura et al. (2012, pp. 101-102) as *kagaku gijyutsu kanko*, that is, “tourism that aims to learn about science and technology, including natural science, by looking (observing, seeing), listening (hearing, communicating) and experiencing (touching, moving, making).” In this study, “scientific tourism” was discussed in terms of the latter meaning.
 - 22) Barentine (2019, p. 10) remarked that there is still no clear definition of a dark sky.

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Endnotes

1. This is an English translation of the original Japanese article: Sawada, K, & Okyudo, M (2021). Kokugai ni okeru Asutoro-Turizumu Kenkyu no Syoroncyo: Kokunai Kenkyu no Furemuwaku Kochiku ni mukete no Kosatsu. *Kankogaku (Tourism Studies)*, 24, 21–40. doi: 10.19002/AA12438820.24.21 [published in March, 2021]
2. The translation is done by the authors and the editing is supported by Research Activity Promotion Grants for Graduate Students of

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