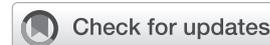


Viability of astrotourism in South African National Parks as a revenue source for conservation

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South African National Parks (SANParks) face increasing pressure to generate revenue from tourism. Astrotourism has been identified as a potential low-impact income generating activity suitable for parks. However, SANParks need to understand the potential elements impacting on viability of astrotourism prior to development of such activities. The aim of the study was to explore the viability of low environmental impact astrotourism activities in SANParks to generate income based on important economic and practical considerations. A mixed-methods approach, using responses from 1150 participants in quantitative online surveys, combined with insights obtained through qualitative semi-structured interviews with 13 stakeholders in SANParks and 42 semi-structured interviews with stakeholders of global astrotourism initiatives, was used. Results from the online survey indicated that a demand exists for astrotourism activities in parks. Interest in astrotourism activities appealed to a wide range of respondents, from those with limited knowledge of astronomy to experts in the field. Tourists prefer authentic astrotourism experiences that have a low environmental impact and are not over-commercialised. The economic viability of astrotourism activities in parks was determined by considering demand and willingness to pay, while practical concerns derived from stakeholder interviews included suitable locations, availability of resources, expectations of the experience and challenges to be mitigated. In conclusion, astrotourism activities, if developed with these considerations, can be viable income-generating opportunities to generate direct income for SANParks and add value to the regional economy.

Conservation implications: South African National Parks need to develop income-generating activities with a low, non-degrading environmental impact to fund conservation. If implemented with the practical considerations highlighted in the article, astrotourism might be a viable option.

Keywords: astrotourism; stargazing; income-generating activities; viability; willingness to pay; light pollution; low environmental impact; SANParks.

Introduction

National parks play a major role in the South African tourism industry and economy by contributing substantially to the gross domestic product, foreign exchange income and employment opportunities (Boshoff et al. 2007; Engelbrecht 2015; SANParks 2012). South African National Parks (SANParks) act as custodian to conserve ecosystems and biodiversity in South Africa through the management of unique biomes (Hermann et al. 2016; Kruger, Saayman & Slabbert 2015). Expansion of nature-based activities in parks is receiving particular attention (SANParks 2017). South African National Parks must remain competitive in offering tourist attractions while utilising each park's competitive advantages to its full potential (Engelbrecht 2015). Reduced government funding compels SANParks to generate income, rely on its own resources and remain sustainable (Engelbrecht 2015; Kruger et al. 2015; SANParks 2012). Any activity developed must be responsibly managed and have a low environmental impact to remain within SANParks' conservation mandate (Engelbrecht 2015; SANParks 2012). Astrotourism has been identified as a potential low-impact activity that could be beneficial to SANParks. This article focuses on economic viability to determine the sustainability of astrotourism and diversify the economy by finding new income sources (Koodsela, Dong & Sukpatch 2019; Sanagustín-Fons, Moseñe Fierro & Patiño 2011). Economic viability stimulates economic activity and growth to support local economies (Koodsela et al. 2019) and thus play a significant role in generating an income to conserve the natural environment.

From literature, it was found that astrotourism requires an unpolluted night sky, a naturally available resource, to develop activities with a particular focus on astronomical observations

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(Belij & Tadic 2015; Fayos-Solá, Marín & Jafari 2014). Astrotourism destinations offer high-quality night sky views through conscious light pollution reduction initiatives (Begley 2016; Jacobs et al 2019). Because of astrotourism relies on minimally polluted dark skies, remote sites such as national parks usually offer optimal conditions (Batinoluho 2024; Begley 2016; Soleimani et al. 2019). Astrotourism can fulfil a niche market within the tourism industry, while providing economic development and employment opportunities in rural areas (Batinoluho 2024; Fayos-Solá et al. 2014; Jacobs et al. 2019). Astrotourism has been established in various North American parks through interpretive night sky programmes (Mace & McDaniel 2013; Manning et al. 2015) and have become some of the best-attended events in these parks, attracting tourists globally (Betz 2019). Similarly, European dark sky initiatives provide a unique and sustainable way to provide income to rural regions (Carter 2013; Rodrigues, Rodrigues & Peroff 2015). Astrotourism is increasing in Australia and New Zealand, with areas where 'the main economy [is] astrotourism' (participant [P]27; Trusock 2015). Although limited literature is available on astrotourism, mapping artificial light at night and the impact thereof on the environment in Africa showed that the continent still has large areas with pristine night skies (Coetzee et al. 2023). However, its astrotourism potential has not been fully explored and requires improved coordination among existing initiatives (Batinoluho 2024; Jiwaji 2016). Increased interest in pristine night skies has been observed among the South African public (Ras 2017; Van Zyl 2014). The Karoo presents outstanding conditions for astrotourism, prompting the growth of other tourist amenities and astrotourism activities by local entrepreneurs (Dyer 2014; Ingle 2011a, 2011b; Jacobs et al. 2019; Van Zyl 2014). The observatory in Prince Albert, the South African Large Telescope (SALT) and the South African Astronomical Observatory in Sutherland, as well as the development of the MeerKAT (Karoo Array Telescope) as part of the multinational Square Kilometre Array (SKA) facility near Carnarvon, attract astronomers, scientists and tourists (Dyer 2014; Van Zyl 2014). Various local astronomy clubs present astrotourism events in pristine areas including the Magaliesberg and Cederberg (Van Zyl 2014), Makuleke Concession, Makhado and Waterberg areas in Limpopo, (Van Zyl 2014), the Anysberg Nature Reserve and Marakele National Park (henceforth abbreviated as NP) (Ras 2017; Van Zyl 2014), the Tankwa Karoo NP, Ai-Ais/Richtersveld Transfrontier Park and Mapungubwe NP (Ras 2017; Van Zyl 2014). All these destinations are popular for their pristine night skies and could potentially expand their activities to include astrotourism.

Astrotourism has been identified as a potential activity that could meet the income-generating needs of national parks while having minimal impact on the environment. However, current literature does not sufficiently explain the potential role of astrotourism activities in the diversification of product and experiential offerings in SANParks or its viability as a revenue source for conservation. To address this gap,

astrotourism and its viability as an income-generating opportunity in SANParks required research to facilitate the effective implementation thereof. The aim of the study was to determine the viability of low environmental impact astrotourism activities in SANParks to generate income based on important economical and practical considerations. The viability is determined by practical implications that are important to make an astrotourism activity successful. Thus, it was necessary to gain a deeper understanding of the potential role of these and other factors in the success of astrotourism activities. With the objective to meet visitor expectations as well as the requirements of SANParks, appropriate research was necessary to inform responsible development and implementation of potential astrotourism activities (SANParks 2016).

Research methods and design

This study used a mixed-methods approach, employing both a quantitative online survey and qualitative semi-structured interviews. As an exploratory study, it aimed to acquire more in-depth insights into a little-known research area. The qualitative component provided depth of understanding into the problem, while predictions were made possible by the quantitative component. The combination produced more complete insight into the research question than either research approach would have if employed alone (Schiffman et al. 2010).

Data collection

Online survey

Data from potential SANParks visitors were collected through an online survey completed by 1150 respondents from 33 countries between August 2019 and April 2020 (questionnaire available on request). The survey covered national parks in South Africa, but respondents included local and international visitors. The research was limited to adults, 18 years or older, to collect data from individuals who could decide on their own participation in activities. A combination of non-probability sampling strategies, including convenience, purposeful and snowball sampling was used. Respondents were recruited through email forwarding to members of the SANParks Wild programme and local astronomical societies, as well as participation requests on social media groups. The recruitment strategies aimed to reach potential tourists to SANParks, or respondents specifically interested in astronomy. Respondents self-selected by clicking on a link to complete the survey on the Survey Monkey Advantage platform (Clow & James 2014; Wassenaar 2021).

Reliability of the online survey questions was tested during the pilot study, using test-retest methods, with a Pearson correlation coefficient between 0.6 and 1.0 ($p < 0.05$) regarded as acceptable (Salkind & Frey 2014). Online survey questions relied on face validity and content validity and were based on a literature review of relevant concepts and similar surveys, expert revision of survey questions prior to data collection and pre-testing to determine the clarity of questions

to respondents during the pilot study. Data were analysed using SAS Version (SAS Institute Inc.; Cary, NC, United States of America) to arrive at frequency distributions of responses. Where applicable, responses to some questions were cross-tabulated to arrive at a greater depth of understanding of trends in the data collected.

Semi-structured interviews

Semi-structured interviews were conducted with two groups of participants. The first group focussed specifically on stakeholders from SANParks and included general, park, tourism and hospitality managers from SANParks. Purposeful sampling methods were used for semi-structured interviews based on an individual's role in SANParks. Referrals were made by SANParks regarding stakeholders to participate in semi-structured interviews based on their positions and potential to provide relevant information. The second group of participants included contactable stakeholders of various global astrotourism, stargazing and night sky initiatives as identified from an initial literature review, the website of the International Dark Sky Association (International Dark-Sky Association 2020) and stakeholder referrals. Inclusion criteria for this participant group required participants to be presenters or stakeholders of astronomy-related recreational pursuits offered to the public at initiatives not connected to SANParks.

Three interview guides were used based on the relevant information required from the specific stakeholder. The first interview guide was used to obtain policy- and management-related information from decision-makers within the top management of SANParks (SANParks Head Office). The second interview guide was used to obtain relevant practical information from individuals involved in the daily management of different national parks and their activities. The third interview guide was used to obtain extensive policy- and management-related, as well as practical information from stakeholders from global astrotourism initiatives. Interview guides (available on request) were used as guidelines to ensure all topics were covered but were flexible for follow-up questions. Fourteen interviews were conducted online and transcribed afterwards, and 41 through email, depending on each participant's preference. A total of 13 semi-structured interviews were conducted with SANParks stakeholders and 42 semi-structured interviews with stakeholders from other astrotourism initiatives (Table 1).

Data analysis

Information obtained from all the interviews was manually grouped by question on Microsoft Word by the researcher. Thereafter, it was grouped by theme as presented by the headings in the results section. The information under each theme was analysed to make comparisons, identify differences, make inferences from the practical experience presented by managers and draw conclusions. These

TABLE 1a: Semi-structured interview participants and online survey respondents.

Semi-structured interview participants	Participant code
Group 1: SANParks	
Mapungubwe National Park	SP1
Addo National Park	SP2
Marakele National Park	SP3
Karoo National Park	SP4
Kgalagadi National Park	SP5
Mokala National Park	SP6
Tankwa National Park	SP7
Ai/Ais-Richtersveld Transfrontier Park	SP8
Namaqua National Park	SP9
Augrabies National Park	SP10
SANParks Head Office	SP11
Garden Route National Park	SP12 and SP13
Group 2: Astrotourism initiative	
Arches and Canyonlands National Parks, Utah, USA	P1
Big Bend Ranch State Park, Texas, USA	P2
Big Cypress National Preserve, Florida, USA	P3
Bryce Canyon National Park, Utah, USA	P4
Capulin Volcano National Monument, New Mexico, USA	P5
Central Idaho Dark Sky Reserve, Idaho, USA	P6
Craters of the Moon National Monument, Idaho, USA	P7
Dead Horse Point State Park, Utah, USA	P8
Death Valley National Park, California, USA	P9
Dr T.K. Lawless International Dark Sky Park, Michigan, USA	P10
Enchanted Rock State Natural Area, Texas, USA	P11
Glen Canyon National Recreation Area, Arizona, USA and Rainbow Bridge National Monument, Utah, USA	P12
Fort Collins, Colorado, USA	P13
Goblin Valley State Park, Utah, USA	P14
Grand Canyon National Park, Arizona, USA	P15
Kartchner Caverns State Park, Arizona, USA	P16
Middle Fork River Forest Preserve, Illinois, USA	P17
Natural Sounds and Night Skies Division, USA	P18
Petrified Forest National Park, Arizona, USA	P19
Texas State Natural Area, Texas, USA	P20
Tonto National Monument, Arizona, USA	P21
De Boschplaat Dark Sky Park, Terschelling, Netherlands	P22
Elan Valley International Dark Sky Park, Wales, United Kingdom	P23
Exmoor National Park, England, United Kingdom	P24
Sternenpark Rhön, Rhön, Germany	P25
Australian Age of Dinosaurs Museum, Queensland, Australia	P26
Aoraki Mackenzie International Dark Sky Reserve, South Island, New Zealand	P27
Maasai Mara, Kenya	P28
Tanzania	P29
!Ae!Hai Kalahari Heritage Park, Northern Cape, South Africa, Namibia	P30
Anysberg Nature Reserve, Western Cape, South Africa	P31
ASSA Durban, KwaZulu-Natal, South Africa	P32
Boyden Observatory and Lamont Hussey Observatory, Free State, South Africa	P33
Department of Science and Innovation	P34
Grahamstown, Eastern Cape, South Africa	P35
Hartebeesthoek Radio Astronomy Observatory, Gauteng, South Africa	P36
Limpopo, South Africa	P37
Starwaders, South Africa	P38
Sterland Stargazing, Sutherland, Northern Cape, South Africa	P39
Waterberg, Limpopo, South Africa	P40
Canada	P41
Eastern Cape, South Africa	P42

Source: Wassenaar, A.S. & Coetzee, B., 2024, 'Global astrotourism initiatives and the applicability of their strengths, weaknesses, opportunities and threats to astrotourism in South African National Parks', *Journal of Outdoor Recreation and Tourism* 46, 100766. <https://doi.org/10.1016/j.jort.2024.100766>

SP, SANParks participant; P, participant.

TABLE 1b: Semi-structured interview participants and online survey respondents: Online survey respondents' demographic information (N = 1150).

Variable	n	%
Gender		
Male	613	55.3
Female	537	46.7
Age (years)		
18–25	39	3.4
26–35	120	10.4
36–45	210	18.3
46–55	246	21.4
56–65	316	27.5
≥ 66	219	19.0
Area of residence		
South Africa	1012	88.0
Europe and United Kingdom	88	7.7
North America	24	2.1
Asia and Australia	14	1.2
Africa (excluding South Africa)	9	0.8
South America	3	0.3

Source: Wassenaar, A.S. & Coetzee, B., 2024, 'Global astrotourism initiatives and the applicability of their strengths, weaknesses, opportunities and threats to astrotourism in South African National Parks', *Journal of Outdoor Recreation and Tourism* 46, 100766. <https://doi.org/10.1016/j.jort.2024.100766>

conclusions were then integrated and presented with the results of the online survey to arrive at a more comprehensive understanding of the research problem. (Wassenaar 2021)

The trustworthiness of results of semi-structured interviews was addressed through the consideration of credibility, transferability, dependability and confirmability. Credibility was established by conducting interviews with different internal stakeholders in different management roles as identified by SANParks based on their role and ability to provide credible and relevant information. It was further established through triangulation with results from the online survey. Results obtained through triangulation between interview and survey findings were ultimately combined to consider all relevant aspects in the recommendations section. (Wassenaar 2021)

Transferability between different contexts was confirmed by finding similar results from stakeholders involved in different national parks. While each park had unique circumstances, overall results presented multiple similarities, indicating a high level of transferability within the context of the different parks. The transferability of results to other contexts outside of SANParks will depend upon the similarities of the context to which it is applied with that of SANParks and can be determined by individuals who wish to apply it to other contexts.

Confirmability was established by keeping an audit trail of interviews from transcription, thorough analyses and presentation. Confirmability was further enhanced by limiting researcher bias through the presentation of results in the most direct way possible from original interview words and phrases as allowed by the consolidation of results. Records were kept of all interview transcriptions. Dependability was enhanced by the availability of interview

guides, the description of recruitment strategies and data analyses to allow repetition of similar research processes in the future (Wassenaar 2021).

Ethical considerations

Ethical clearance to conduct this study was obtained from the University of the Free State General/Human Research Ethics Committee (No. UFS-HSD2019/0185/1304). The study by Wassenaar (2021) was approved by SANParks (AST/2018/04). The privacy, anonymity and confidentiality of respondents and participants were protected throughout the research process, with prior consent obtained and rights and responsibilities provided prior to participation. No information collected from interviews or online surveys was made available to third parties in any form other than the anonymous, abstracted final published research results.

Results

Respondents to the online survey represented various age groups, with 53% being male and 47% female. As shown in Table 1, 88% of respondents were South African citizens, followed by 12% of respondents from Europe and 7.7% from the United Kingdom.

Viability of astrotourism activities in South African National Parks

Economic considerations

The viability of astrotourism activities in SANParks as an income-generating activity is reliant on various economic factors, such as demand, willingness to pay and marketing. Once a demand for such activities was observed, tourists' willingness to pay for astrotourism activities and marketing to the correct target market were found to play a vital role in the economic viability of the activity.

Demand: A demand for formally arranged astrotourism activities instead of simply observing the night sky on their own was identified. Seventeen per cent of respondents indicated that they would prefer to participate in formally arranged stargazing activities, 29% preferred to do stargazing on their own initiative and 54% of respondents indicated a preference to do stargazing both during formally arranged activities and on their own initiative.

Approximately half of the respondents (48.6%) indicated that they would be very interested and 39.5% indicated that they would be interested in astrotourism activities offered in national parks (Table 2). The overall trend was similar between South African residents and non-residents, with an even greater interest in such activities observed among non-South Africans. Likewise, Fayos-Solá et al. (2014) and Soleimani et al. (2019) found that interest from the public in night skies had increased the popularity of activities such as astrotourism as a special-interest product, particularly in natural areas. The interest in stargazing activities was not limited to respondents with a good or

expert knowledge of astronomy (Table 2) but included respondents with basic or no knowledge of astronomy. In Tanzania, Batinoluho (2024) found that 92.3% of international visitors were aware of astrotourism, while only 4.6% of locals were aware of astrotourism, limiting locals' support and participation in such activities.

When cross-tabulating data from responses that indicated an interest in stargazing activities in SANParks and individuals' level of knowledge of astronomy, similar patterns were observed among all levels of knowledge of astronomy and interest in stargazing activities in parks. Among individuals with a basic knowledge of astronomy, 89% showed interest in stargazing activities in parks. Similarly, among individuals with no knowledge of astronomy, 79% of respondents indicated an interest in stargazing activities in parks. Comparably, other studies found that an increased interest in dark skies from both astronomers and the general public has led to the recognition of protecting dark skies (Mace & McDaniel 2013; Manning et al. 2015; Sawada, Agata & Okyudo 2024; Wassenaar 2021).

While 66% of respondents preferred an activity during a normal visit to the park, 44% indicated an interest in stargazing activities during special celestial events and 23% would be interested in annual stargazing weekends.

When SANParks visitors' responses were compared to individuals from astronomical societies (Table 3), it indicated that a market exists for all three types of activities, but perhaps with different levels of scientific content and in different parks. Greater interest was observed among respondents from astronomical societies (55%) to participate in annual stargazing weekends than respondents among SANParks visitors (22%).

TABLE 2a: Interest in stargazing activities: Interest in stargazing activities in response to online survey.

Participants	Survey question: To what extent would you be interested in stargazing activities if offered in national parks?							
	Very interested		Interested		Maybe		Not interested	
	n	%	n	%	n	%	n	%
South African (SA) residents (n = 915)	433	47.3	370	40.4	103	11.3	9	1.0
Non-SA residents (n = 120)	70	58.3	39	32.5	11	9.2	0	0
Total (N = 1 035)	503	48.6	409	39.5	114	11.0	9	0.9

Source: Wassenaar, A.S., 2021, 'Astrotourism as an income-generating opportunity in South African National Parks', Unpublished doctoral thesis, University of the Free State

TABLE 2b: Interest in stargazing activities: Participants' interest in stargazing activities versus knowledge of astronomy.

Level of interest in-stargazing activities in national parks	How would you describe your knowledge of astronomy?							
	Expert (N = 42)		Good (N = 105)		Basic (N = 710)		None (N = 178)	
	n	%	n	%	n	%	n	%
Very interested	22	52.4	72	68.6	339	47.8	70	39.3
Interested	14	33.3	29	27.6	295	41.6	71	39.9
Maybe	5	11.9	4	3.8	69	9.7	36	20.2
Not interested	1	2.4	0	0	7	1.0	1	0.6

Source: Wassenaar, A.S., 2021, 'Astrotourism as an income-generating opportunity in South African National Parks', Unpublished doctoral thesis, University of the Free State

Most respondents (88%) preferred to do stargazing as a by-product during their visit to a park. Although often not considered the main reason for visits to parks, dark skies play an unrecognised role in motivating visitors in their choice of destination (Manning et al. 2015). Clearly, a market for astrotourism in parks exists among individuals who already visit parks and want to add value to their experience. A smaller percentage of respondents (12%) would visit a park specifically for stargazing activities, creating a niche market among this group for tailor-made activities. In contrast to 88% of respondents doing stargazing as a by-product when visiting parks, an increasing interest was found by Mace and McDaniel (2013), where tourists are specifically visiting parks for clear night skies as light pollution increases in the areas where they reside. When cross tabulating the above responses with different

TABLE 3a: Preferred activities, stargazing preferences and willingness to travel.

Activity preferred	Activity preferred versus respondent group			
	Wild Card SANParks visitors (N = 667)		Astronomical society members (N = 93)	
	n	%	n	%
Stargazing activity during a normal visit to the park	597	89.5	74	79.6
Stargazing during special events: comets, lunar eclipses, meteor showers	319	47.8	67	72.0
Annual stargazing weekend	145	21.7	51	54.8

Source: Wassenaar, A.S., 2021, 'Astrotourism as an income-generating opportunity in South African National Parks', Unpublished doctoral thesis, University of the Free State

TABLE 3b: Preferred activities, stargazing preferences and willingness to travel: Participants' stargazing preference versus knowledge of astronomy.

Preference	How would you describe your knowledge of astronomy?							
	Expert (N = 36)		Good (N = 103)		Basic (N = 673)		None (N = 164)	
	n	%	n	%	n	%	n	%
Stargazing as a by-product or activity when visiting a park	22	61.1	78	75.7	609	90.5	150	91.5
To visit a park specifically for stargazing	14	38.9	25	24.3	64	9.5	14	8.5

Source: Wassenaar, A.S., 2021, 'Astrotourism as an income-generating opportunity in South African National Parks', Unpublished doctoral thesis, University of the Free State

TABLE 3c: Preferred activities, stargazing preferences and willingness to travel: Participants' willingness to travel and distance willing to travel for stargazing activities.

Survey question	South African (SA) residents (N = 859)		Non-SA residents (N = 117)		Total (N = 976)	
	n	%	n	%	n	%
Would you be willing to travel specifically for stargazing?						
Yes, I will travel to a specific location based on its stargazing potential.	462	53.8	53	45.3	515	52.8
No, I will only participate in stargazing activities if it is presented in my preferred holiday destination.	397	46.2	64	54.7	461	47.2
How far are you willing to travel one way?						
0 km – 100 km	272	31.6	40	34.2	312	32.0
101 km – 300 km	187	21.7	12	10.3	199	20.4
301 km – 500 km	238	27.7	11	9.4	249	25.5
501 km – 1000 km	95	11.1	3	2.6	98	10.0
≥ 1001 km	49	5.7	3	2.6	52	5.3
International	18	2.1	48	41.0	66	6.8

Source: Wassenaar, A.S., 2021, 'Astrotourism as an income-generating opportunity in South African National Parks', Unpublished doctoral thesis, University of the Free State

knowledge levels of astronomy among respondents (Table 3), it was observed that most respondents from all levels of astronomy knowledge would prefer to do stargazing activities during a normal visit to a park. Similarly, Jacobs et al. (2019) found that visitors to the Karoo area in South Africa preferred to do stargazing as part of an extended product offering, including other rural tourist activities unique to the area when visiting on weekends or short trips.

However, it was also observed that respondents with a good (24%) or excellent (39%) knowledge of astronomy would consider visiting a park specifically for its stargazing potential, creating a niche market among knowledgeable tourists in parks considered excellent dark sky areas. Pásková, Budinská and Zelenka (2021) indicated that visitors with an interest in astrotourism will travel substantial distances to access areas with dark skies, while Jacobs et al. (2019) indicated that tourists with excellent knowledge of astronomy would plan extended stays in ideal astrotourism areas such as the Karoo. Similarly, 38% of respondents who were involved in astronomical societies and were consequently considered to have some special interest in astronomy indicated that they would visit a park specifically for stargazing.

Seventy-six per cent of respondents indicated a preference for a short game drive to the stargazing area, followed by a short information session, stargazing and light refreshments as their first or second choice of activity, making it the most popular activity among respondents (Table 4). Dinner, a short game drive to the stargazing area, followed by a short information session and stargazing was selected as the first or second choice by 62% of respondents. Forty-three per cent of respondents selected a rustic sleep-out with various stargazing and night drive activities including dinner and breakfast as their third choice. However, with 45% of respondents indicating it as their first or second choice, it was less popular than the first two activities, but most likely still an activity that will draw interest from visitors. In contrast, 70% of respondents selected a luxury sleep-out with various stargazing and night drive activities, including dinner and breakfast, as their least preferred activity (Wassenaar 2021).

According to stakeholders from SANParks, different types of astrotourism activities have the potential to be viable in SANParks. Correspondingly, astrotourism programmes are considered economically viable in many areas (P2; P13; P22; P29; P40; P42; Tobin & Dunne 2017). Activities play a vital role to add value to the tourist experience.

Stargazing can be combined with existing activities such as night drives. Regular presentations with constellation viewing and stargazing through a telescope were quite successful in Tsitsikamma, despite being considered as not ideally situated for stargazing. Stargazing with telescopes was the most popular astrotourism activity in parks (P5; P6; P17; P18; P26; P38; P41; Tobin & Dunne 2017). Guided night

hikes can be ideal in parks that do not have dangerous animals on full-moon nights when the sky is not at its darkest for telescope viewing. This presents a unique opportunity while simultaneously increasing the number of nights available to offer astrotourism activities.

Full moon hikes have proved to be very popular in parks in Ireland (Tobin & Dunne 2017). While the annual Grand Canyon Star Party in Arizona is the park’s best-attended special event (Betz 2019; Melroy 2019), weekend star parties are not considered to be a viable option in SANParks by some stakeholders because similar activities could not be offered at economically viable prices in the past (SP13). Astrophotography workshops are considered ‘too specialised to host in parks’, unless offered by a specialist presenter (SP13). However, it is still worth consideration because a high demand for astrophotography and dark sky photography workshops has been observed in some areas such as Big Bend Ranch State Park, Grand Canyon National Park (National Parks at Night 2025) and South Africa (VentureKJ 2021).

A few stakeholders mentioned that tourist activities are often labour intensive, have limited direct income-generating potential (P33; SP6), and will be more viable ‘in

TABLE 4a: Activity choice and willingness to pay: Participants’ order of preference (choice) of activities (N = 976).

Preferred activity	Order of preference (choice)							
	1st		2nd		3rd		4th	
	n	%	n	%	n	%	n	%
Short game drive to stargazing area, short information session, stargazing and light refreshments	560	57.4	185	19.0	133	13.6	98	10.0
Dinner provided by organisers, short game drive to stargazing area, short information session and stargazing	109	11.2	498	51.0	296	30.3	73	7.5
Dinner, rustic sleep out with various stargazing and night drive activities and breakfast	227	23.3	208	21.3	420	43.0	121	12.4
Dinner, luxury sleep out with various stargazing and night drive activities and breakfast	80	8.2	85	8.7	127	13.0	684	70.1

Source: Wassenaar, A.S., 2021, ‘Astrotourism as an income-generating opportunity in South African National Parks’, Unpublished doctoral thesis, University of the Free State

TABLE 4b: Activity choice and willingness to pay.

Activity	Mean amount per group shown in SA Rand		
	SA residents (N = 802)	Non-SA residents (N = 101)	Total (N = 903)
Short game drive to stargazing area, short information session, stargazing and light refreshments	R410	R510	R420
Dinner provided by organisers, short game drive to stargazing area, short information session and stargazing	R560	R800	R620
Dinner, rustic sleep out with various stargazing and night drive activities and breakfast	R1230	R1540	R1270
Dinner, luxury sleep out with various stargazing and night drive activities and breakfast	R2820	R3280	R2870

Source: Wassenaar, A.S., 2021, ‘Astrotourism as an income-generating opportunity in South African National Parks’, Unpublished doctoral thesis, University of the Free State

Note: Participants’ response to the online survey question, ‘How much would you be willing to pay for the following stargazing activities in parks?’.

combination with other activities' (P42). Similarly, Jacobs et al. (2019) found that astrotourism could be more viable if promoted along with a variety of products and services in an area. These stakeholders indicate that activities should 'cover costs' but aim to fill beds in the park by 'add[ing] value to the experience' (P6; P14; P15; P17; P23; SP6; Rodrigues et al. 2015). Astrotourism can also add value to smaller parks by promoting longer periods of tourism during the low season and providing a steadier source of income for the park (P3; P6; P14; P15; P17; Mitchell & Gallaway 2019).

Willingness to pay: In US parks, events are usually open to the public at no cost, attracting high participant numbers (U.S. National Park Service 2020). Various respondents indicated price consciousness and affordability as motivations for simpler experiences that are more focused on stargazing rather than activities that present additional benefits or commercialised experiences.

On average, non-South Africans were willing to pay more than South African residents for astrotourism activities (Table 4). Compared to the 2020–2021 prices of activities in SANParks, visitors' willingness to pay for stargazing activities was in line with existing price structures at the time (SANParks 2020). At the time of the study, basic game drives in SANParks varied in price from R285 (US\$ 17.41, based on ZAR to USD average of 0.0611 USD in 2020 [Exchange Rates UK 2023]) to R470 (US\$ 28.72) per person (p.p.), with drives including snacks and drinks presented at a rate of R565 (US\$ 34.52) p.p. in Addo Elephant NP (SANParks 2020). Guided walks in parks ranged between R365 (US\$ 22.30) and R735 (US\$ 44.91) p.p., while bush 'braais' (barbecues) were around R780 (US\$ 47.66) p.p. in Mapungubwe NP (SANParks 2020). More specialised activities such as cheetah tracking in Mountain Zebra NP and guided horse riding in Addo Elephant NP ranged between R460 (US\$ 28.11) and R610 (US\$ 37.28) p.p. (SANParks 2020). Visitors were willing to pay a similar amount for astrotourism activities. The growing trend among tourists' increased willingness to pay for dark sky experiences has also been observed internationally (Mitchell & Gallaway 2019).

Marketing: As most people are not familiar with astrotourism, special attention should be paid to marketing. SANParks activities are generally promoted through word-of-mouth, brochures, SANParks' website, Facebook page, SANParks magazine and *Getaway* magazine (SP1; SP2; SP4; SP5). Activities are promoted at camp receptions and in some parks, guides go around in the rest camps to promote game drives (SP2; SP10). Some participants indicated that marketing should highlight the best of each park while creating realistic expectations (SP6). Other studies also saw the need for 'funding to focus on marketing' and focused marketing efforts to 'draw more tourists' to the region to be vital (P33; P38; Jacobs et al. 2019). According to the participants, most of the existing SANParks activities do not have a specific target market (SP5; SP6; SP7; SP8; SP9; SP10).

However, it was indicated that some parks draw 'mostly international guests who participate in game drives' and 'largely dependent on foreign visitors' (SP10; SP12), while in other parks, it is 'mostly [tourists] from South Africa' and the 'target market... [is] 4x4 enthusiasts and campers' (SP3; SP10; SP12). The 'greatest challenges' to implement astrotourism activities in SANParks were indicated to be 'marketing and affordability' (SP6; SP13). Marketing of astrotourism activities seems to be challenging in other areas too, with Mkwizu (2024) indicating a lack of marketing of astrotourism in Tanzanian protected areas, particularly after the coronavirus disease 2019 (COVID-19) pandemic. Similarly, Proos (2025) and Jacobs et al. (2019) highlighted the need for more dedicated marketing initiatives and the hosting of more events among potential tourists to attract visitors to existing South African astrotourism initiatives.

Practical considerations

Several practical considerations were found to impact on viability. Key stakeholders from SANParks described the operational structure of current income-generating activities in various SANParks as the context within which astrotourism activities would need to operate. Various practical considerations were considered important in activity development and included suitable location, availability of resources, expectations of the experience and challenges to be mitigated.

Suitable locations: Finding a suitable location with unpolluted, 'clear skies' is a crucial part of astrotourism activity planning as 'dark sky is most important' and 'the darker, the better' (P7; P12; P15; P17; P23; P25; P28; P32; P33, P34; P41; Coetzee et al. 2023). National parks are often remote and considered a 'wonderful complement' to offer optimal conditions for astrotourism (P3; P16; P20; P22; P24). The most suitable SANParks for astrotourism would be the 'arid parks' such as 'Kgalagadi Transfrontier Park, Meerkat NP, Namaqua NP, Ai-Ais/Richtersveld Transfrontier Park, Mokala NP, Augrabies Falls NP, Tankwa NP, Mountain Zebra NP and Karoo NP, and parts of Addo Elephant NP' (SP1; SP2; SP4; SP6; SP7; SP9; SP10; SP13).

Respondents' willingness to travel specifically for stargazing yielded interesting results (Table 3). Fifty-three per cent of respondents were willing to travel based on a destination's stargazing potential, while 47% would only participate in stargazing activities if they were presented at their preferred holiday destination. Thus, astrotourism activities should be developed in the ideally located parks as attractions associated specifically with the destination, while the most visited parks can develop astrotourism activities as value-adding products in the existing destination portfolio. While most South African residents would be willing to travel ≤ 100 km (32%), ≤ 300 km (22%) and ≤ 500 km (28%) one way for stargazing activities, only 2% were willing to travel internationally for stargazing. In contrast, 41% of non-residents were willing to travel internationally for stargazing, while in their own countries, 34% of non-residents would only be willing to travel ≤ 100 km.

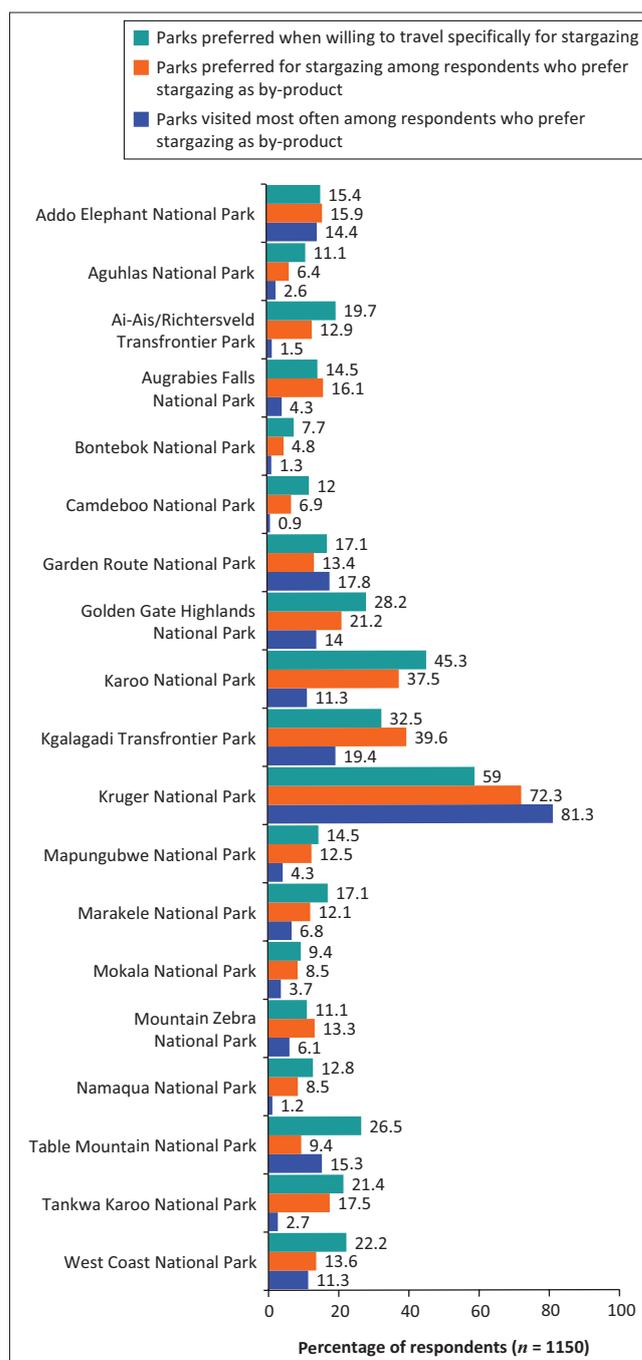
Respondents indicated that the SANParks they visited most often were Kruger NP (67%), Kgalagadi Transfrontier Park (16%), Garden Route NP (16%), Table Mountain NP (14%), Golden Gate Highlands NP (12%) and Addo Elephant NP (12%). When cross-tabulating the responses of individuals who would not be willing to travel specifically for stargazing, but rather prefer to do stargazing activities at their normal holiday destination with responses to the parks they visited most often, the parks that stood out as the most frequently visited among these participants were Kruger NP (84%), Kgalagadi Transfrontier Park (21%), Garden Route NP (16%), Karoo NP (13%), Golden Gate Highlands NP (12%), Addo Elephant NP (12%) and Table Mountain NP (11%).

Taking it a step further and cross-tabulating the responses of individuals who prefer to do stargazing as a by-product with the most-frequently visited parks, as well as the parks in which they preferred to do stargazing activities, responses yielded noteworthy results (Figure 1). Parks in which respondents preferred to do stargazing were not necessarily the parks they visited most often.

Parks such as Kruger NP and Kgalagadi Transfrontier Park were both frequently visited and preferred for stargazing activities as a by-product. The Karoo NP was more preferred for astrotourism activities than some of the other more frequently visited parks, such as Addo Elephant NP, Garden Route NP, Golden Gate Highlands NP and West Coast NP. Table Mountain NP presents an interesting case in that it is frequently visited, but not one of the most popular parks for astrotourism as by-product. Conversely, Tankwa Karoo NP, Au-grabies Falls NP, Mountain Zebra NP, Ai-Ais/Richtersveld Transfrontier Park, Mapungubwe NP and Marakele NP were not indicated as frequently visited parks but were selected as parks preferred for astrotourism activities as a by-product when visiting the park. This opens the opportunity for astrotourism activities in parks that are not necessarily frequently visited.

When cross-tabulating the responses of the group of respondents who indicated that they would visit a park specifically for astrotourism with the parks in which they would prefer to participate in astrotourism activities (Figure 1), Kruger NP (59%), Karoo NP (45%), Kgalagadi Transfrontier Park (33%), Golden Gate Highlands NP (28%), Table Mountain NP (27%), West Coast NP (22%), Tankwa Karoo NP (21%), Ai-Ais/Richtersveld Transfrontier Park (20%), Marakele NP (17%), Addo Elephant NP (15%), Au-grabies Falls NP (15%) and Mapungubwe NP (15%) were indicated to be the most popular parks for astrotourism among this group. Interestingly, the type of activity preferred by respondents did not vary considerably between different parks.

Availability of resources: Respondents found various elements important to create a memorable stargazing experience (Table 5). Availability of seasonal or monthly



Source: Wassenaar, A.S., 2021, 'Astrotourism as an income-generating opportunity in South African National Parks', Unpublished doctoral thesis, University of the Free State

FIGURE 1: Parks preferred by online survey respondents.

sky maps with descriptive information was considered important (48%) and very important (33%) to create a memorable experience. The availability of telescopes during stargazing activities was also considered very important (49.5%) to important (36.4%). While 44% of respondents did not consider it important to have the option to bring along their own telescope to stargazing activities, 27% of respondents considered it to be important. Although minimal equipment is required for astrotourism, certain physical resources such as sky maps and telescopes are important for memorable experiences. Other studies and participants also mentioned that lack of 'proper

TABLE 5: Participants' view on the importance of creating memorable stargazing experiences ($N = 976$).

Factors contributing to memorable experiences	Level of importance							
	Not important		Important		Very important		Unsure	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Availability of seasonal or monthly sky maps with descriptive information	120	12.3	472	48.4	326	33.4	58	5.9
Availability of telescopes during activity	106	10.9	355	36.4	483	49.5	32	3.3
The option to bring along your own telescope	429	44.0	266	27.3	169	17.3	112	11.5
Knowledgeable guides during stargazing activities	20	2.0	221	2.3	717	73.5	18	1.8
Interpretation of activities, e.g., informative sessions and specialist talks	83	8.5	477	48.9	367	37.6	49	5.0
Educational information on the threat of light pollution and ways to limit light pollution in one's own environment	124	12.7	506	51.8	304	31.1	42	4.3
Visitor interpretation centre	206	21.1	490	50.2	186	19.1	94	9.6
Information on local astronomy related cultural beliefs and/or stories and/or anecdotes	150	15.4	476	48.8	294	30.1	56	5.7

Source: Wassenaar, A.S., 2021, 'Astrotourism as an income-generating opportunity in South African National Parks', Unpublished doctoral thesis, University of the Free State

equipment' and the expense of telescopes can be a 'limiting factor' to some astrotourism initiatives (P19; P31; P42; Batinoluho 2024; Jacobs et al. 2019; Tobin & Dunne 2017). Participants stated the importance of 'maintenance of equipment' (P35) and that it should be kept in good working order.

Minimal infrastructure is required, although the lack of existing good infrastructure can hold many challenges for activity planning (P10; P13; P16). In some parks, access is mainly via 'rock gravel roads' and the road conditions are often poor (P20). Poorly maintained roads and neglected tourist amenities were cited by visitors to the Karoo as limiting and unpleasant elements in trips to the area (Jacobs et al. 2019). While access roads are an important consideration, it has also been found that different age groups of participants may require different access options (Solano-Sánchez et al. 2024). While younger participants may be willing to walk some distance to reach suitable viewpoints, older participants may require destinations to accommodate their access requirements (Solano-Sánchez et al. 2024). Because astrotourism activities are presented at night, safe and 'a reasonable variety of accommodation in the area' is also important (P4; P13; P15).

Most respondents (73.5%) regarded the involvement of knowledgeable guides during stargazing activities as a key aspect of creating memorable stargazing experiences (Table 5). Similarly, Baral Stern and Hammett (2012), Saayman and Dieske (2015) and Botha Saayman and Kruger (2012) indicated that the experience and connection with nature can be improved by a guide's interpretation thereof. Regular training must be implemented, as the success of the activity depends largely on the guide.

Most activities in SANParks are presented by field guides (SP2; SP5; SP6; SP8; SP10; SP12). However, some parks do not have guides because all activities are self-guided (SP3; SP4; SP7; SP9; SP11). Sometimes activities are outsourced to third parties (SP9). 'People from local communities' are occasionally 'trained to present activities' or 'trained as guides' (SP3; SP6; SP12). By involving local stakeholders, astrotourism presents the opportunity to organise resources and foster partnerships between local stakeholders (Tapada et al. 2021). However, when guides are only contracted on a seasonal basis, it 'does not provide a continuous income for them' (SP6). As many of the parks have limited staff, the absence of staff can be quite problematic (SP2). Limited trained staff was also considered a challenge by Batinoluho (2024). Participants P7, P12, P24, P28, P35 and P40 agreed that parks will need to invest in 'proper training' and staffing to promote the viability of astrotourism.

Expectations of the experience: Educational information on the threat of light pollution and ways to limit it in one's own environment was considered important by 52% and very important by 31% of the respondents (Table 5). Interpretation activities with informative sessions and specialist talks (49% important; 38% very important), visitor interpretation centres (50% important) and information on local astronomy-related cultural beliefs and/or stories and/or anecdotes (49%) were considered important. Pásková et al. (2021) likewise confirmed the importance of education and interpretation in dark sky programmes.

Ninety-nine per cent of respondents participating in the online survey supported the development of low environmental impact astrotourism activities in national parks. However, respondents indicated that activities should be an educational, authentic stargazing experience, preferably in wilderness areas and not an overly commercialised activity simply for the sake of presenting more activities in parks. Similarly, Pásková et al. (2021) indicated that visitors often participate in astrotourism for its authenticity, citing motivations such as a desire for increased knowledge and a sense of calm, freedom and joy to be derived from the experience. Other concerns expressed included over-commercialisation of popular parks and whether astrotourism would truly have a low environmental impact. While a sufficient number of tourists is necessary for viability, big groups can lead to an activity becoming too commercialised, losing the feeling of authentic experiences altogether. Loveridge et al. (2014) also warned that while areas can benefit greatly from tourism, the increased utilisation of and access to the area can potentially degrade the environment.

Challenges to be mitigated: One of the most extensive challenges posed to astrotourism is the constant threat of developments close to parks (P8; P12; P14; P16; P20; P23; P25; P28). Various concerns were expressed about existing light pollution and 'unchecked development', as well as the vulnerability of parks to light pollution 'beyond the park's boundaries' (P2; P10; P19; Sovick 2001). Gaston and Sánchez

de Miguel (2022) highlighted that light pollution is expected to continue to grow in developing countries with the expansion of urbanisation and the availability of off-grid technology in rural areas. Sawada et al. (2024) found that astrotourism can mitigate this risk through educational and outreach activities in local communities raising awareness of light pollution.

Bad weather conditions are beyond the control of the guides. 'Weather ... play[s] a big role' and can be a huge challenge. Therefore, astrotourism should include activities that are not dependent on clear skies should the weather not permit stargazing (P16; P24; P29; P33; P35; Pásková et al. 2021; Tobin & Dunne 2017).

'It can be challenging to conduct activities in a dangerous environment' and 'activities are restricted in Big Five parks' (SP12; SP13). Consequently, legislation requires that two guides with rifles are present, even if only two people participate in an activity deemed potentially dangerous, resulting in the need for more human resources (SP6).

'Low occupancy' of activities can be a challenge (SP2). Most parks require at least two people to participate for an activity to take place (SP2; SP6; SP8; SP9; SP10). However, in smaller parks, the 'activity will go ahead even for one person as it is necessary to keep it going' (SP6).

As much as 'distance and remoteness' can be a strength for dark skies and astrotourism activities, it can also be 'incredibly challenging' to draw tourists and presenters (P2; P12; P17; P26; P41). Communication and a lack of infrastructure can be problematic because of the geographical

location of a park with long travelling times and no cell phone reception (P13; P16; P38). Furthermore, open-access parks or parks with free activities can become a challenge, as people can access the area or activities without permits, meaning that it is 'not a source of income' (P4). With careful planning and innovation, most of these challenges can be mitigated to develop viable astrotourism activities.

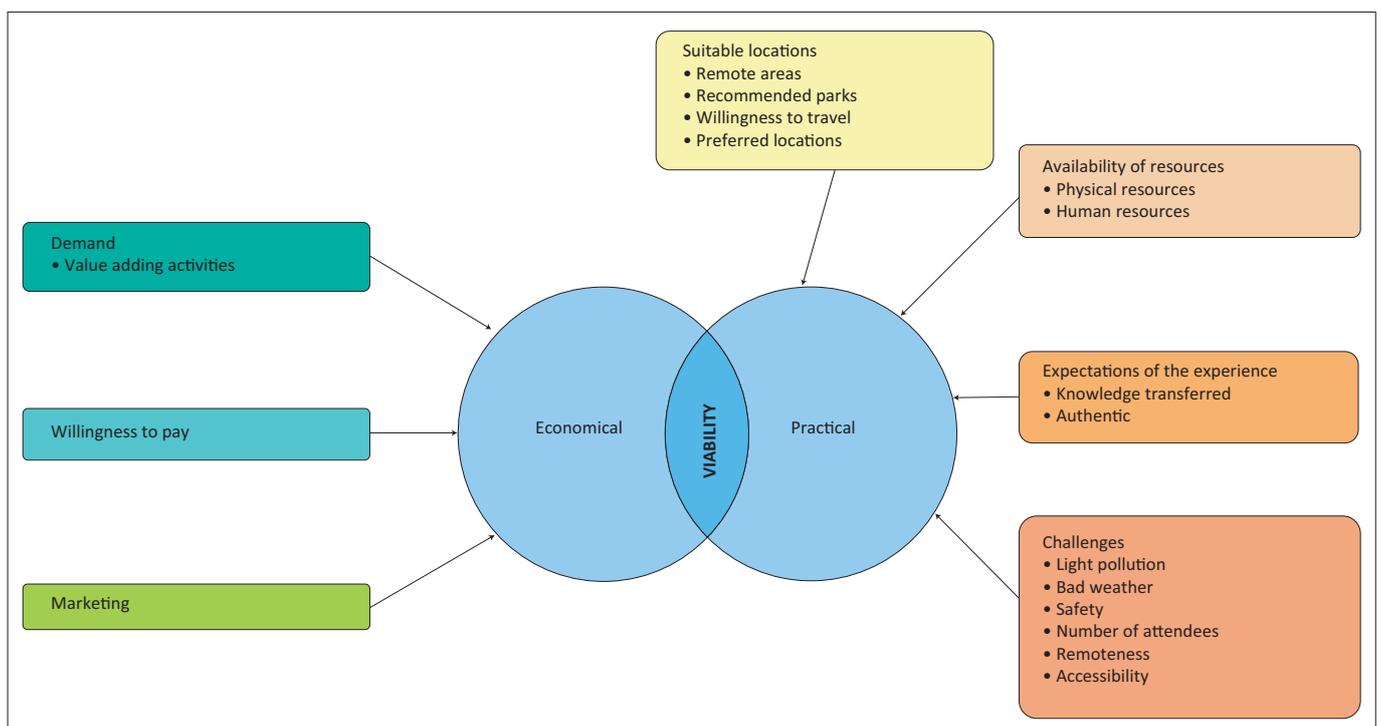
Discussion

Viability

Astrotourism activities can only be economically viable if a demand for activities exists, if activities are presented at a price that tourists are willing to pay, and if effective marketing to the target market is achieved (Figure 2). Practical considerations that are important to present viable astrotourism activities include suitable locations in remote areas, and parks that are recommended for stargazing, while being preferred by tourists who are willing to travel there. Availability of both physical and human resources to manage activities is another practical consideration. Likewise, expectations of tourists need to be met by transferring knowledge and keeping the activity authentic, rather than commercialised. Lastly, challenges such as light pollution, bad weather, safety, number of attendees, remoteness and accessibility must be mitigated. Together, the economical and practical considerations determine the viability of astrotourism events in SANParks as an income-generating activity.

Implications and recommendations

Astrotourism in SANParks has considerable potential, particularly because parks are generally remote and



Source: Wassenaar, A.S., 2021, 'Astrotourism as an income-generating opportunity in South African National Parks', Unpublished doctoral thesis, University of the Free State

FIGURE 2: Important factors to consider for determining the viability of astrotourism activities.

consequently have exceptional dark skies with limited light pollution. It became clear that most respondents were in support of the development of low environmental impact stargazing activities in national parks, with the prerequisite that stargazing activities should be authentic experiences and not overly commercialised.

Participants want stargazing activities that are educational and presented in natural wilderness areas. Thus, SANParks need to ensure that parks do not lose their sense of place as a natural area to visitors through the development of additional activities.

Furthermore, the development of astrotourism activities should consider the different needs between visitors with little or no knowledge of astronomy and the needs of visitors with more in-depth knowledge of astronomy. It is recommended that the activities be differentiated based on visitor level of knowledge of astronomy rather than following a 'one-size-fits-all' approach.

Respondents were concerned by the affordability of such activities and the over-commercialisation of popular national parks by the development of additional activities, and whether it would truly be a low environmental activity. Rates must still allow stargazing activities to be accessible to visitors and both the development and implementation of such activities must adhere strictly to a low-impact strategy.

It became clear from the responses that a demand exists for activities where tourists can engage with the night sky as part of formally arranged activities in parks instead of merely observing the night sky on their own. This holds the important benefit that with effective marketing, SANParks can develop stargazing activities and add value and draw tourists to the parks, instead of only focusing on generating an income.

Furthermore, a low percentage of respondents would travel to a park specifically for its night sky experience. This group indicated that apart from the mainstream stargazing activities, a smaller niche market exists among visitors for tailor-made stargazing activities. These respondents had good or excellent knowledge of astronomy and would be willing to travel to a park specifically for exceptional dark sky areas.

Among all the respondents, the greatest preference was observed for stargazing activities during normal visits to a park. However, among SANParks visitors, almost half the respondents indicated that they would be interested in astrotourism activities during special celestial events. Respondents from astronomical societies also showed a preference to participate in annual stargazing weekends. It could be considered for more experienced astronomers given that it could be presented at a reasonable price and marketed well.

Most respondents indicated a preference for a short drive to the stargazing location, as well as a meal or staying the night in accommodation that does not require extensive travelling in the dark after the activity. Respondents' preference for an authentic astrotourism experience that is not overshadowed by other add-ons, combined with price consciousness, served as motivation to various respondents to opt for simpler experiences more focused on stargazing. The amount that respondents were willing to pay was generally in line with the current prices of other activities presented in SANParks, thus making it viable, depending on the costs of implementation.

Knowledgeable guides were a key aspect of any type of astrotourism activity. Respondents focused on the importance of an educational approach, including information on the threat of light pollution and its prevention or mitigation. Continuous training of guides to offer a quality experience was highly recommended by stakeholders from SANParks.

Other desirable aspects during astrotourism activities included informative sessions by specialists, visitor interpretation centres, information on local astronomy-related cultural beliefs and anecdotes, and the availability of seasonal or monthly sky maps with descriptive information.

The availability of telescopes provided by the park during stargazing activities was rated very important. It is recommended that activities aimed at visitors with a good or expert knowledge of astronomy allow participants to bring their own telescopes if desired, while still making telescopes available for individuals who do not own or bring along their own telescope.

Fifty-three per cent of respondents indicated a willingness to travel to a destination based on its stargazing potential, while 47% would only participate in stargazing activities if presented at their preferred holiday destination. However, some parks are considered more suitable for the development of activities based on the frequency of visitors, while other parks may be visited less frequently, but their excellent quality night skies draw tourists who are willing to travel specifically for a park's astrotourism potential. South African respondents indicated a willingness to travel within South Africa, specifically based on an area's stargazing potential, while non-South African respondents indicated a greater willingness to travel internationally for stargazing. Thus, a market exists among both South Africans and international tourists for astrotourism activities, which can generate valuable foreign currency.

Finally, it is recommended that various astrotourism activities potential within the unique circumstances of each park is explored. While frequently visited parks may be suitable for mainstream astrotourism activities, some of the less frequently visited parks may present unique astrotourism opportunities and such activities can draw more tourists to

these parks. It is crucial to the success of such activities, however, to consider each park's unique attributes during the development and planning stages rather than using a blanket approach for all parks. The uniqueness of each park should form part of the marketing and planning of astrotourism activities in SANParks.

Limitations

The limitations of the study are associated with the representability of semi-structured interviews and online survey because of the use of non-probability sampling strategies.

Conclusion

National parks in South Africa face increasing pressure to generate income from tourism instead of relying on government funds. Innovative opportunities must be developed to draw tourists to the parks by offering valuable experiences. While the African continent has large, undeveloped areas with pristine skies, this resource is not exploited to its full potential. Astrotourism is a unique opportunity relying on the natural resource of dark skies available in most parks. To determine the viability of astrotourism in national parks, current income-generating activities in SANParks were explored together with results from the visitor survey. Most respondents supported the development of low environmental impact astrotourism activities within national parks. It is important that the activities should be authentic astrotourism experiences and not be over-commercialised. Affordability of these activities was a concern. Although astronomy can be a specialised field, both people with limited or no knowledge of astronomy, as well as astronomy experts indicated high levels of interest in astrotourism activities in parks. The different needs of visitors based on their knowledge of astronomy should be considered with the development of astrotourism activities. The focus of activities should be to add value to visitors' experience. Various activities can be considered for several suitable SANParks. Every park's unique attributes should, however, be considered when planning activities, as the same approach cannot be applied to all parks. If these factors are taken into account, the research concluded that astrotourism activities can add value to the regional economy and be developed as viable income-generating opportunities to generate direct income for SANParks.

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Authors' contributions

All authors, A.S.W. and B.A.C. contributed to the conceptualisation, design of the study, data collection, writing (original draft), literature, methodology, results and findings. They were also involved in writing – review and editing of the final article.

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Data availability

The data from the study cannot be made available, because ethical clearance and participant consent for the study did not include consent to share raw data with third parties.

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