Preferences of Recreationists for Vegetation Types in Okinawa, Japan

Eri Takahashi¹, Diana Surová², Masashi Konoshima³※

Abstract: An increasing number of tourists from both within and outside of Japan are attracted to the rich natural resources in Okinawa, as result recreation has become potentially an important source of income to the local economy. Previous survey show that tourists are particularly interested in outdoor recreation in the context of natural surroundings of Okinawa. However, few studies have analyzed the relationships between landscapes preferences for vegetation types on different landscapes and recreation activities. We conducted interview survey to explore public preferences toward various landscapes for various recreational uses in Okinawa. We designed a photo-questionnaire in order to identify desirable surrounding vegetation for each recreation use. A total of 93 survey responses were collected and a non-parametric analyzes (chi-square test, gamma coefficient) was applied to examine the effect of socio-demographic characteristics (age, gender, marital status, employment status, income, education level, birthplace, current residential address, the number of family members) on their preferences. Our results show that Pasture landscape, Coastal forest and Mangrove forest were the most appreciated for recreational activities in this study. Forest landscapes were ranked the highest for nature observation and marine sports. For the other recreational activities, the three top ranked landscapes included a mixture of an open landscape such as pasture and forests. Our results also show that preference for a particular landscape depends on the socio-demographic characteristics of the respondent. In summary, it can be concluded that both the type of recreational activity and the socio-demographic characteristics of recreationists, significantly influence their landscape preferences.

Keywords: Landscape preferences, vegetation types, nature-based recreation, Okinawa

1. Introduction

An increasing number of tourists from both within and outside of Japan are attracted to the rich natural resources in Okinawa. They visit Okinawa for tourism and recreation which is an important source of income to the local economy. Tourism is recognized by the Okinawa prefecture office as a leading economic driver for economic growth and welfare improvement. For that reason much emphasis has been placed on strengthening the tourism industry (Okinawa Prefectural Government, Department of Culture, Tourism and Sports 2020).

Surveys results from a previous study show that tourists are particularly interested in nature-based recreation where visitors participate in recreation activities such as; walking, sightseeing, scuba diving and snorkeling in natural surroundings of Okinawa (Okinawa Prefectural Government, Department of Culture, Tourism and Sports 2019). Okinawa was recommended for inscription as a World Natural Heritage Site along with Amami Oshima, Tokunoshima and Iriomote in May, 10, 2021. As the newest World Natural Heritage Site in Japan, it is also expected that Okinawa will be a centre of attraction for domestic and international tourists to Okinawa (Okinawa Prefectural Government, Department of Environmental and Community Affairs 2020). To buttress this fact, Song and Kuwahara (2016) revealed that the number of visitors to Yakushima Island, Kagoshima, Japan increased significantly after it was declared a World Natural Heritage.

Although most parts of the world are experiencing “tourism-led economic growth” (Tang and Tan 2018), it has also been reported that excessive pressure from increasing visitors have degraded the natural environment in many places (Davis and Tisdell 1995; Okuda 2007; Brooks 2012). For example, Arai (2008) reported that the overuse of natural resources by visitors degraded the forest environment in Shirakami-Sanchi after it was registered as a World Natural Heritage in 1993. Poorly managed tourism can degrade natural environment, which is an important resource and fundamental to nature-based tourism (Masuruli 2014). Therefore, any mismanagement could be seen as a threat to the sustainability of nature-based tourism.

To promote sustainable nature-based tourism, recreation demands must be balanced against the conservation of natural resources. To achieve such a balance, landscape management plans should
address conflicting land uses between recreation activities and nature conservation. Management plans should explicitly take into account the options, needs and preferences of landscape users and relate them to sociological and cultural features (Atauri et al. 2000; Filova et al. 2015). Incorporating these concerns into a management plan is essential to the development of a conservation policy in areas of high conservation value that are under increasing recreational demand (Atauri et al. 2000). However, only few studies have analyzed the relationships between landscapes preferences for vegetation types on different landscapes and recreation activities in Okinawa. In this study, we conducted an interview survey to explore public preferences towards various landscapes for various recreational uses in Okinawa.

2. Methods

We designed a questionnaire with pictures (photo-questionnaire) to identify desirable surrounding vegetation for each recreational use. Our study site is the northern part of Okinawa Island (Figure 1) where there are many opportunities for a wide range of outdoor recreational activities.

![Figure 1. Map showing the location of Okinawa Island and the study site on Okinawa Island.](image)

2.1. Vegetation types and preparing photo questionnaires

Based on a GIS map of national vegetation survey (the National Survey on the Natural Environment conducted by the Ministry of the Environment), we selected nine surrounding vegetation types which are representative landscapes for this area (Figure 2).

In order to ensure quality of our survey results, it is important to carefully design the survey, especially with respect to the choice of photos (Barroso et al. 2012). We took a series of photos for each vegetation type and selected one photo for each type as the most representative of each landscape area. All photos were taken with a D7000 Nikon® Digital Camera with a 18.0-105mm f/3.5-5.6 lens.

Barroso et al. (2012) indicate that size, contrast, view depth, season, weather conditions and the presence of different element such as livestock or cultural elements affect respondent’s preferences and therefore, stressed the importance of controlling these factors through digital manipulation. In this study, we set the following guidelines for taking photos:
Although we tried to follow the guidelines as much as possible, we still needed to adjust scales, view depth or cloud cover of the sky and to remove elements such as utility poles, lines, cars, and birds accidentally captured in photos. We used Adobe Photoshop CS6 in order to control factors other than vegetation affecting preferences of respondents. Previous studies (Stamps 1992; Stamps 1993; Tempesta 2010) have shown that adjusting the photographs used in the questionnaire does not affect landscape assessments or preferences for landscape because the adjustment is usually not identifiable.

2.2. Designing a photo-questionnaire

We conducted face to face “questionnaire survey”. The questionnaire was made up of three components. They included items related to (i) demographic characteristics of the respondents age, gender, marital status, employment status, income, education level, birthplace, current residential address, the number of family members; (ii) activities involved in outdoor recreation; and (iii) landscape preference. In this study we consider the following seven recreation activities: hiking, nature observation, camping, running, bicycling, four-wheel driving, and marine activities. To obtain respondents’ landscape preference, colored photographs were printed on photo-quality paper and participants were asked to rate each scene in terms of their preference for each studied recreation activity using a 5 – point rating scale, where the ends of the scale are 1 and 5 representing strongly dislike it and strongly like it respectively (additional option: don’t know). Thus, each photo was evaluated seven times for specific recreation activity. Each face to face questionnaire took about 10 to 20 minutes to complete. The respondents were made aware that the information collected would be strictly confidential and anonymous, and will be used for the purpose of this research only.

Face to face questionnaire survey was conducted at “Yui Yui Kunigami” and “Peace Memorial Park” from August 2013 to November 2013. These two sites were selected to obtain the data because they are a good catchment for people from Okinawa and people from other parts of Japan. This is because these two areas provide souvenirs, food, and facilities such as convenient parking lots and
clean restrooms, which are popular attractions for all kinds of tourists. At each site visitors were contacted randomly. In all, 93 visitors answered the questionnaire on site.

2.3. Statistical analysis

In this study the data drawn from the survey were mainly qualitative data, which can be classified into two types, ordinal or nominal. While nominal data means that number is used only for labeling purpose and has no arithmetic significance, ordinal data can be listed in some order, but there is no meaning about the distance between the ordered items.

We carried out nonparametric tests for analyzing the qualitative data. For nominal data such as “gender”, “marital status”, “occupation”, “birthplace” and “current residential address”, we perform Chi-square test for investigating the relationship between two categorical variables. For ordinal data such as “age class”, “income”, “education level”, we computed a Gamma coefficient to evaluate the relationship between two variables. We used a statistical software R (R Development Core Team 2011) to conduct the statistical analysis.

Chi-square test of Independence

To find out if preferences can be differentiated among categories, we performed the Chi-square test based on crosstabulation, where data is classified according to two categorical variables, namely: respondents’ attributes (e.g. “gender”, “marital status”, “occupation”, etc.,) and preference scores for each studied recreation activity. The categories for one variable are shown in rows, while the categories for the other variable are shown in columns. The number in each cell represents the total count of cases for a specific pair of categories. Here, the null hypothesis is: row and column are independent. In R, crosstabulation can be created using the command `table()`. The test statistics for the Chi-Square Test of Independence (Eq.[1]), can be computed using the command `chisq.test()`.

\[
\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{(o_{i,j} - E_{i,j})^2}{E_{i,j}}
\]

where \(o_{i,j}\) represents the observed cell count in the \(i^{th}\) row and \(j^{th}\) column of the table and \(E_{i,j}\) represents the expected cell count in the \(i^{th}\) row and \(j^{th}\) column of the table and computed as:

\[
E_{i,j} = \frac{(\text{Total of row } i) \times (\text{Total of col } j)}{\text{grand total}}
\]

The calculated test statistics value was compared with the critical value using the Chi-square distribution table with degrees of freedom and chosen significance level. The above null hypothesis is rejected when the calculated test statistics value is greater than the critical value. Suppose the null hypothesis is “preference score for a particular landscape can be independent from gender”. Then, if the computed test statistics value is greater than the critical value, we can reject the null hypothesis and conclude that the preference score of a particular landscape depends on gender.

In addition to reporting p-values for these tests, we also compute Cramer’s V to measure effect sizes of these tests. Unlike p-values, effect size is independent of sample size and allows us to compare the results to results from different studies (Sun et al. 2010; McLeod 2019).

Gamma coefficient

Gamma coefficient (Goodman and Kruskal’s gamma) is a well-known rank correlation measure, frequently used to quantify the strength of dependence between two variables of ordinal data (Ruiz and Hüllermeier 2012). Therefore, it is often interpreted as the index for measuring the effect size (Woodwell 2013). Gamma-coefficient is defined as the following ratio (Agresti 2003):

\[
\gamma = \frac{C - D}{C + D}
\]

where \(C\) represents the number of concordant pairs of observations, and \(D\) represents the number of discordant pairs of observations. Gamma-coefficient takes on values between -1 and +1. When
values are significantly different from zero it indicates a strong association between two variables. To compute Gamma coefficient in R, we installed a package called “rpartOrdinal”, then used the command `ordinal.gamma()`.

3. Results

3.1. Respondents’ characteristics

A total of 93 survey responses were collected. There were 48 male and 45 female respondents. Figure 3 represents the age distribution of the respondents. Respondents varied in level of education, with the highest percentage having a high school degree (46%), while the lowest percentage had a graduate degree (5%). With respect to current marital status, 48 respondents were married, while 45 respondents were single. The birthplace of 43 respondents was Okinawa prefecture, while 50 respondents were born outside of Okinawa. The current residential address for the majority of respondents (N 54) was Okinawa prefecture, while 39 respondents lived elsewhere. From all respondents, 41 were employed, 20 were retired, 20 were housewives, 28 were students, and 4 mentioned other occupation. In this study four income levels were defined (&lt; JPY 3,000,000/year, JPY 3,010,000 &lt; 5,000,000/year, JPY 5,010,000- 7,000,000/year, &gt;= 7,010,000/year). Figure 4 represents the distribution of income levels. It is worth noticing that there are 22 non-respondents for this particular question.

![Figure 3. The distribution of age classes of respondents.](image)

3.2. Preferred landscapes for nature-based recreation activities

Table 1 summarizes the results of the average score of the preferred landscape for each nature-based recreation activity. Results show that the Pasture land (Photo 8) and the Coastal Forest (Photo 2) received the highest average scores for the studied activities. The Pasture land obtained the highest score for hiking, running, bicycling and four-wheel driving, while the Coastal forest was appreciated especially for camping and marine activities. The Mangrove Forest (Photo 4) overtook the previous two landscapes in nature observation activity. On the contrary, the Urban area was the less appreciated, except of running, bicycling and four-wheel driving.

Nature observation and marine sports were the activities for which respondents ranked the highest for forest landscape. For the other five studied recreational activities, the three top ranked landscapes included a mixture of forests and open landscapes. Specifically, for hiking and camping, two forest types (Coastal forest and Mangrove forest) and the pasture were the most appreciated.

The top three photos for running, cycling, and four-wheel driving were two open landscapes and one forest type. While for running and driving the coastal forest was the top ranked photo, and the Mangrove forest received the highest score for cycling.

We can conclude, based on the above-mentioned results, that for most of the studied recreational
activities a landscape mosaic, including both forests and open landscape were the vegetation types that best meet the expectations of recreational users in Okinawa Island.

3.3. Relationships between landscape preferences and demographic characteristics

Table 2 and Table 3 show the results from our statistical test for association between preferences and demographic characteristics for the respondents. Table 2 summarizes statistically significant results for Chi-square test of Independence with statistical significance for \( p < 0.05 \). The values of Cramer’s V range from 0.313 to 0.401. The interpretation of these values depends on the context of the study and become meaningful in comparing with existing studies in the related literature (Thompson 2008; Sun et al. 2010). One of the most widely applied guidelines is the so called Cohen’s rule and indicators; negligible (< 0.10), small (0.10–0.3), medium (0.3–0.5) and large (0.5 or more) (Cohen 1988; Sun et al. 2010; Fix et al 2013). Table 3 summarizes the results of rank correlation measures with Gamma coefficient value of greater than 0.30 in absolute term. The rule of thumb by Rea and Parker (1992) has often been applied to interpret Gamma coefficient value (Vojíř and Rusck, 2021). The values of Gamma coefficient rage from 0.304 to 0.473 in absolute term. According to Rea and Parker (1992), these values indicate moderate to relatively strong effect sizes. It shows that in all of the seven studied activities some specific socio-demographic characteristics of respondents were related with the level of landscape type appreciation.

The following results summarize significant relations between landscape type appreciation for specific activities and socio-demographic characteristics of respondents, according to Table 2 and 3.

The origin of the respondents (i.e., residence place and birthplace) shows the impact evaluation of some forest types for recreational activities. The current residence in Okinawa and the birthplace in Okinawa were positively associated with the appraisal of the Ryukyu Pine Forest for hiking, nature observation, and camping. On the other hand, the birthplace in Okinawa was negatively related to appreciation of Coastal Forest for running.

Gender differences reveal that women like Pasture land more than men for most of the studied activities (i.e. nature observation, camping, running, bicycling and four-wheel driving). Additionally, women added higher score to the Chigaya-Suzuki landscape for four-wheel driving than men. However, the Chigaya-Suzuki vegetation type received relatively low average score for the last mentioned activity.

The formal education level of respondents was negatively related to Mangrove forest evaluation for five of the seven studied recreational activities: hiking, running, bicycling, four-wheel driving, and marine activities. In the case of four-wheel driving, respondents with higher education like more Pine Forest and less Mangrove forest in comparison with other respondents. For marine activities, the Coastal and Mangrove forests were worse, and Pasture was better for people with higher level of education.
Higher income of respondents was related to higher appreciation of Chigaya-Suzuki landscape for nature observation and running.

Younger people like more Coastal Forest for camping, Urban area for bicycling and four-wheel driving than the older respondents. Contrary, they like less Pine Forest and Pineapple field as surrounding vegetation for marine activities.

The marital status was related to valorization of some vegetation types receiving low average scores. Married respondents in comparison to unmarried respondents liked more of the following: Pineapple field for camping, Itaji forest for bicycling, and Pine Forest, Chigaya-Suzuki landscape and Pasture land for marine activities.

Table 1. The ranking of preferred landscape for each nature-based recreation activity based on the preference average score (in parentheses) for different recreational activities.

| Activities          | 1st            | 2nd            | 3rd            | 4th            | 5th            | 6th            | 7th            | 8th            | 9th            |
|---------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Hiking              | Pasture (3.65) | Coastal forest (3.51) | Chigaya-Suzuki (3.27) | Mangrove (3.2) | Rice field (3.17) | Ryukyu pine (3.17) | Pasture (3.09) | Pineapple (2.95) | Urban (2.16) |
| Nature observation  | Mangrove (3.92) | Coastal forest (3.71) | Ryukyu pine (3.65) | Rice field (3.48) | Itaji (3.46) | Pasture (3.44) | Pineapple (3.34) | Chigaya-Suzuki (3.33) | Urban (1.71) |
| Camping             | Coastal forest (3.71) | Pasture (3.44) | Mangrove (2.84) | Ryukyu pine (2.67) | Chigaya-Suzuki (2.63) | Itaji (2.57) | Pineapple (2.46) | Rice field (2.46) | Urban (2.99) |
| Running             | Pasture (3.23) | Urban (3.05) | Coastal forest (2.76) | Chigaya-Suzuki (2.71) | Rice field (2.63) | Ryukyu pine (2.57) | Pineapple (2.46) | Mangrove (2.35) | Itaji (2.20) |
| Bicycling           | Pasture (3.39) | Urban (2.75) | Coastal forest (2.49) | Chigaya-Suzuki (2.65) | Rice field (2.63) | Ryukyu pine (2.59) | Pineapple (2.46) | Coastal forest (2.39) | Itaji (2.14) |
| Four-wheel driving  | Pasture (3.20) | Coastal forest (3.19) | Mangrove (1.18) | Urban (1.06) | Ryukyu pine (2.86) | Mangrove (2.76) | Chigaya-suzuki (2.69) | Rice field (2.55) | Itaji (2.65) |
| Marine activities   | Coastal Forest (2.27) | Mangrove (2.36) | Ryukyu pine (1.76) | Itaji (1.61) | Pineapple (1.36) | Rice field (1.33) | Pasture (1.32) | Chigaya-suzuki (1.14) | Urban (1.17) |

Table 2. Summary of Chi-square test of Independence.

| Activities          | Demographic Characteristics | Preferred by | Landscape | Chi-square | p-value | Cramer’s V |
|---------------------|-----------------------------|--------------|-----------|------------|---------|------------|
| Hiking              | Current residential address | Okinawa      | Ryukyu pine | 12.097     | 0.007   | 0.351      |
|                     | Birthplace                  | Okinawa      | Ryukyu pine | 13.608     | 0.003   | 0.373      |
| Nature observation  | Current residential address | Okinawa      | Ryukyu pine | 15.375     | 0.002   | 0.396      |
|                     | Gender                      | Female       | Pasture    | 10.114     | 0.018   | 0.321      |
|                     | Current residential address | Okinawa      | Itaji      | 10.078     | 0.018   | 0.321      |
|                     | Current residential address | Okinawa      | Ryukyu Pine | 10.88      | 0.012   | 0.333      |
|                     | Marital Status              | Married      | Pineapple  | 11.137     | 0.011   | 0.337      |
|                     | Gender                      | Female       | Pasture    | 14.099     | 0.003   | 0.378      |
| Running             | Birthplace                  | non-Okinawa  | Coastal Forest | 10.737     | 0.013   | 0.331      |
|                     | Gender                      | Female       | Pasture    | 11.905     | 0.008   | 0.349      |
| Bicycling           | Marital Status              | Married      | Itaji      | 12.172     | 0.007   | 0.352      |
|                     | Gender                      | Male         | Ryukyu Pine | 10.401     | 0.015   | 0.326      |
|                     | Gender                      | Female       | Pasture    | 10.663     | 0.014   | 0.330      |
| Four-wheel driving  | Gender                      | Female       | Chigaya-suzuki | 9.624      | 0.022   | 0.313      |
|                     | Gender                      | Female       | Pasture    | 15.747     | 0.001   | 0.401      |
| Marine activities   | Marital Status              | Married      | Ryukyu Pine | 12.179     | 0.007   | 0.353      |
|                     | Marital Status              | Married      | Chigaya-suzuki | 9.901      | 0.019   | 0.318      |
|                     | Marital Status              | Married      | Pasture     | 11.272     | 0.010   | 0.339      |
Table 3. Summary of rank correlation measures.

| Activities          | Demographic Characteristics | Landscape          | Gamma coefficient |
|---------------------|-----------------------------|--------------------|-------------------|
| Hiking              | Education                   | Mangrove           | -0.304            |
| Nature observation  | Income                      | Chigaya-Suzuki     | 0.371             |
| Camping             | Age                         | Coastal Forest     | -0.369            |
| Running             | Education                   | Mangrove           | -0.399            |
|                     | Income                      | Chigaya-Suzuki     | 0.339             |
| Bicycling           | Education                   | Mangrove           | -0.383            |
|                     | Age                         | Urban District     | -0.318            |
| Four-wheel driving  | Education                   | Ryukyu Pine Forest | 0.316             |
|                     | Education                   | Mangrove           | -0.363            |
|                     | Age                         | Urban District     | -0.322            |
|                     | Education                   | Coastal Forest     | -0.31             |
|                     | Education                   | Mangrove           | -0.473            |
| Marine activities   | Age                         | Pasture            | 0.328             |
|                     | coastal                     | Coastal Forest     | 0.372             |
|                     | Age                         | Ryukyu Pine Forest | 0.309             |
|                     | Age                         | Pineapple          | 0.445             |

4. Discussion and Conclusions

This study attempts to identify desirable surrounding vegetation for different outdoor recreation activities and to examine the effect of socio-demographic characteristics on the level of appreciation of vegetation types. From the best of our knowledge, there is lack of published studies which have investigated landscape preferences for different recreational activities in Okinawa Island. We applied the photo-questionnaire to identify the level of appreciation of different vegetation types for different recreational activities. Subsequently, we analyzed the collected data using non-parametric tests (i.e. chi-square test, gamma coefficient).

Our results show that Pasture land is the most appreciated vegetation type for hiking, running, bicycling and four-wheel driving, while Coastal forest is valued especially during camping and marine activities. Mangrove Forest overtakes the previous two landscapes in nature observation activity. These findings indicate that landscape appreciation depends on the way landscape is used, which is similar to the findings in several previous studies applied in other countries (e.g. Purcell, 2006; Surová and Pinto-Correia 2016).

Our study also reveals that for most of the recreational activities in Okinawa Island’s diverse vegetation types, including forests and open landscape types are similarly appreciated. This finding can indicate a general visual preference for diverse landscapes. This result is similar to findings in previous studies about landscape preferences in various regional contexts (Hafner at al. 2017).

Among the nine socio-demographic factors analyzed (age, gender, marital status, employment status, income, education level, birthplace, current residential address, and the number of family members), all except employment status and the number of family members, significantly influenced the level of landscape appreciation for recreational activities. These findings are not surprising as they are similar to previous research findings which reveal association between different socio-demographic variables and landscape preferences (Hafner at al. 2017). Our study shows that particularly the respondent’s local origin (i.e., current residence place and the birthplace in Okinawa), which increases the level of familiarity with the local landscape, is associated with a higher valorization of the Ryukyu Pine Forest for several recreational activities. These findings can be explained by Purcell et al. (2001) and Tveit (2009) who have indicated that “familiarity with the landscape” can be an important factor which affects landscape preferences. Ryukyu Pine Forest is a unique traditional landscape in Okinawa and thus can support an identity value appreciated particularly by local people.

On the other hand, the non-local respondents (born outside of Okinawa) like the Coastal Forest the most, especially for running. Practicing such physical activity under the Coastal forest could
be more attractive to people born outside of Okinawa, who might not have easy access to such environment and mainly visit the coastal areas.

This study also shows that younger people like the Coastal forest for camping more than older people, which is consistent with Howley (2011), who indicated that water related landscape is negatively associated with age. This is because of the fear generated by these landscapes on older people (López-Martínez 2017). The level of education is another important variable which significantly impacts how the landscape is evaluated (Surová and Pinto-Correia 2016; Hafner at al. 2017). People with higher level of formal education can be more sensitive towards the concept of sustainability. This may explain why respondents with higher education added less value to Mangrove Forest for most of the recreational activities. The awareness that Mangrove Forest need ecological protection rather than a recreational use can be gained by formal education and can subsequently impact landscape evaluation for specific activity. It would be however interesting to explore these findings in more detail in future research.

In addition, our results show that gender, marital status, as well as income, influence landscape evaluation. These findings are consistent with results from previous studies (Lyon 1983; Strumse 1996; Filova et al. 2015; López-Martínez 2017).

Although the results are specific to our study area, the underlying issues that motivated the present study are common to many other places within and outside Japan and the method used are applicable to other areas. In addition, the discussion of the general findings, such as the impact of socio-demographic characteristics on landscape appreciation, contributes to the existing empirical findings in literature by quantifying the strength of these relationships.

Nevertheless, we acknowledge the potential limitations of conducting a face-to-face photo questionnaire survey for exploring public preferences toward various landscapes and various recreational uses. First, we utilized colour photographs to investigate people’s preference to different landscapes. Although various studies have shown that there is high correlation between preferences based on photographs and preferences based on direct experience of the represented landscapes (e.g. Shafer and Richards 1974; Zube 1974; Daniel and Boster 1976; Shuttleworth 1980; Kellomaki and Savolainen 1984; Stamps 1990), the “representational validity” of photographs has been the subject of controversy because people must rate each landscape without direct experience with them (Hetherington et al. 1994; Daniel and Meitner 2001). Especially, Daniel and Meitner (2001) pointed out that photographs must be carefully utilized for accessing actual environment experiences. There may be the case where using an additional representation media is necessary (Hetherington et al. 1994). Therefore, in future studies to examine the preference of landscape for nature-based activities, it is important to consider also some other forms of visual representation. Most recently, an immersive virtual reality (VR) system, which provides users with more immersive and realistic experience, have been increasingly used in the tourism industry (Loureiro et al. 2020). VR system could provide useful surrogate for evaluating the landscape for nature-based activities because it presents both visual and audio stimuli through stereoscopic head-mounted displays.

Secondly, our sample size is relatively small. Future studies with inclusion of more samples would be necessary for validating the results from our case study and therefore provide useful information for future landscape planning. Also, the range of landscape as well as outdoor activities considered in this study was limited. Although previous studies of landscape preferences have paid little attention to the range of landscapes sampled (Brush et al. 2000), studies that include a broad range of landscape and outdoor activities in addition to the inclusion of bigger sample, will increase our understanding of the relationships between socio-demographic characteristics and landscape preferences for nature-based recreation activities. However, adding more photographs to the survey which considers more landscapes or outdoor activities, would require an effective design of the survey (e.g. giving a small break during the survey) to avoid “fatigue effect” (Tveit 2009), which could lead to a longer completion time for respondents. Therefore, it is important to balance the range of landscapes and outdoor activities considered and potential time required for completing a set of questionnaires.

Thirdly, our results show higher nonresponse rate for the question on income. Survey question about income is usually considered sensitive and tend to produce higher nonresponse rates than questions on other topics (Tourangeau and Yan 2007). The response rate for sensitive questions can be higher with computer assisted self-interview compared to face-to-face interviews (Szolnoki and Hoffmann 2013; Heerwegh and Loosveldt 2008). Although, we chose face-to-face setting to collect data, in the future study, we may consider the internet as our medium for communicating with the
respondents. Various studies (Bishop 1997; Wherrett 1999; Roth 2006) have indicated that online questionnaires could be suitable for conducting experimental studies of preferences because there is no significant difference between the validity of the data collected in face-to-face questionnaires and online questionnaires.

Lastly, although our study focused on visual evaluation of landscapes for recreation activities, other factors such as resource qualities (such as water quality, the number of wildlife species etc.), accessibility, presence of facilities (such as parking lot, clean bathrooms, etc.) and services (such as the availability of tour guides) are also important factors for influences preferences for sites (Rephann 2012) and therefore, worth further investigations.

In spite of these limitations, our study demonstrates that the relationship between level of landscape appreciation and socio-demographic variables can be examined. Knowing the relationship between landscape preferences and demographic variables as well as understanding people’s perception of the surrounding landscape is important for developing a landscape management plan (Dearden 1984). This information when provided to land managers is useful for the identification of valuable landscapes (Filova et al. 2015). The present study identifies the level of appreciation of vegetation types for different recreational activities, and also reveals the complex relationships between vegetation type appreciation and the socio-demographic factors. We believe that these results bring to light some useful knowledge for future research, as well as help planners and managers to allocate recreational sites more appropriately based on identification of visitors’ preferences. Efficient landscape planning will be especially important because Okinawa along with other Nansei Islands have become the newest Natural World Heritage Sites in Japan. Balancing recreational demands against the conservation of the natural resources is necessary to achieve sustainable nature-based tourism in Okinawa.

Acknowledgement

This research was partially supported by a Grant-in-Aid for Scientific Researches (No. 17H00806 & 21K12366) from the Ministry of Education, Culture, Sports, Science, and Technology of Japan. The authors appreciate the insightful comments on earlier drafts made by anonymous reviewers.

References

Agresti, A. (2003) Categorical data analysis (Vol. 482), John Wiley & Sons, 734p.

Arai, N. (2008) Study of World Heritage Registration and Sustainable tourism spot making, Studies of Regional Policy 11(2):39–55. (in Japanese)

Atauri, J. A., Bravo, M. A., Ruiz, A. (2000) Visitors’ landscape preferences as a tool for management of recreational use in natural areas: A case study in Sierra de Guadarrama (Madrid, Spain), Landscape Res. 25(1): 49-62.

Barroso, F. L., Pinto-Correia, T., Ramos, I. L., Surová, D., Menezes, H. (2012) Dealing with landscape fuzziness in user preference studies: Photo-based questionnaires in the Mediterranean context, Landscape Urban Plan. 104(3-4): 329–342.

Bishop, I.D. (1997) Testing Perceived Landscape Colour Difference Using the Internet. Landscape Urban Plan. 37(3-4): 187–196.

Brooks, G. (2011) Heritage as a driver for development: Its contribution to sustainable tourism in contemporary society, ICOMOS 17th General Assembly, Paris.

Brush, R., Chenoweth, R.E., Barman, T. (2000). Group differences in the enjoyability of driving through rural landscapes, Landscape Urban Plan. 47(1-2): 39-45.

Daniel, T.C., Boster, R.S. (1976) Measuring Landscape Aesthetics: the Scenic Beauty Estimation Method. USDA Forest Service Research Paper RM-167. Fort Collins, CO: Rocky Mountain Forest and Range Experiment Station.
Daniel, T.C., Meitner, M.M. (2001) Representational validity of landscape visualizations: the effects of graphical realism on perceived scenic beauty of forest vistas, *J. Environ. Psychol.* 21(1): 61–72.

Das, G., Sarkar, R. (2020) *Global Environmental Challenges in the 21st Century*, In: Sarkar, R. (eds), Environmental sustainability in the 21st century: Emerging issues and the way forward, Namy Press, Delhi, India 364pp.

Davis, D., Tisdell, C. (1995) Recreational scuba-diving and carrying capacity in marine protected areas, *Ocean & Coastal Management*, 26(1): 19–40.

Dearden, P. (1984) Factors influencing landscape preferences: an empirical investigation, *Landscape Plan.* 11(4): 293–306.

Filova, L., Vojar, J., Svobodova, K., Sklenicka, P. (2015) The effect of landscape type and landscape elements on public visual preferences: ways to use knowledge in the context of landscape planning, *J. Environ. Plan. Man.* 58(11): 2037–2055.

Fix, P.J., Carroll, J., Harrington, A.M. (2013). Visitor experiences across recreation settings: A management or measurement issue? *J. Outdoor Recreat. Tour.* 3: 28–35.

Häfner K., Zasada I., van Zanten B.T., Ungaro F., Koets E., Piorr A. (2018) Assessing landscape preferences: a visual choice experiment in the agricultural region of Märkische Schweiz, Germany, *Landscape Res.* 43(6): 846–861.

Hall, C. M. (1992) *Hallmark tourist events: impacts, management and planning*, Belhaven Press, 225p.

Heerwegh, D., Loosveldt, G. (2008) Face-to-face versus web surveying in a high-internet-coverage population: Differences in response quality, *Public Opin. Quart.* 72(5): 836–846.

Hetherington, J., Daniel, T.C., Brown, T.C. (1994) Is motion more important than it sounds? The medium of presentation in environmental perception research, *J. Environ. Psychol.* 13: 283–291.

Kellomaki, S., Savolainen, R. (1984). The scenic value of the forest landscape as assessed in the field and the laboratory, *Landscape Plan.* 11: 97–107.

López-Martínez, F. (2017) Visual landscape preferences in Mediterranean areas and their socio-demographic influences, *Ecol. Eng.* 104: 205–215.

Loureiro, S.M.C., Guerreiro, J., Ali, F. (2020) 20 years of research on virtual reality and augmented reality in tourism context: A text-mining approach, *Tourism Manage.* 77: 104028.

Lyons, E. (1983) Demographic correlates of landscape preference, *Environ. Behav.* 15(4): 487–511.

Masuruli, M.B. (2014) *Costs and Benefits of Nature-Based Tourism to Conservation and Communities in the Serengeti Ecosystem*, PhD dissertation, University of Victoria, Victoria, BC, Canada.

McLeod, S.A. (2019, July 10). What does effect size tell you? Simply psychology: <https://www.simplypsychology.org/effect-size.html> (Accessed 15 March, 2021)

Montagni, I., Cariou, T., Tzourio, C., González-Caballero, J. L. (2019) “I don’t know”; “I’m not sure”; “I don’t want to answer”: a latent class analysis explaining the informative value of nonresponse options in an online survey on youth health, *Int. J. Soc. Res. Methodol.* 22(6): 651–667.

Nasseef, M. A., Alshayeb, H., Ojilat, J., Alshafiee, M. (2017) The effect of sport tourism management on support for tourism development. *J. Manag. Strategy* 8(3): 20–34.

Okinawa Prefectural Government, Department of Culture, Tourism and Sports (2019) Okinawa Prefecture Tourism Statistics Actual Conditions Survey, <https://www.pref.okinawa.jp/site/bunkasports/kankoseisaku/kikaku/report/tourism_statistic_report/documents/gaiyouban.pdf> (Accessed 15 March, 2021)
Okinawa Prefectural Government, Department of Culture, Tourism and Sports (2020) Okinawa Prefecture Tourism Industry Survey Full-year Report Year 2019, <https://www.pref.okinawa.jp/site/bunka-sports/kankoseisaku/kikaku/report/industry_survey/documents/r1tourismindustrysurveyp1-592.pdf> (Accessed 15 March, 2021)

Okinawa Prefectural Government, Department of Environmental and Community Affairs (2020) <https://www.pref.okinawa.jp/site/kankyo/shizen/sekaishizenisan/index.html> (Accessed 15 March, 2021)

Okinawa Preecture Office (2020) <https://www.pref.okinawa.jp/site/kankyo/shizen/sekaishizenisan/documents/panfuretto.pdf> (Accessed 15 March, 2021)

Okuda, N. (2007) The current situation of and problems related to “Ecotourism” in Japan: Field Studies in Iriomote, Island, Okinawa, Japan.

Perić, M., Durkin, J., Vitezic, V. (2018) Active event sport tourism experience: The role of the natural environment, safety and security in event business models, Int. J. Sustain. Dev. Plan. 13(5): 758–772.

Purcell, T., Peron, E., Berto, R. (2001) Why do preferences differ between scene types, Environ. Behav. 33: 93–106.

R Development Core Team (2011) R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Available in: <http://www.r-project.org>

Rea, L.M., Parker, R.A. (1992) Designing and conducting survey research, Jossey-Bass, San Francisco, 254p.

Rephann, T.J. (2012) Outdoor Recreation Demand for Virginia: An Analysis Using 2011 Virginia Outdoors Survey Data. Center for Economic and Policy Studies, Weldon Cooper Center for Public Service: University of Virginia.

Roth, M. (2006) Validating the use of Internet survey techniques in visual landscape assessment – An empirical study from Germany, Landscape Urban Plan. 78(3): 179–192.

Ruiz, M.D., Hüllemeyer, E. (2012) A formal and empirical analysis of the fuzzy gamma rank correlation coefficient, Inf. Sci. 206: 1-17.

Schmutz, V., Elliott, M.A. (2016) Tourism and sustainability in the evaluation of World Heritage Sites, 1980–2010, Sustainability 8(3): 261.

Shafer, E.L., Richards, T.A. (1974) A Comparison of Viewer Reactions to Outdoor Scenes and Photographs of those Scenes. USDA Forest Service. Research Paper NE-302. Upper Darby, PA: Northeastern Forest Experiment Station.

Shuttleworth, S. (1980) The use of photographs as an environmental presentation medium in landscape studies, J. Environ. Manag. 11: 61–76.

Song, D., Kuwahara, S. (2016) Ecotourism and world natural heritage: Its influence on islands in Japan, J. Mar. Isl. Cult. 5(1): 36–46.

Stamps III, A.E. (1990) Use of photographs to simulate environments: A meta-analysis, Percept. Mot. Ski. 71(3): 907–913.

Stamps III, A.E. (1992) Perceptual and preferential effects of photomontage simulations of environments, Percept. Mot. Ski. 74(3): 675–688.

Stamps III, A.E. (1993) Public preferences for residences: precode and code minimum, and avant-garde architectural styles, Percept. Mot. Ski. 77: 99–103.

Strumse, E. (1996) Demographic differences in the visual preferences for agrarian landscapes in western Norway, J. Environ. Psychol. 16(1): 17–31.
Sun, S., Pan, W., Wang, L.L. (2010) A comprehensive review of effect size reporting and interpreting practices in academic journals in education and psychology, *J. Educ. Psychol.* 102(4): 989.

Surová, D., Pinto-Correia T. (2016) A landscape menu to please them all: Relating users’ preferences to land cover classes in the Mediterranean region of Alentejo, Southern Portugal, *Land Use Policy* 54: 355–365.

Szolnoki, G., Hoffmann, D. (2013) Online, face-to-face and telephone surveys – Comparing different sampling methods in wine consumer research, *Wine Econ. Policy* 2(2): 57–66.

Tang, C.F., Tan, E.C. (2018) Tourism-led growth hypothesis: A new global evidence, *Cornell Hosp. Q.* 59(3): 304–311.

Tempesta, T. (2010) The perception of agrarian historical landscapes: A study of the Veneto plain in Italy, *Landscape Urban Plan.* 97(4): 258–272.

Thompson, B. (2008) *Computing and interpreting effect sizes, confidence intervals, and confidence intervals for effect sizes.* In: Osborne J.W. (ed.) Best practices in quantitative methods, Thousand Oaks, CA: Sage, pp. 246–262.

Tourangeau, R., Yan, T. (2007) Sensitive questions in surveys, *Psychol. Bull.* 133(5): 859.

Tveit, M.S. (2009) Indicators of visual scale as predictors of landscape preference; a comparison between groups, *J. Environ. Manag.* 90(9): 2882-2888.

Vojíř, K., Rusek, M. (2021) Preferred Chemistry Curriculum Perspective: Teachers’ Perception of Lower-Secondary School Textbooks, *J. Balt. Sci. Educ.* 20(2): 316.

Wherrett, J.R. (1999) Issues in Using the Internet as a Medium for Landscape Preference Research, *Landscape Urban Plan.* 45 (4): 209–217.

Woodwell, D. (2013) *Research Foundations: How Do We Know what We Know?* SAGE Publications, 224p.

Zube, E.H. (1974) Cross-disciplinary and inter-mode agreement on the description and evaluation of land-scape resources, *Environ. Behav.* 6: 69–89.