CHARACTERISTICS OF WINTER USE OF MICHI-NO-EKI IN HOKKAIDO

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1.Abstract

Michi-no-Eki are highway stopovers offering comfortable rest facilities and a variety of other high-quality services. Presently, these facilities have been built in great numbers throughout Japan, including Hokkaido. It is expected that the reasons for using *Michi-no-Eki* change according to the season. For example, because Hokkaido is a cold, snowy region, *Michi-no-Eki* provide improved safety in winter. A large-scale questionnaire was distributed to Hokkaido *Michi-no-Eki* users to determine the seasonal usage characteristics of *Michi-no-Eki*, specifically in summer and winter. User intention data was collected, the usage characteristics in summer and winter were analyzed using cluster analysis methods, and the results were compared. In summer, tourism uses like "sightseeing" and "stamp rally" are prominent. In winter, functions like "resting", "restrooms", and "weather information" were important. The type of information that users requested at *Michi-no-Eki* also changed from summer to winter. In other words, it became clear that a function shift phenomenon was taking place.

2. Introduction

Hokkaido is cold, snowy region. Our predecessors overcame its severe climate through the use of technology and persistent effort. Their hard work has created a comfortable region to live in. One of the world's great metropolises, Sapporo, is located in snowy Hokkaido. We have a responsibility to develop this region so that our children may inherit an even better place.

As motorization has progressed, professional drivers and less-skilled drivers have come to mix more on roads. Roads require a resting function for drivers so that traffic may flow smoothly. Consequently, facilities called *Michi-no-Eki* (highway stopovers) have been constructed throughout Japan. Drivers stopping at these facilities can rest in a comfortable environment and take advantage of various advanced services. In Hokkaido, where sightseeing is a key industry, the *Michi-no-Eki* itself becomes a destination, instead of just a stopping place. In other words, the usages of *Michi-no-Eki* are diversifying. For example, its role shifts in the winter to offering safety functions such as "resting" and "providing information". While it is difficult to apply a uniform, ideal standard, all *Michi-no-Eki* characteristics were evaluated on an equal basis. The regional characteristics should be taken into account when determining the changes and improvements to be

adopted. In Hokkaido, the winter characteristics are particularly important. During the winter, the presence of *Michi-no-Eki* and the safety they offer are valued very highly by users.

Based on this kind of background, this study clarifies how Hokkaido *Michi-no-Eki* are used. Using these results, *Michi-no-Eki* are categorized according to summer and winter characteristics, then compared and examined. Based on the analyzed results, we examine the effects unique to *Michi-no-Eki* in a cold, snowy region as well as ways to improve their functions in line with their usage characteristics. We consider an ideal *Michi-no-Eki* for the future, taking into account seasonal and regional characteristics.

3.Execution and comparison of totals of Hokkaido *Michi-no-Eki* user questionnaire

1) The outline of questionnaire

In this study, *Michi-no-Eki* user questionnaire provides the basic data for understanding how visitors use *Michi-no-Eki*. Two investigations were carried out in order to compare features in summer and winter (Table 1).

Table -1 Outline of Hokkaido *Michi-no-Eki* user questionnaire (summer and winter)

	Summer	Winter
Investigation period	August 7th, 2000 ～ September 10th, 2000.	February 17th, 2001 ～ March 8th, 2001.
Research method	Field automatic recording research method. (Each 300-part distribution in all 66 *Michi-no-Eki*).	Field automatic recording research method. (Each 150-part distribution in all 70 *Michi-no-Eki*).
Distribution frequency situation.	Distribution number: 19800 Recovery number: 12481 Recovery rate: 63.0% Valid responses: 12115	Distribution number: 10500 Recovery number: 3105 Recovery rate: 29.6% Valid responses: 3105
Investigation content	①Type of transportation (bus, auto, rental car, etc.) ②On present travel action (purpose of travel, schedule, itinerary, and hours of continuous driving). ③On the usage of present *Michi-no-Eki* (frequency of usage, date and time, stopping time, reasons for usage, level of satisfaction) ④On the usage of Hokkaido *Michi-no-Eki* in general (frequency of usage, well-used MICHI-NO-EKI, opinions and requests) ⑤Subject attributes (residential area, sex, age, occupation)	

2) *Michi-no-Eki* utilization characteristics comparison analysis in summer and winter

a) Comprehensive comparison of reasons for stopping at *Michi-no-Eki* in summer and winter

Figure -1 shows the results of analyzing "reason for stopping at the MICHI-NO-EKI" in summer and winter.

①"Resting and restroom" usage increases somewhat in winter, compared to summer. The following consideration explain this change: Because of the nature of winter driving, the average speed of travel drops, and driving time as well as fatigue increases.

②"Dining" increases in winter. It can be assumed that the increase in dining coincides with the

increase in rest.

③"Sightseeing" and "stamp rally" decrease in winter. The drop in auto traffic for the purposes of sightseeing and stamp rallies explains this decrease.

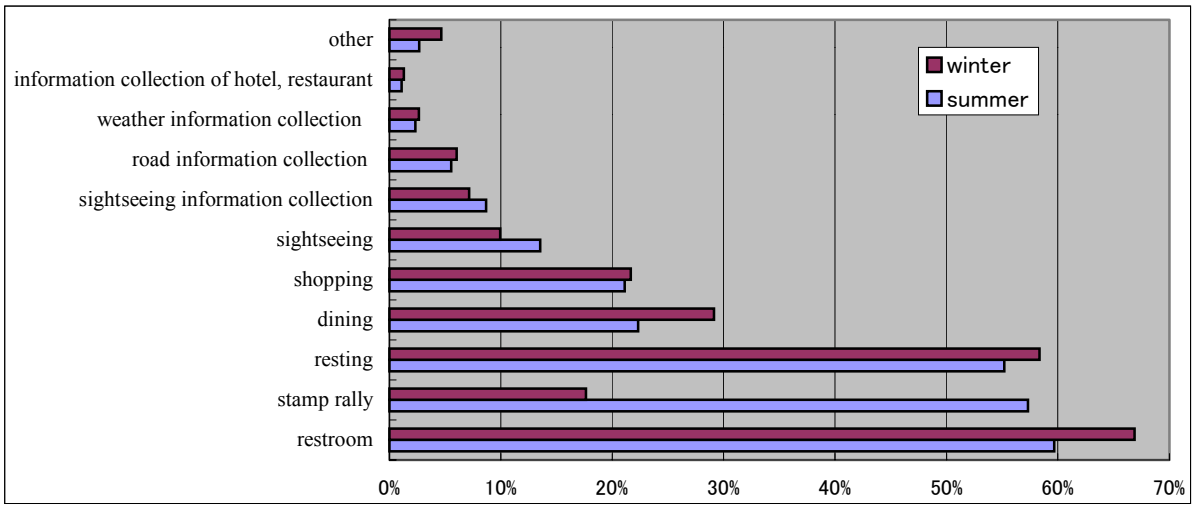

Figure -1 Comparison of summer and winter reasons for stopping

b) Synthetic comparison in summer and winter on "got merit by stopping *Michi-no-Eki*"

The analysis of summer and winter of the item "stopping at Michi-no-Eki was advantageous" is shown in figure 2.

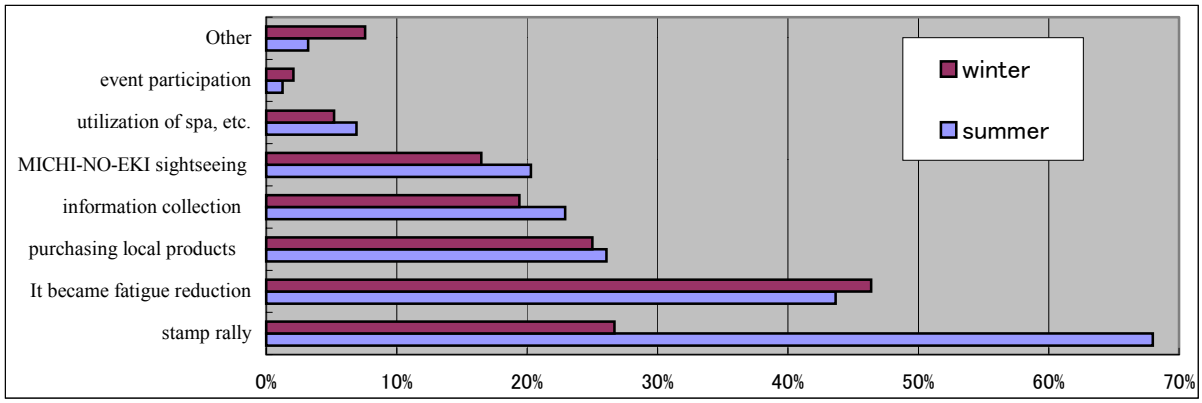

Figure-2 Comparison of summer and winter regarding "stopping at Michi-no-Eki was advantageous"

The following facts are examined from figure 2.

①Proportion of responses indicating "fatigue" increases in winter. Winter driving increases fatigue, and the number of drivers taking advantage of Michi-no-Eki for resting rises.

②Factors related to sightseeing (purchasing local products, stamp rally, *Michi-no-Eki* sightseeing) decrease in winter.

c) Comparison of total results for summer and winter regarding " reasons for present travel"

The results of comparison and analysis of " reasons for present travel" in summer and winter is shown in figure 3. The following facts from figure 3 are examined.

①In summer, a considerable number travel for purposes like "sightseeing" and "driving".

②In winter, a high proportion of users travel for purposes like "personal reasons", "commuting" and "work".

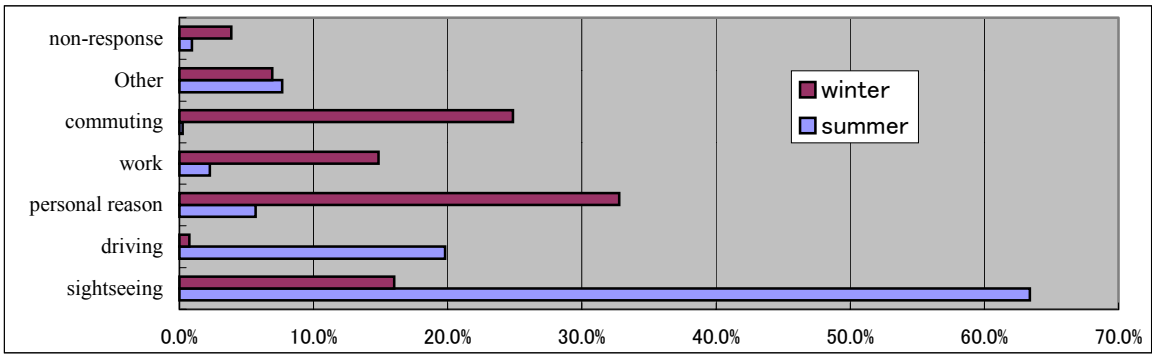

Figure -3 Comparison of summer and winter regarding "present reasons for travel"

4. Cluster Analysis Classification of *Michi-no-Eki* based on Usage Characteristics

1) Hierarchical cluster analysis using user attitude data

a) Analytical process

The results of summer and winter questionnaires is used as basic data, and *Michi-no-Eki* classification is carried out based on user attitude. Cluster analysis is used in this study to classify *Michi-no-Eki*. The standardization Euclidean distance method is used to define dissimilarity in cluster analysis. Six representative methods (minimum distance, maximum distance, group average, elastic center, median, and Ward) are applied to the summer and winter data. One method is chosen once the results of all methods have been examined. Then, the adopted method (in this study, the Ward method), is used for examination and comparison of results.

b) Measuring method of dissimilarity in hierarchical cluster analysis

From the set of valid responses, the proportion of each reason for stopping at the *Michi-no-Eki* is calculated. The result is defined as an attribute variable. In other words, the *Michi-no-Eki* user attitude is our data. Standardization Euclidean distance is used to measure dissimilarity between individuals in attribute space. In this case, dissimilarity of individuals i and j is defined using formula (1).

$$d_{ij} = \sum_{k=1}^{m} (x_{ki} - x_{kj})^2 / {s_k}^2 \qquad (1)$$

X_k is a variable, and ${s_k}^2$ is the dispersion of variable x_k.

2) Cluster combinatorial method

In this study, synthetic judgment is performed by applying six methods: minimum distance, maximum distance, group average, elastic center, median, and Ward method.

Cluster (p) and cluster (q) are fused to form a new cluster (t). The number of elements of each cluster is set to n_p, n_q, n_t (= n_p+n_q). The value d_{tr} is defined as the dissimilarity between cluster (t) and optional cluster (r). In this case, d_{pr},d_{qr} which is dissimilarities between cluster (p),(q) and cluster (r) is used.

From these, each method is respectively defined according to following equations.

a) Nearest neighbor method

$$d_{tr} = \min(d_{pr}, d_{qr}) \qquad (2)$$

b) Furthest neighbor method

$$d_{tr} = \max(d_{pr}, d_{qr}) \quad (3)$$

c) Group average method

$$d_{tr} = (n_p d_{pr} + n_q d_{qr}) / (n_p + n_q) \quad (4)$$

d) Centroid method

$$d_{tr} = \frac{n_p}{n_p + n_q} d_{pr} + \frac{n_q}{n_p + n_q} d_{qr} - \frac{n_p n_q}{(n_p + n_q)^2} d_{pq} \quad (5)$$

e) Median method

$$d_{tr} = \frac{1}{2} d_{pr} + \frac{1}{2} d_{qr} - \frac{1}{4} d_{pq} \quad (6)$$

f) Ward method

$$d_{tr} = \frac{n_p + n_r}{n_t + n_r} d_{pr} + \frac{n_q + n_r}{n_t + n_r} d_{qr} - \frac{n_r}{n_t + n_r} d_{pq} \quad (7)$$

3) Description of the classification process, and synthetic judgment of its results

a) Selection of object *Michi-no-Eki* in classification process

For the summer analysis, there were 66 *Michi-no-Eki* objects. For the winter, the number of objects increased to 70, with the addition of four new *Michi-no-Eki*. However, there was some defective data for the winter analysis. In addition, in some cases there were an extremely small number of examinees for a *Michi-no-Eki*. These data should be excluded for the sake of reliability of the results. In this case, the following standard for object exclusion was applied. The total number of examinees for the winter investigation is 3105, and the number of *Michi-no-Eki* is 70. The average number of examinees is 3105 ÷ 70 = 44.4 persons/location.

In this study, for the sake of reliability, *Michi-no-Eki* having 20% or less of average number of examinees is excluded, i.e. a *Michi-no-Eki* of 9 persons or fewer (44.4 × 20% = 8.88 examinees/location). There was a total of 10 *Michi-no-Eki* with defective data using this reference value. In short, the number of *Michi-no-Eki* objects in winter dropped to 60.

b) The synthetic judgment of the classification result.

Dendrogram of summer and winter of 12 by 6 techniques is classified into optional number clusters (in this study, four were chosen because of the tendency of characterization and the comprehensibility of the classification result). In each dendrogram, optional standardization Euclidean distance d_i was the cut-off threshold. The dendrogram of the classification results was omitted here for space considerations. These results showed that the classification results of the maximum distance method and the Ward method were good.

In the maximum distance method, one specific individual value becomes the central value of the group. The question of reliability comes up when one individual value is greatly separated from the average value of a group.

The Ward method can ensure the homogeneity in the analysis, because the increment of the sum of squared deviation of dissimilarity by the cluster intensiveness is used.

Classification result by Ward method is adopted in order to consider that it is cluster combinatorial method, which Ward method is the most appropriate by synthetically judging from above fact.

The dendrograms based on the Ward method for summer and winter are shown in figures 4,5.

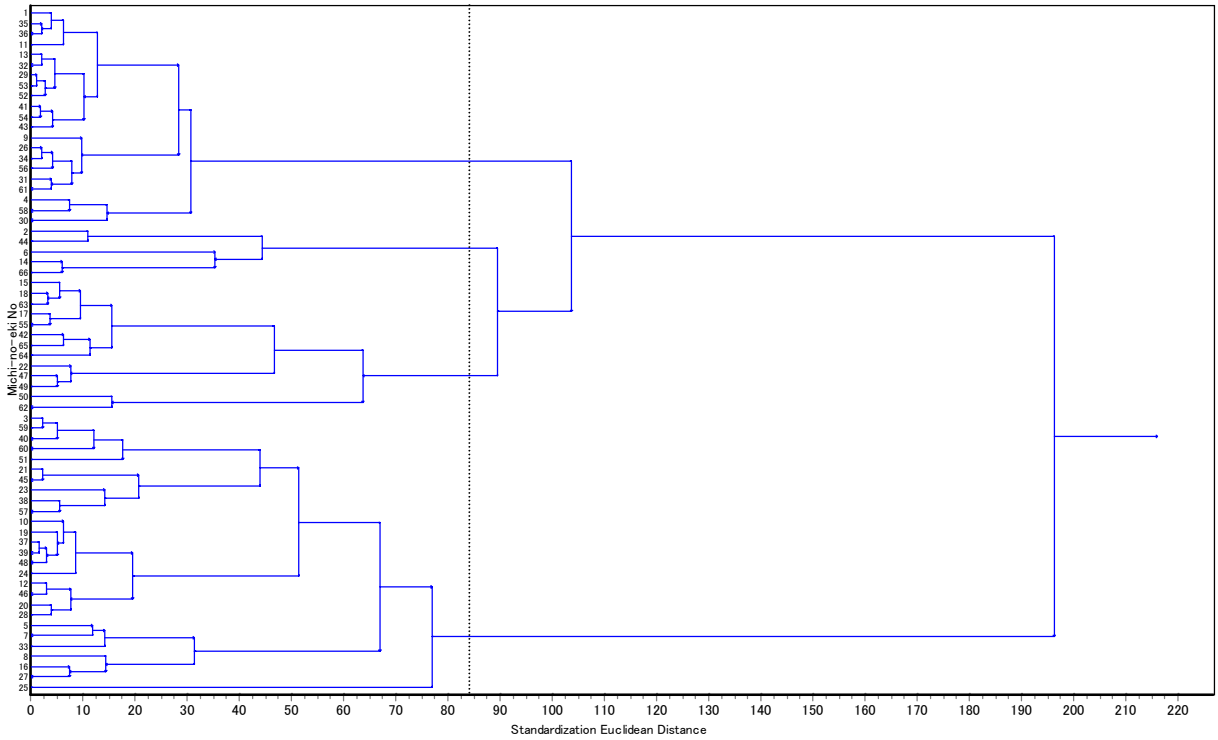

Figure 4　Dendrogram based on the Ward method (summer)

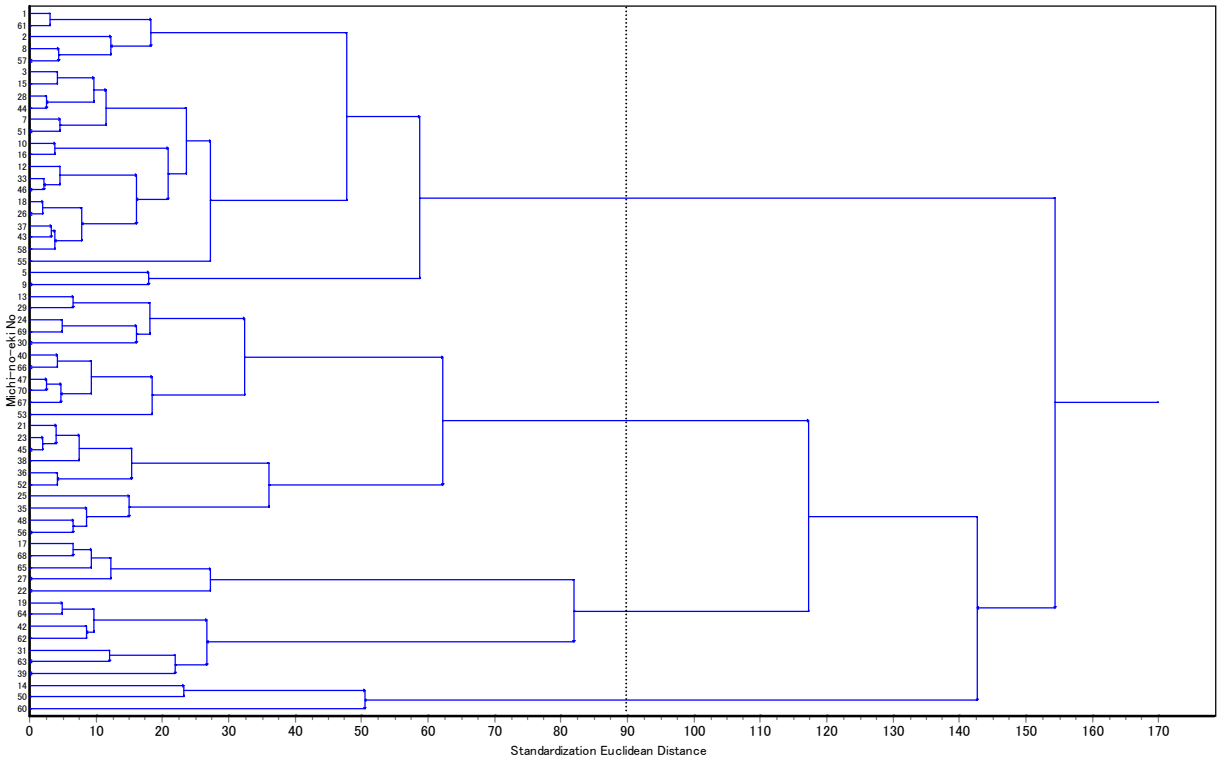

Figure -5　Dendrogram based on the Ward method (winter)

5. Consideration of the features of each cluster

1) Analysis of each cluster

On the basis of the classification results from the Ward method, the features of each of the four clusters are analyzed. Then, the results of the questionnaires item "reasons for using *Michi-no-Eki*" were totaled for each *Michi-no-Eki* in summer and winter. The results are shown in figures 6,7.

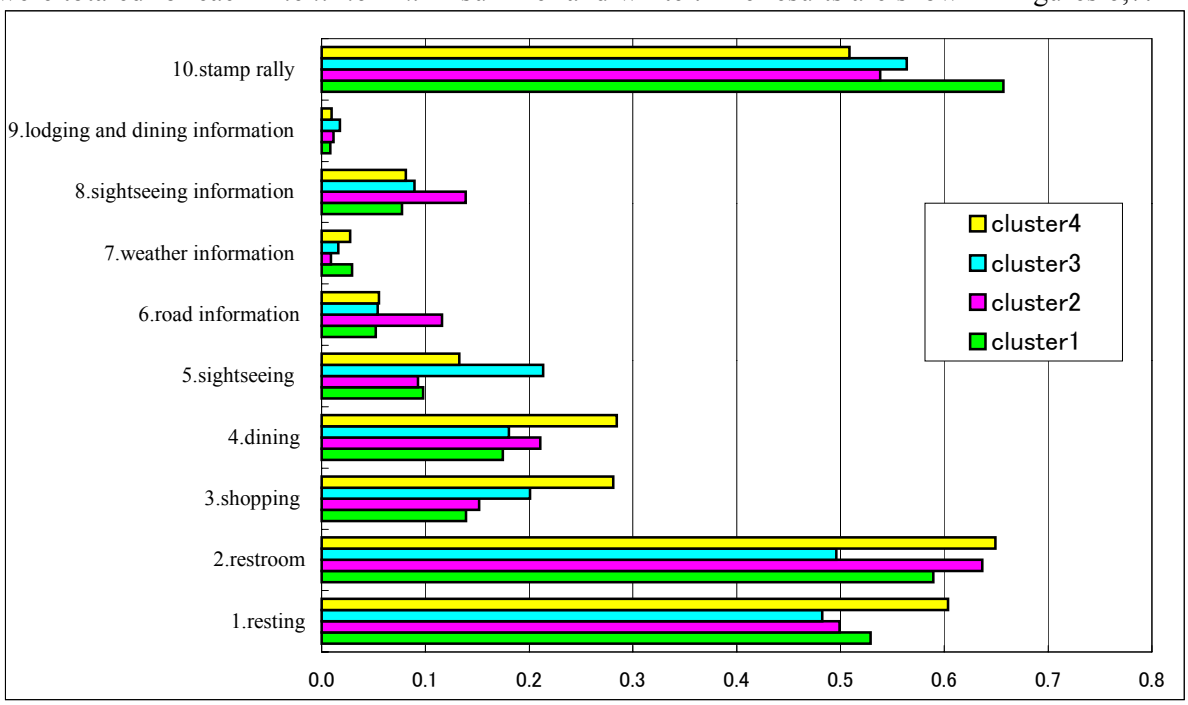

Figure-6 Results of the analysis of the features of each cluster of user attitude data (summer)

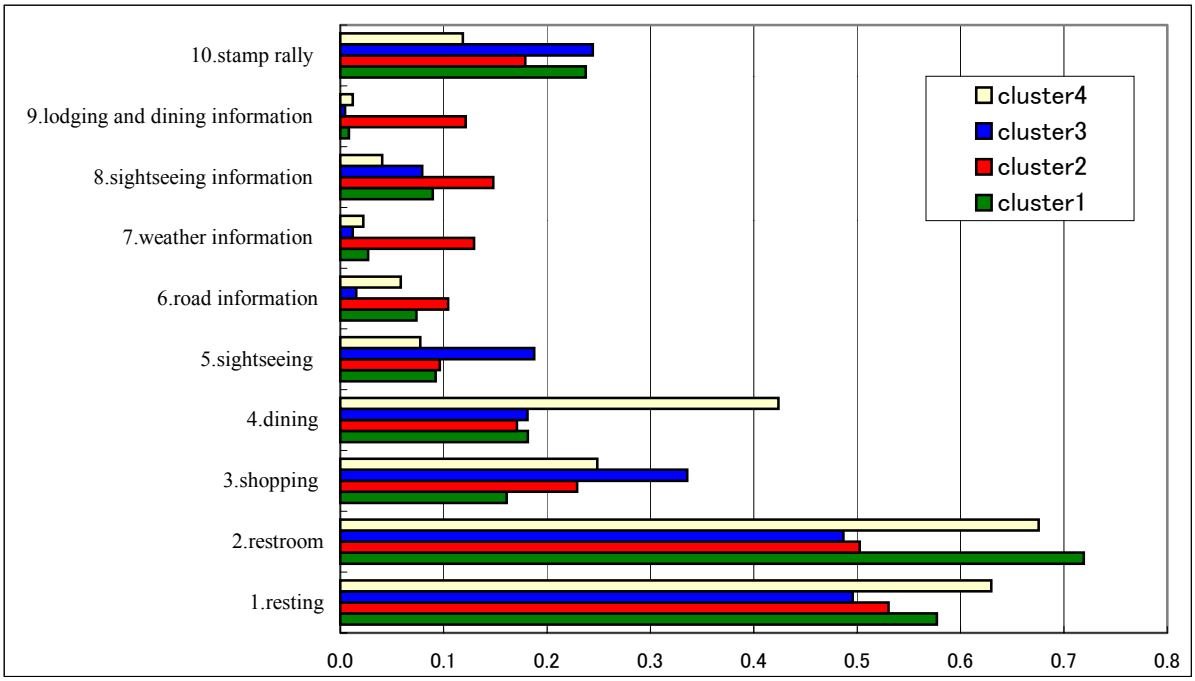

Figure -7 Results of the analysis of the features of each cluster of user attitude data (winter)

2) Location analysis of each cluster

The location distribution of each cluster in summer and winter is shown in figures 8,9.

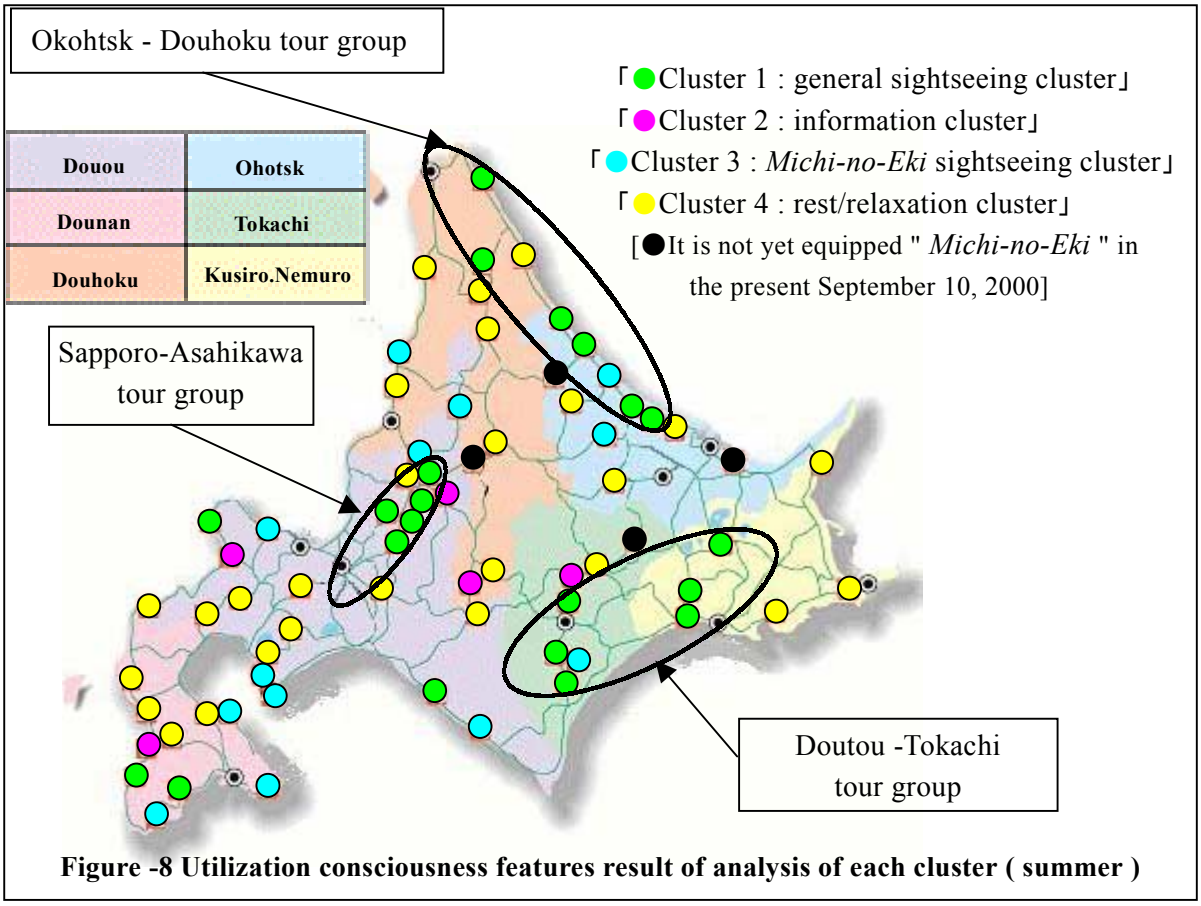

Figure -8 Utilization consciousness features result of analysis of each cluster (summer)

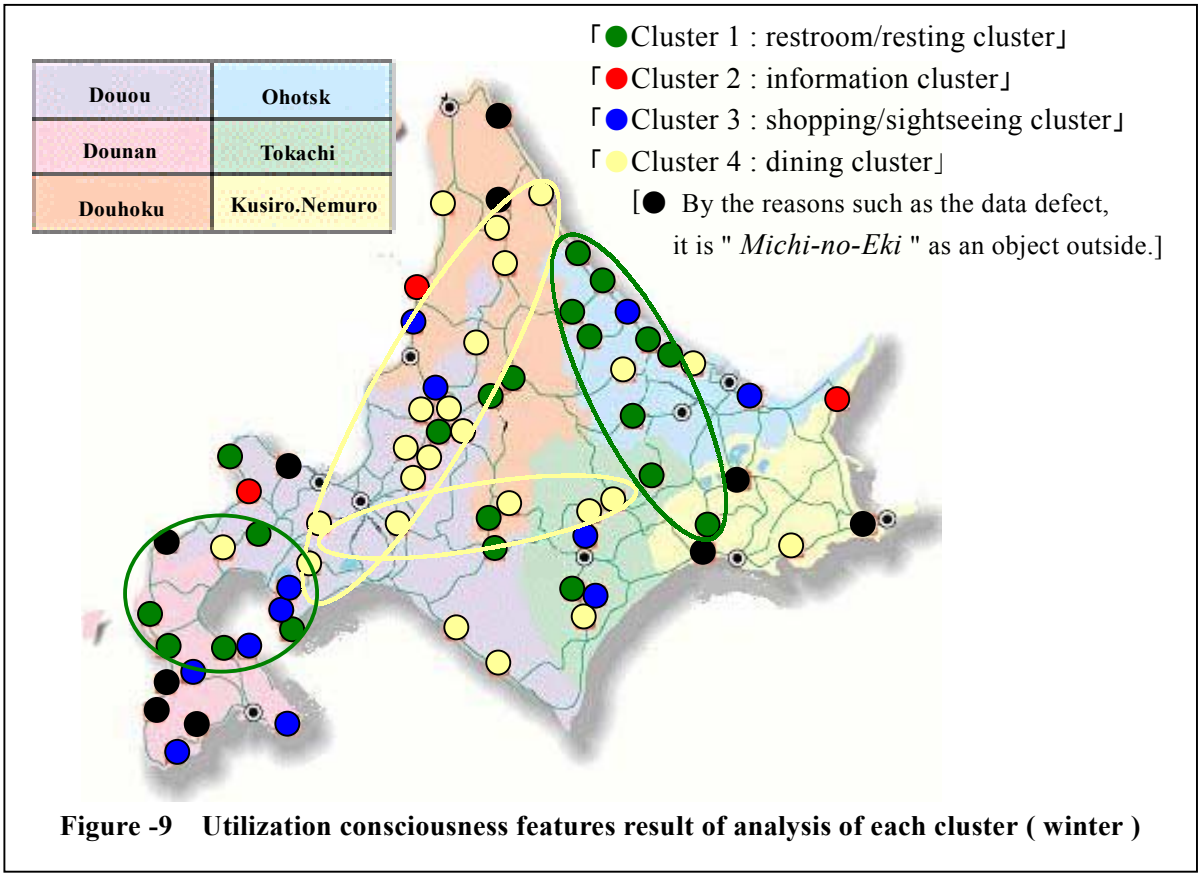

Figure -9 Utilization consciousness features result of analysis of each cluster (winter)

3) Consideration of the features of each cluster in summer

「Cluster 1 : General sightseeing cluster●」

As can be seen in figure 6, usages such as "resting" and "restroom" are of average level. "Stamp rally" is the most frequent reason for usage. This cluster has the properties of promoting sightseeing. In figure 8, the groupings "Ohotsk - Douhoku tour", "Sapporo - Asahikawa tour", and "Doutou - Tokachi tour" confirm the reason for the characteristics in this cluster.

「Cluster 2 : Information cluster●」

In particular, information factors such as "road information and sightseeing information" are higher than in other clusters (refer to figure 6). It is proven that this cluster is distributed at key traffic points (the "nodes" in figure 8).

「Cluster 3 : *Michi-no-Eki* sightseeing cluster●」

From figure 6, it is proven that not "restroom" and "resting" factors but rather "sightseeing " are especially frequent. As seen in figure 8, these are located near the main prefectural sightseeing spots. This cluster can be thought to indicate that the *Michi-no-Eki* itself is a tourist destination.

「Cluster 4 : The Rest cluster●」

In figure 6, "resting" and "restroom" functions and "dining, shopping" are high. In figure 8, this cluster is the most broadly distributed. This is *Michi-no-Eki* in its basic form, i.e. a place offering "rest".

4) The consideration on characteristics of each cluster in winter

「Cluster 1 : Restroom/resting cluster●」

In figure 7, "restrooms" and "resting" are very high. Though it is winter, the fact that "stamp rally" remains relatively high is noteworthy. From figure 9, it is clear that this cluster is mainly distributed in Doutou and Dounan regions of Hokkaido.

「Cluster 2 : Information cluster●」

In figure 7, it is proven that the need for "information" is very pronounced, though "restroom/resting" are of average level. As seen in figure 9, this cluster is clearly located along coastal areas. From this trend, it can be assumed that the need for road and weather information services is great.

「Cluster 3 : Shopping and sightseeing cluster●」

In figure 7, it is proven that factors such as "shopping", "sightseeing" and "stamp rally" are especially high, though "restroom" and "resting" are lower than in other clusters. Figure 9 shows that this cluster is primarily distributed in Dounan and Ohotsk region.

「Cluster 4 : The resting and dining cluster●」

Figure 7 shows that "dining" is particularly high, though "restrooms" and "resting" are also high. Though this cluster is similar to Cluster 1 (the restroom/rest cluster), "stamp rally" appears relatively little. In figure 9, it is clear that this cluster is distributed within the "Douou - Douhoku" and "Douou - Tokachi" regions.

5) Result comparison and synthetic consideration in summer and winter

From the above results, the following facts are examined by comparing summer and winter characteristics.

① Two clusters (namely Clusters 1 and 3, General sightseeing and *Michi-no-Eki* sightseeing) are related to sightseeing in the summer. The role of *Michi-no-Eki* has been transformed from not only one of offering rest, but also to one of promoting sightseeing in summer. The stamp rally

was a very efficient means of promoting tourism.

② In winter, tour sightseeing decreases because of the weather and the fact that stamp rally season closes. However, it was proven that visitors still come for "shopping and sightseeing" and "stamp rally". From these facts, it can be concluded that continuing the stamp rally and sightseeing attractions through the winter would be a good management policy. Winter tourism could be increased considerably.

③ In summer, "sightseeing" is prominent, and consists of two related clusters. In winter, uses like "resting", "restroom" and "dining" are emphasized, and consist of two related clusters. Clearly, a seasonal "function shift phenomenon" is occurring at *Michi-no-Eki*.

④ From ③, *Michi-no-Eki* have an "existence value", that is, their presence is important to drivers for the safety that they offer.

⑤ "Sightseeing and road information" is emphasized in summer, and "weather information" is emphasized in winter. In short, because sightseeing is frequent in summer, sightseeing and traffic delay information is being sought. In winter, it's clear that visitors are seeking information about weather and road conditions. From these facts, it seems necessary that the available information should change with the season.

6. Conclusion

Cluster analysis was performed on Hokkaido *Michi-no-Eki* using the user attitude data. All features were classified, and the properties were clarified. In the summer results, four clusters appeared: 1) general sightseeing cluster, 2) information cluster, 3) *Michi-no-Eki* sightseeing cluster, 4) rest/relaxation cluster. Classification of the winter results revealed four clusters: 1) restroom/resting cluster, 2) information cluster, 3) shopping/sightseeing cluster, 4) dining cluster. The usage characteristics of Hokkaido *Michi-no-Eki* changed according to the season, a "function shift phenomenon". In summer, visitors trek there for reasons like "sightseeing" and "stamp rallies", while in winter, "resting/relaxation", "restrooms" and "weather information" become the prominent reasons. It was proven that the information sought by visitors changed from summer to winter. It is necessary to take into account these seasonal characteristics when planning management measures for the Hokkaido *Michi-no-Eki* of the future.

The number of users declines in winter as a result of the climate in Hokkaido. With cost-benefit analysis, the effects of building new Michi-no-Eki may not be seen directly. However, *Michi-no-Eki* offer facilities vital to everyday winter life for resting, dining and weather information, as this study clearly shows. We must continue to improve this marvelous region which our predecessors left us. Expanding and improving *Michi-no-Eki* facilities, especially in the ways used most in winter are of particular importance.

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