投稿

Public astronomical observatories in Japan ～Current status, challenges and potential～

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本稿は、2023 年に日本公開天文台協会（JAPOS）が発行した『公開天文台白書 2018』[1] の概要を英訳したものである。『公開天文台白書 2018』は、198 の施設状況をとりまとめた報告書で、わが国における公開天文台の現状を様々な角度から把捉することができる [2]。「天文台王国」の様相を呈するわが国の公開天文台の現状を [3]、国際的に発信することを企図して、その概要を英文で報告することとした。また近日中に、同様の調査を実施する予定である。関係施設の皆様からの引き続きのご協力・ご助言を頂けると幸いである [JAPOS 調査研究委員会]。

1. Introduction

Astronomy has made a significant contribution to stimulating public interest in astrophysics and the universe. Further, astronomical observatories have served not only as academic research facilities but also as institutions connecting amateur and academic astronomers and as practical facilities for the general popularisation of astronomy [1][2]. In Japan, the observatories established primarily for the purpose of serving the public are referred to as 'public astronomical observatories' (*kōkai tenmondai*; PAO)', which are distinguished from those established for the purpose of academic research.

A distinctive feature of the Japanese PAOs is that many are equipped with large-aperture telescopes [3]. Since the 1980s, telescopes with apertures larger than 60 cm have been successively installed [4], including 14 PAOs with apertures larger than 100 cm since 1990 (Table. 1.). Currently, at least 300 PAOs are in Japan, including smaller facilities [5].

However, PAOs have faced challenges due to secular changes in the local governments' socioeconomic environment, as operating entities are unable to raise funds to maintain their instruments and operate their facilities, forcing them to operate with limited staff. In recent years, some observatories have been forced to close down (Table.1.).

This report presents the results of an extensive survey of Japanese PAOs conducted by the Japan Public Observatory Society in 2018. The results were documented in "*The White Paper of PAO in 2018*" (in Japanese). This report aimed to provide information on the current status, operational challenges, and potential of Japanese PAOs.

Table.1. Japanese PAOs with telescopes with apertures larger than 100 cm

Observatory Name	Aperture (cm)	Since (year)
Nishi-Harima Astronomical Observatory	200	2004
Nayoro Observatory KITASUBARU	160	2010
Gunma Astronomical Observatory	150	1999
Sendai Astronomical Observatory	130	2008
Rikubetsu Space and Earth Science Museum	115	1998
Anan Science Center	113	1999
Ishigakijima Astronomical Observatory	105	2006
Misato Astronomical Observatory	105	1995
Tottori Saji AstroPark	103	1994
The Yamazaki Observatory	101	1994
Bisei Astronomical Observatory	101	1993
Hoshi no Bunkakan	100	2017
Toyama Astronomical Observatory (closed)	100	1997
Kawabe Cosmic Park (closed)	100	1996

2. Method

In this study, a PAO is defined as 'a facility with fixed ground-based optical telescopes or mobile telescopes open to the general public'. Mobile telescopes refer to telescopes equipped with mobile astronomical vehicles (e.g. ASTROCAR) or trolleys. Therefore, science centres and museums with assembled telescopes for star parties were excluded from the survey. Universities and academic institutions primarily used for research purposes were also excluded.

The questionnaire consisted of two parts. The first part included basic information about the facility, such as its year of establishment, opening hours, participation fees for night sky observations (NSO), and the installation status of the surrounding accommodation facilities. The second part consisted of the operational status of the facility, such as the type of operating entity, number of staff members, operational budget, and number of participants in the NSO.

This survey was distributed to 360 PAOs who met these criteria. The survey was conducted via the web and mail. A total of 198 facilities completed the survey (response rate of 55 %).

3. Results

3.1 Location and the size of telescope aperture

PAOs were installed throughout Japan, but the number in northern Japan tended to be relatively smaller. In addition, the western part of Japan had telescopes with apertures that tended to be larger than those in the eastern part of Japan (Fig.1.). This may be related to the fact that the weather is more stable in the western part of Japan (e.g., a greater number of

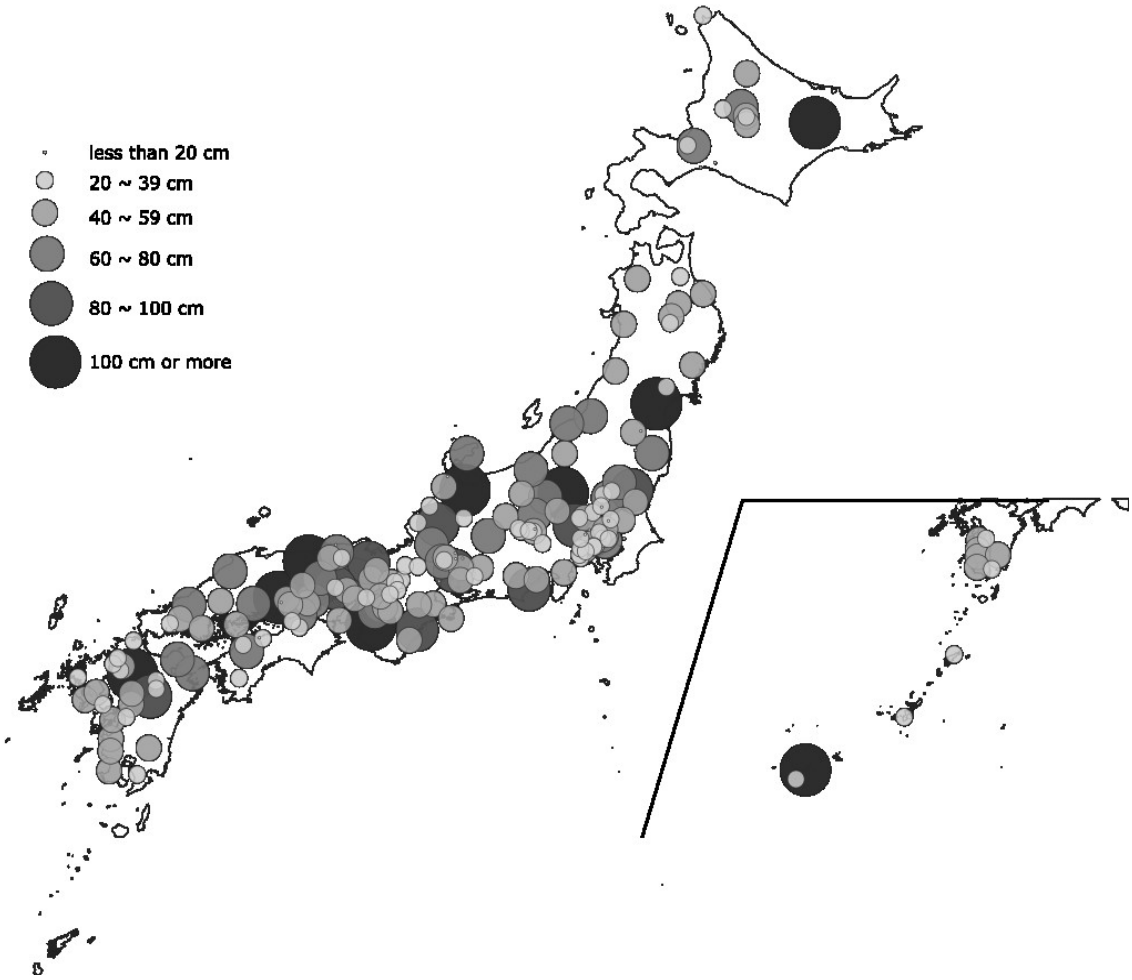

Fig.1. The PAOs distribution map by telescope aperture size (n=198)

sunny days).

The '20 cm–39 cm' and '40 cm–59 cm' classes were the most dominant telescope apertures, with telescope apertures larger than 60 cm in approximately a quarter of the total (Fig.2.). In terms of installation rates by telescope type, 33% of telescopes were refracting telescopes and 66% were reflector telescopes.

3.2 Establishing and operating entities

PAOs were most commonly established by cities or wards, accounting for 61% of the total population (Fig. 3, [6]), followed by the prefectures (11%) and towns (9%). Therefore, approximately 80% were established by local governments, while the remaining 20% were established by private companies or corporate organisations, such as the third sector (e.g. an

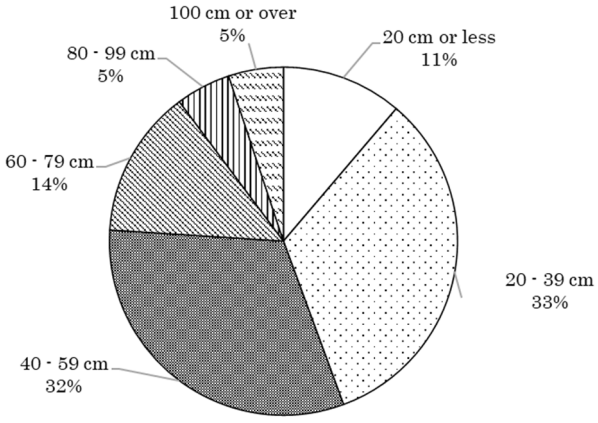

Fig.2. Percentage of main telescope apertures installed in PAOs (n=189)

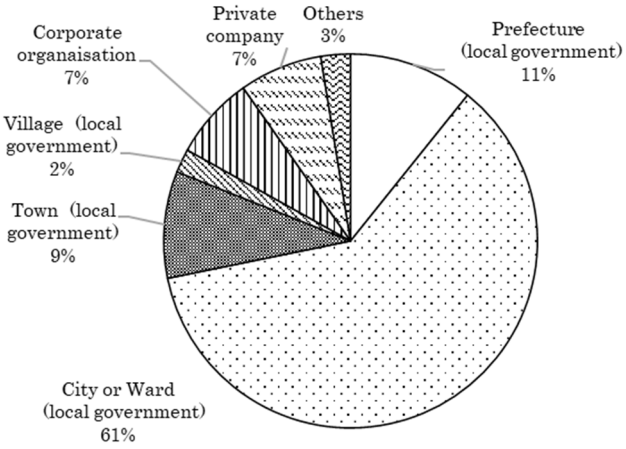

Fig.3. Establishment entities of PAOs (n=195)

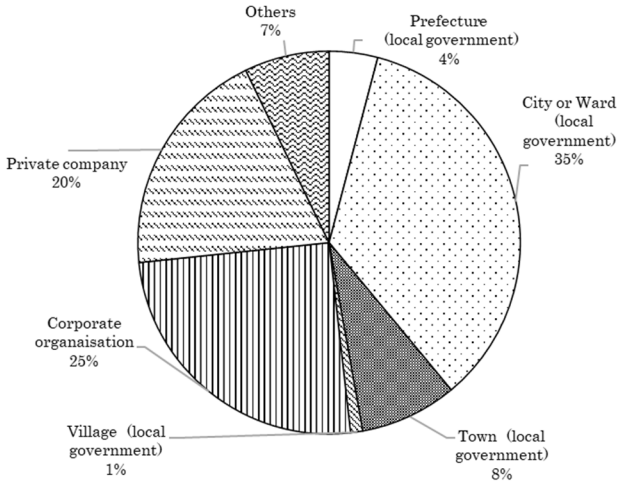

Fig.4. Present operating entities of PAOs (n=195)

independent administrative institution).

Although cities and wards represented the largest operating entities, accounting for 35%, their share has decreased compared to when they were established (Fig.4.). Fig.4 shows that 48% PAOs are currently operated by local governments. Conversely, the proportion run by private companies or corporate organaisations has increased compared to the time they were established. Therefore, PAOs established by local governments were likely taken over and run by these organisations.

This feature seems to be related to the deteriorating financial situation of Japan's local governments and the adoption of the Designated Administrator System (DAS) since 2003. DAS is a management system whereby public facilities (e.g. museums, cultural centres) previously operated by local governments are given to private companies, NPOs, and corporate organisations to manage on their behalf, allowing public facilities to utilise their expertise to improve the services. We found 35% of PAOs had already adopted DAS, and 7% were considering introducing the system.

Both advantages and disadvantages (for example, [7]) existed in DAS. However, emphasising short-term cost savings and management efficiency may lead to the devaluation of PAOs, which are less likely to generate direct economic benefits. The effects of DAS must be carefully examined from a range of perspectives.

3.3 Equipment

Fig.5 shows the percentage of each type of observation equipment, illustrating that digital cameras (with replaceable lenses) and video cameras were owned by more than half the PAOs.

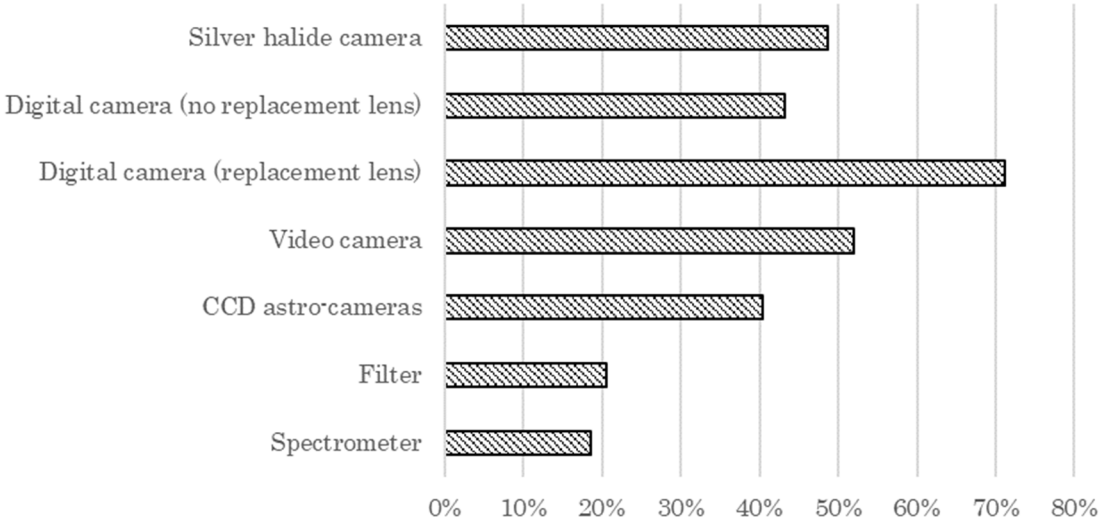

Fig.5. the percentage of each type of observation equipment owned PAOs(n=146)

Planetariums were present in 47% of PAOs. In particular, larger institutions, such as museums and science centres, tended to have this type of equipment. Further, 38% of PAOs owned solar telescopes. Of these, 21% responded that they used solar telescopes to project or display images of the sun to visitors.

Regarding wheelchair accessibility in the observatories, 12% of PAOs allowed those in wheelchairs to visit freely, 41% could visit in their caregivers, and 47% could not visit. These results suggest that Japanese PAOs are not sufficiently barrier-free—for example, the lack of lifts or ramps in the facilities.

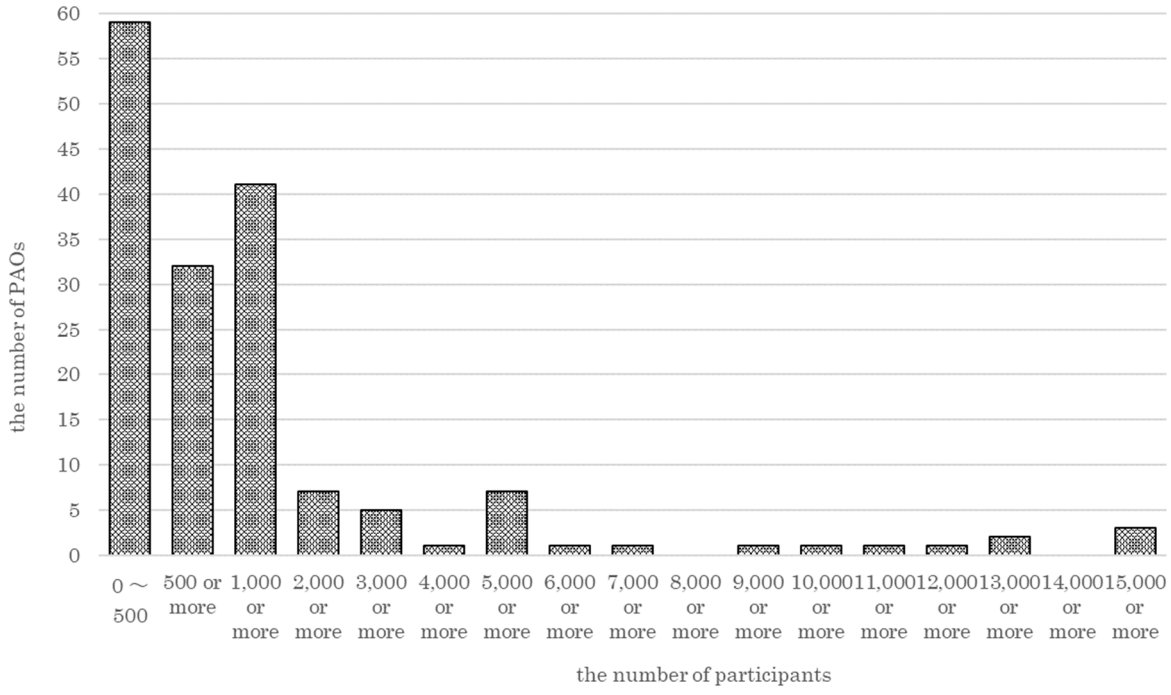

Fig.6. The histogram of NSO participants in 2017 (n=163)

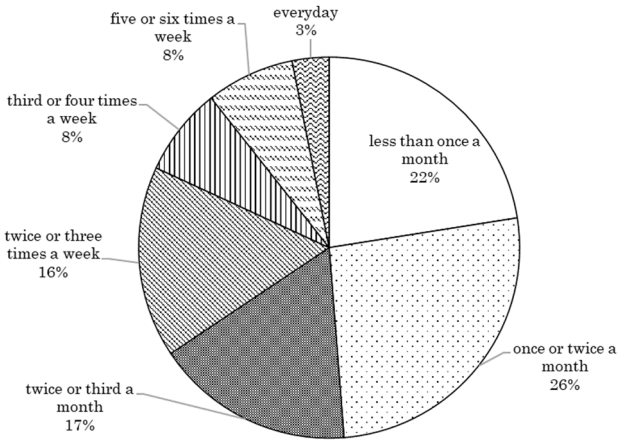

Fig.7. NSO frequency (n=160)

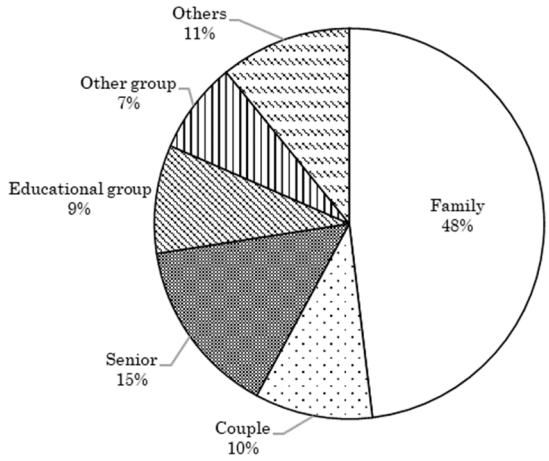

Fig.8. The demographic of NSO participants (n=189)

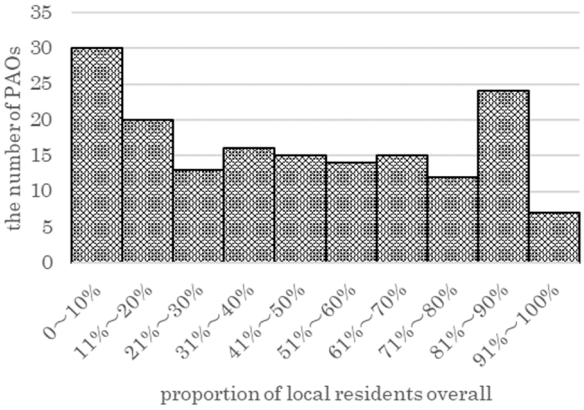

Fig.9. The histogram of proportion of local users overall (n=166)

3.4 NSO for the public

In 2017, the total number of NSO participants was 363,065. In terms of frequency, the largest proportion had fewer than 500 visitors in 2017 (56%), followed by 1,000–2,000 and 500–1,000 visitors (Fig.6.). Some NSOs had more than 15,000 participants, particularly those with an observatory along with their accommodations.

The most frequent NSOs was 'once or twice a month' (26%), followed by 'less than once a month', and 'twice or third a month' (Fig.7.). However, 10% of all facilities held NSOs more than five times a week.

In terms of participation fees, 56% of the facilities were free of charge. The average cost to visit the fee-paying facilities was JPY 367. Thus, most observatories in Japan charge less than JPY 1,000 to participate in NSOs operations.

Regarding changes in the number of NSO visitors over the past five years, 31% of facilities reported an 'increased' number of visitors, 55% 'remained stable', and 12% 'decreased'. The most commonly selected demographic for NSO visitors was 'family' (48%), followed by 'seniors' (Fig.8.).

In terms of accommodations, 24% of the PAOs had accommodations, 26% had accommodations close to the observatory, and 46% had no accommodation facilities. The proportion of local users visiting facilities was highest at '0%–10%', followed by '81–90%' (Fig.9.). Although the characteristics of visitors varied depending on the PAOs, as facilities with fewer local residents (i.e. more tourists from other areas) tended to be equipped with

accommodations.

3.5 Staff

The most frequent number of employees in the PAOs was '2–5' full-time staff (31%), followed by '6–10' and '0–1' full-time staff (Fig.10.). Full-time staff tends to be more prevalent in larger institutions, such as museums and science centres.

The most common employment status of the staff was full-time public servants (25%), followed by contracted staff and permanent employees of private companies (Fig.11.). The high proportion of contracted staff seems to be related to the DAS, showing that non-permanent employees are responsible for operating more than half of the Japanese PAOs facilities.

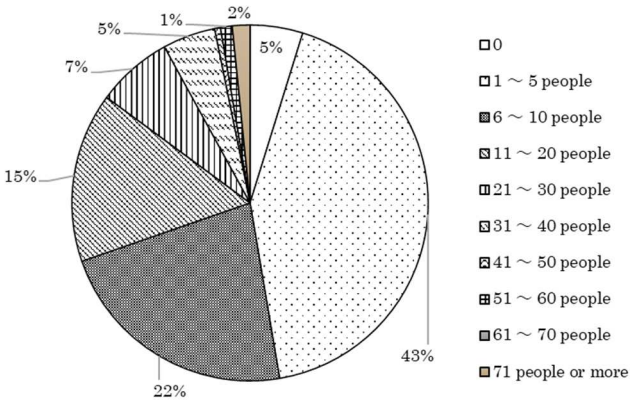

Fig.10. The number of full-time staffs (n=188)

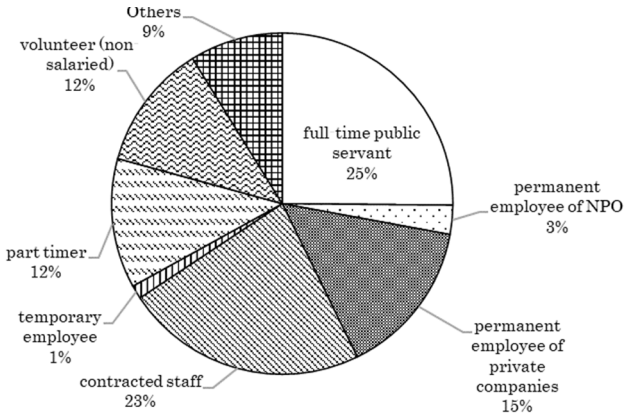

Fig.11. The employment status of PAOs' staff (n=182)

3.6 Budget

In terms of annual operating costs, excluding personnel and utilities, more than 70% of the facilities reported annual operating costs of less than JPY 2 million (Fig.12.). No annual operating costs were incurred for any of these facilities.

Regarding equipment maintenance and operating costs, 65% of facilities reported budgeting for them annually (Fig.13.).

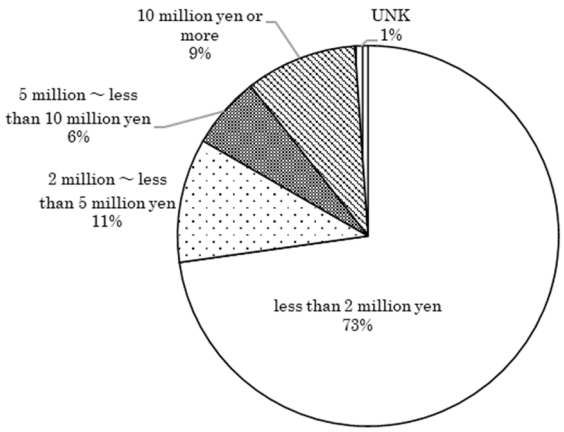

Fig.12. Annual operating budgets excluding personnel and utilities (n=180)

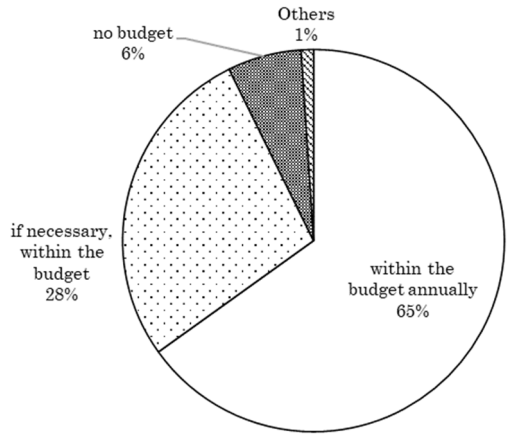

Fig.13. The status of equipment & management budget (n=192)

However, 6% of facilities reported that they had not budgeted for these costs. Such facilities may become inoperable if their observational equipment is broken down.

3.7 Effort distribution

Fig.14 shows the responses regarding the top three important factors in the external evaluation of facilities. The most frequent response was 'lifelong training / school education' (39%), followed by 'the number of visitors to the facility' (38%). 'Academic research' accounted for only 3% of the research.

The demands for 'lifelong training / school education' and 'the number of visitors to the facility' indicated that Japanese PAOs should fulfil both their role as social education facilities and tourism resources.

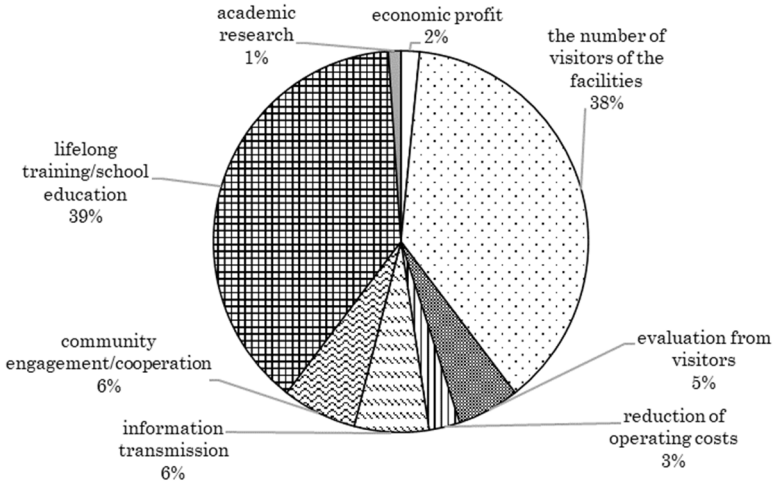

Fig.14. Effort distribution of PAOs (n=187)

4. Summary

Despite its small size of national land, Japan has many PAOs. Japanese PAOs have played a role in providing opportunities for astronomy experiences to the general public (c.f., [8]). One feature of Japanese PAOs is the relatively low cost of participation fee and accessibility to the general public.

However, PAOs are currently forced to operate with low budgets and limited staff to make ends meet. Facilities that do not consider the risk of equipment maintenance costs find sustainable operation difficult. The introduction of DAS has led to confusion among staff at facilities where the operating entity changes regularly. PAOs are expected to provide social education facilities, including lifelong training and school education, as well as tourist attractions, offering high satisfaction to visitors. Future operational challenges are related to the ability of PAOs to provide such diverse roles with limited management resources.

Japanese PAOs face challenging operating conditions, but the staff are by no means pessimistic about running their facilities. Some PAOs organise astronomy courses for the general public and practice astronomical observations in cooperation with amateur astronomers (e.g., [9]). More importantly, observatories are valuable local resources. Therefore, creating a system in which observatories can be managed in collaboration with local residents are necessary.

註

1) 日本公開天文台協会調査研究委員会編 (2023)『公開天文台白書 2018』, 日本公

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2）米澤樹・澤田幸輝・日本公開天文台協会調査研究委員会（2024）「公開天文台白書2018の完成報告」，日本公開天文台協会第17回大会集録，77-79.
3）南阿蘇ルナ天文台編（2024）『博物館としての公開天文台』，日本公開天文台協会第9回全国研修会テキスト．https://www.koukaitenmondai.jp/kenshukai/tokyo2024/tokyo2024.pdf

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