Governance performance and social networks in endangered species conservation: a case of Rebun Lady's Slipper

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Abstract: Co-management conducted by diverse stakeholders is an important key element in the governance of natural resources as public commons, since relationships between stakeholders have a significant effect on the performance of that governance. This study analyzes how the relationships of stakeholders influence the performance of collaborative natural resource governance using social network analysis. Conservation activity regarding the Rebun Lady's-Slipper (*Cypripedium macranthos var. rebunense*), which is an endangered species, was used as a case study. Conservation activity is implemented under two formal institutions: the Rebun Lady's-Slipper Conservation and Breeding Program and the Rebun Town Alpine Flowers Council. The former is responsible for overall policy making, and the latter conducts monitoring and education activities. I asked 38 actors who were involved in the Rebun Lady's-Slipper conservation activity to assess the activities. Most respondents evaluated "monitoring and patrol" and "education activity" as good, while less than half of the respondents evaluated "policy making" as good. The social network of the Rebun Town Alpine Flowers Council that conducts "monitoring and patrol" and "education activity" was highly cohesive and had a high proportion of ties between actors in different subgroups. This indicates that bonding and bridging social capital are developed, fostering a collaborative relationship that is necessary for monitoring and education activities. On the other hand, centralization was low, and the network was separated into subnetworks in the Rebun Lady's-Slipper Conservation and Breeding Program, indicating that leadership is lacking in the policy-making process. It is concluded that the performance of Rebun Lady's-Slipper conservation activities is closely related to the social network structures.

Keywords: governance, social networks, performance, conservation, endangered species

1. Introduction

Ecological services (Millennium Ecosystem Assessment 2005) offered by the richness of a biodiversity of ecosystem give human society many benefits to support economic development and social well-being. The effort to conserve biodiversity as public commons is one of the critical issues of modern society. However, great numbers of species that constitute biodiversity are decreasing around the world. More than 5,000 species are registered in the IUCN (International Union for Conservation of Nature) red list as rare species, and about 3,500 species are at risk of extinction in Japan. Presently, endangered species are conserved by laws and several conservation measures. Generally, diverse actors such as governments,

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NGOs, local residents, land owners, and researchers are involved in endangered species conservation efforts. Accordingly, governance is required in natural resource management, including endangered species conservation (Folke et al. 2005).

Searching for appropriate institutions for natural resource governance is a challenging task (Dietz et al. 2003). Governance is a process by which policy is produced to address challenges and opportunities with multi actors who are located beyond formal institutions (Armitage et al. 2009, Carlsson and Sandström 2008, Rhodes 1997). Governance thus involves a wide range of organizations and individuals from across public, private, and voluntary sectors to achieve the sustainability and stability of ecology, economy, and society (Holt et al. 2012). Such a concept of governance is characterized by co-management. In the co-management process, actors cooperate and share power in order to solve problems related to natural resource management (Armitage et al. 2007, Berkes 2009, Carlsson and Sandström 2008, Olsson et al. 2004, Plummer 2009). Co-management promotes access to and exchange of material and non-material resources such as goods, money, information, and knowledge between involved stakeholders (Carlsson and Berkes 2005). Furthermore, this process facilitates trust building, institutional development, and social learning, which are prerequisites for self-organization of governance (Armitage et al. 2009). Self-organization involves the emergence of formal and informal networks that create a collaborative process to solve issues and undertake new innovative changes, i.e., collective action.

Social capital is considered important for fostering collective action by lowering transaction cost and inhibiting free-riding (García-Amado et al. 2012, Ostrom 1990). In natural resource governance, social capital plays a key role in forming collective action (Ballet et al. 2007, Pretty 2003, Pretty and Smith 2004, Pretty and Ward 2001). The definition of social capital is “social networks and the norms of reciprocity associated with them” (Putnam 2002). Social capital forms the following things in networks and groups: (1) relationships of trust, (2) reciprocity and exchange, (3) common rules, (4) norms and sanctions, and (5) connectedness, which positively affect collective action. Though there are several ways of categorization, social capital is usually divided into two types: bonding social capital and bridging social capital (Putnam 2000, Newman and Dale 2005, Svendsen and Svendsen 2009, Woolcock and Narayan 2000). Bonding social capital aids cooperation because it undergirds specific reciprocity and builds solidarity in a network. On the other hand, bridging social capital is better for linkage to external assets and for information diffusion and is used for obtaining diverse resources from outside.

Meanwhile, there has been increasing attention to the role of network governance in natural resource management (Bodin and Ernstson 2006, Bodin and Crona 2009, Crona and Hubacek 2010, Dougill et al. 2006, Lauber et al. 2008, Schneider et al. 2003, Prell et al. 2009). Social network structure influences the performance of collective action (Luo 2005). Social network analysis is a useful tool for unraveling the relationships between social capital and collective

action in natural resource governance (Bodin and Prell 2011, García-Amado et al. 2012). Sandström and Rova (2010a, 2010b) analyzed the relationship between the performance of governance and social network structure and indicated that social network structure influenced the performance of natural resource governance. Though Cundill and Fabricius (2010) conducted the assessment of performance of governance in natural resource management, the amount of research to examine how the network structure in natural resource governance affected its performance is limited. Moreover, very few studies have been conducted on the governance of endangered species conservation. This paper describes a case study to fill the gap in these issues.

A collaborative conservation partnership for Rebun Lady's-Slipper conservation was chosen as a case study for this paper. The study examines the relationship between the performance and social network structure of the conservation activities. First, this paper describes the theoretical framework of network structure and performance of governance and indicates three concepts, such as network cohesion, network centralization, and network heterogeneity. Second, methods for data collection and measurements for the above concepts are described. Third, the results are indicated; and finally, the relationship between performance and social network structure is discussed.

2. Network structure and performance of governance

New institutionalism argues that network influences and is influenced by formal and informal institutions (Carlsson and Sandström 2008, Holt et al. 2012). Collective action for governing such institutions emerges through social networks formed by the relationships between actors. Hence, performance of collective action is associated with the structure of the network. Past studies have found two typical forms of network structures that influence performance: network closure and heterogeneity (Sandström and Carlsson 2008, Sandström and Rova 2010a, 2010b). There are two different forms of network closure (Burt 2000). The first is a cohesive network in which a high percentage of the actors are directly connected to one another. The other is a centralized network in which most of the actors are indirectly connected via a central actor. Though both network types have been used to assess the extent of closure of a network, the characteristics are different. On the other hand, heterogeneity of network is related to the connection between different subgroups, such as organizations or sectors. Thus, as mentioned above, network closure corresponds to bonding social capital, while network heterogeneity corresponds to bridging social capital.

2.1 Network closure

a) Network cohesion

Network cohesion considers the extent to which actors are densely connected in a network. Actors who have ties are intimately connected with each other, thereby reducing the transaction costs of communication, fostering trust and norms, and facilitating cooperation. In a cohesive network, actors are densely connected and share norms and a common view, and

solidarity and stability of the network are promoted. A cohesive network improves the internal decision-making process and fosters effective conflict resolution mechanisms (Carlsson and Sandström 2008, Sandström and Rova 2010a). Collaboration and resource exchange are encouraged more in a higher cohesive network than in a lower one; higher cohesion is advantageous to generating higher performance of natural resource governance, such as resource management activities, on a daily basis. However, a network that is too highly cohesive obstructs connection from outside the network and leads to homogenization of information and knowledge, which prevents efficient resource use, innovation in resource use, and flexible action against unexpected risk (Bodin and Crona 2009).

b) Network centralization

In network centralization, ties are concentrated on a specific actor who is central to the network. The central actor is in a position to influence others and obtain power in this hierarchical structure and thus has ability to take leadership. Leadership is a process of extending interpersonal influence over a whole group to accomplish a common task. Leadership mobilizes and coordinates actors, and accordingly, collaboration in co-management settings can be facilitated by a central coordinating actor. A centralized network is beneficial to generating higher performance of collective action that needs internal decision making with leadership. Bodin et al. (2006) suggested that the degree of centralization most efficient to natural resource management differs according to the phase of governance. The starting stage of a process with weak leadership requires a centralized network, while the management process of a complex ecosystem with diverse actors favors a less centralized network. A centralized network becomes unstable when the central actor does not take leadership or drops out of the network. Network centralization is thus a great concern for long-term natural resource governance.

2.2 Network heterogeneity

Network heterogeneity refers to the diversity of ties that connect actors in different subgroups within a network; many ties reach across different subgroups. Heterogeneity is closely related to the concept of a structural hole articulated by Burt (2005), which emphasizes disconnection between different subgroups in a network. The existence of structural holes prevents the flow of information and resources between disconnected subgroups, whereas the existence of at least one single tie generates a possibility of interaction between subgroups. A highly heterogeneous network facilitates sharing of a common view and diffuses information and exchange resources between different subgroups, thus enabling innovation and collaboration in co-management settings. A less heterogeneous network has difficulty obtaining innovative information and ideas and useful resources beyond structural holes, suffering from inability to solve problems when it is confronted with a critical situation. Hahn et al. (2006) stated that trustful bridging ties between various actors played a key role in making an adaptive co-management process successful. Hence, a highly heterogeneous network is beneficial to generating higher performance.

To summarize, network cohesion promotes general cooperation, which is necessary for working under a common rule and doing routine work such as resource monitoring and daily management. Network centralization contributes to enhancing leadership and facilitating the policy and decision-making process. Network heterogeneity is useful for sharing a common view and accessing diverse resources between subgroups, thus improving the relationships in co-management settings. Combination of these network structures is associated with the performance of natural resource governance.

3. Methods

3.1. Case study

Rebun Lady's-Slipper (*Cypripedium macranthos var. rebunense*), which is listed as one of the endangered species, is living only on Rebun Island, located in the northernmost part of the Japanese Archipelago (Figure 1). The size of the island is 8 km from east to west and 29 km from north to south. The western part of the island is designated as Rishiri-Rebun-Sarobetsu National Park. The island was covered by forest in former ages, but Sasa bamboo (*Sasa kurilensis*) is now prominent because of artificial forest fire and logging activities. A strong northwest wind in winter blows snow cover and prevents Sasa bamboo from inhabiting the area while permitting alpine flowers to grow in the western part of the island. Alpine flowers, particularly Rebun Lady's-Slipper, which blooms at the beginning of the summer tourism season, attract a lot of visitors and are considered to be important tourism resources for the island's economy.

It is said that Rebun Lady's-Slipper once inhabited many places on the island. However, the population has been decreased because of illegal digging by those who coveted the beautiful, pale yellow flowers. Hence, Rebun Town established the Rebun Town Alpine Flowers Conservation Council (Alpine Flowers Council) in 1983 to protect the plants from illegal harvesting. The town started to breed the plant by artificial culture to avoid the threat of extinction in 1986. In 1994, the plant was designated and protected as a rare wild species under the endangered species act. Following this designation, the Japanese national government started the Program for the Rehabilitation of Natural Habitats and Maintenance of Viable Population of Rebun Lady's-Slipper (Rebun Lady's-Slipper Program) in 1996. Under this program, the Commission for the Rehabilitation of Natural Habitats and Maintenance of Viable Population and the Liaison Meeting for Rehabilitation of Natural Habitats and Maintenance of Viable Population were set up. The Commission is the arena for decision making for the Rebun Lady's-Slipper conservation policy, and the Liaison Meeting is the arena for information exchange between groups who are involved in the Rebun Lady's-Slipper Program.

Presently, conservation activities are implemented through collaboration between several fields of organizations and actors: the Ministry of Environment (MoE), the Forest Agency

belonging to the Ministry of Agriculture, Forestry and Fisheries, the Hokkaido Prefectural Government, Rebun Town, guards, police, a tourism association, a local NPO, researchers, etc. There are two main measures being undertaken to conserve the Rebun Lady's-Slipper: patrolling and monitoring the habitats to protect the plants from illegal digging, and breeding the population using an artificial culture technique. The former is mainly conducted by the Alpine Flowers Council, while the latter is conducted by the Rebun Lady's-Slipper Program. However, the Council and the Program are tightly coordinated, operating cooperatively, and there is some overlap of participants, such as front-line administrators and researchers.

3.2. Data collection

This research analyzes the social network structure formed by the actors involved in Rebun Lady's-Slipper conservation activities. It would be ideal to understand the whole network, but it is difficult to identify because there is no boundary; i.e., the network is formed by both formal and informal relationships. In addition, the network is made up of diverse connections among core and periphery actors: core actors are deeply involved in the network, whereas periphery actors are not. Hence, it is important to understand all the possible core actors. To identify core actors, the following sampling procedure based on the snowballing sampling technique (Scott 2000) was employed to collect data.

An interview survey was conducted from October 2007 to October 2008 to obtain data. First, I conducted pre-interviews of several individuals to identify key actors in Rebun Lady's-Slipper conservation activities. Then the main, semi-structured interview survey was conducted. For the starting point of the survey, some interviewees were chosen out of several actors in different organizations or sectors based on the results of the pre-interviews to prevent selection bias. The main question in the survey was the assessment of conservation activity performances and the relationships of interviewees with other actors. The performances were assessed using 5-point scale, where 1 = very good, 2 = good, 3 = middle, 4 = poor, and 5 = very poor. Items used for the assessment were "monitoring and patrolling," "education activity," "cooperation between different organizations or sectors," "policy making," and "overall conservation measures."

To obtain social network data, respondents were asked to nominate actors who had relationships with them in the conservation activities, using the following question: "Who are closely related actors in your Rebun Lady's-Slipper conservation activity?" Respondents were shown a list of the actors from which to make their nomination. If no desired name was found in the list, they were asked to suggest another actor's name for nomination. Through this process, 109 actors were nominated. The most frequently listed actors were then interviewed in sequence. The interview survey was continued until actors who were frequently nominated in the procedure were interviewed. In total, I interviewed 38 individuals. The numbers of respondents in various organizations and sectors are as follows: 8 town officers, 8 guards, 6 volunteers, 6 national and prefectural government officers, 5 researchers,

and 5 others.

Social network data showing ties of one actor to another were produced in the form of a matrix and analyzed using the social network analysis software package UCINET 6. There are two types of ties between two actors: directed and non-directed ties. The former is a non-reciprocal or one-sided relationship, whereas the latter is a reciprocal or mutually dependent relationship. Reciprocity is one of the indicators of tie strength, and thus non-directed ties express stronger relationships than directed ties. Moreover, stronger ties improve the accuracy of reported information (Sandström and Rova 2010b). Accordingly, the matrix was transformed into a symmetrized matrix by deleting non-reciprocal relationships. Using this data, network measurements such as network cohesion, centralization, and heterogeneity were calculated.

3.3. Measurement

3.3.1. Network closure

a) Network cohesion

The most well-known indicator of network cohesion is network density. Density is calculated by dividing the number of present ties by the maximum possible number of ties in a network (Scott 2000). The value ranges from 0 to 1. The density of a completely connected network is 1.0, whereas that of a network with half of the possible ties is 0.5 (Figure 2). It should be noted that an average actor in a large network needs more ties than one in a small network to achieve the same level of density, i.e., network cohesion. Attention should also be paid when interpreting the structure of a network if there are subgroups. That is, in a network with two isolated and dense subnetworks, the density of the whole network is rather high. However, this type of network is not generally considered cohesive because the network is disconnected. Hence, it is necessary to examine whether structural holes exist in the whole network (Burt 2000).

b) Network centralization

Density examines the general level of cohesion in a network, while centralization examines the extent to which this cohesion is concentrated on particular actors (Scott 2000). Centralization looks at the extent to which density depends on the ties of one individual (Prell 2012, 169). A similar concept to centralization is centrality. Centrality examines the extent to which ties are connected to a particular actor, while centralization examines the extent to which a whole network has a centralized structure. Centralization looks at differences between the centrality values of the actor with highest centrality and those of other actors. Centralization is calculated in the following manner. First, centrality of each individual actor is calculated by counting the number of ties connecting to the actor. Second, the difference between the highest centrality value and every other centrality value is summed. Finally, the sum is divided by a theoretically possible maximum sum (Wasserman and Faust 1994, Scott 2000). A star-shaped network is the most centralized form of network structure: centralization

is 100%, whereas the centralization of completely connected network is 0% (Figure 2).

3.3.2. Network heterogeneity

In co-management settings, resource exchanges such as exchanges of information, knowledge, ideas, etc., and cooperation between different subgroups such as organizations or sectors play significant roles. Connections across different subgroups enhance the heterogeneity of a network. Network heterogeneity is assessed by actors' diversity and cross-boundary exchange (CBE) (Sandström and Rova 2010a, b). Actors' diversity is obtained by calculating the number of subgroups in the network. CBE is calculated as follows: the number of ties connecting actors with different subgroups divided by the total number of ties in the network. A network that has many ties across different subgroups is a highly heterogeneous network. The value of CBE is 0% if all the ties connect actors within a same subgroup, whereas if half the ties connect actors in different subgroups, CBE is 50% (Figure 2).

4. Results

4.1. Assessing the performance of the activities

Figure 3 shows the assessment of conservation activities, in which scales such as 1 and 2 and 4 and 5 were aggregated to good and poor, respectively. More than half of the respondents evaluated the performances of "monitoring and patrolling," "education activity," "cooperation between different organizations or sectors," and "overall conservation measures" as good, indicating that the performances of these conservation activities are at satisfactory levels. However, less than half of the respondents evaluated "policy making" as good. I conducted the Wilcoxon signed-rank test to examine the difference between the assessments. The results indicated that "policy making" was significant at the 1% level, which means that the performance of it is lower than that of other conservation activities. In addition, less than half of the respondents evaluated it as good. Consequently, the performance of policy making is poorer than that of other activities.

As described before, monitoring and patrolling of the habitats and education activity are mainly implemented by the Alpine Flowers Council; network structure of the Council influences the performances of these activities. On the other hand, conservation policy is made in the Rebun Lady's-Slipper Program; network structure of the program influences the performance of policy making. Moreover, overall network structure has a close relationship to the performance of general activities, such as cooperation between different organizations or sectors and overall conservation measures. I examine the relationships between the network structures and the performance of conservation activities in the next section.

4.2. Structure of the networks

The structure of the whole network is shown in Figure 4. This includes the networks formed by the Alpine Flowers Council and the Rebun Lady's-Slipper Program as well as an informal network that is voluntarily formed outside the two formal institutions. Figures 5 and 6 show

the network of the Alpine Flowers Council and the Rebun Lady's-Slipper Program, respectively. Table 1 shows the measures of the networks. The network size of the Alpine Flowers Council is larger than that of the Rebun Lady's-Slipper Program, as is the diversity of actors.

The density of the Alpine Flowers Council is 0.17, which is higher than the other two networks. This suggests that, comparatively, the network is highly cohesive. Degree centralization is 36.15%, which is the highest of the three networks. As shown in Figure 5, ties are concentrated on several particular actors, indicating that the network is centralized. The value of CBE is 58.14%, which indicates that more than half of the ties connect actors who belong to different organizations or sectors, suggesting that the network is heterogeneous. To summarize, the network of the Alpine Flowers Council is highly cohesive, centralized and heterogeneous.

On the other hand, the density of the Rebun Lady's-Slipper Program is 0.13, which is lower than that of the Alpine Flowers Council. Normally, the density of a smaller network size is larger than that of a larger one, suggesting that this network is less cohesive than that of the Alpine Flowers Council. Moreover, as shown in Figure 6, the network is separated into two subnetworks; thus it is more likely that the network is not cohesive. Degree centralization is 30.48%, which is lower than the Alpine Flowers Council. Normally, the centralization of a smaller network size is larger than that of a larger one, thus suggesting that this network is less centralized than that of the Alpine Flowers Council. In addition, as shown in Figure 6, there is no particular actor who is the center of the network, indicating that the network is not centralized. The value of CBE is 37.5%, which is the lowest of the three networks, suggesting that the network is not so heterogeneous. To summarize, the network of the Rebun Lady's-Slipper Program is not cohesive, centralized, or heterogeneous.

The density of the whole network is 0.11, which is the lowest of the three networks. Normally, the density of a larger network is smaller than that of a smaller one, thus suggesting that the density of the network is moderate of the three networks. Though degree centralization is 27.93%, which is the smallest of the three networks, the centralization of the network is moderate in the same manner. The value of CBE is 58.75%, which is the largest of the three networks, indicating that the network is highly heterogeneous. To summarize, the whole network is moderately cohesive and centralized, and is highly heterogeneous.

5. Discussion

The analysis revealed the relationships between performances and network structures of the Rebun Lady's-Slipper conservation activities. The network structure of the Alpine Flowers Council was highly cohesive, centralized and heterogeneous. This formed a rich bonding social capital, which is beneficial for fostering trust and reciprocity between the actors, thus lowering transaction costs of doing cooperative activities and being advantageous for

collective action, such as routine work (Bodin and Crona 2009). Therefore, monitoring and patrolling, and education activities implemented in the Council marked good performances.

Performance of policy making conducted in the Rebun Lady's-Slipper Program, whose network structure lacks cohesion, centralization and heterogeneity, was poor. A network with poor bonding and bridging social capital and lacking a central actor discourages the cooperation and leadership between actors that are necessary in the policy-making process. Hence, it is obvious that this network is not advantageous in generating collective action. A highly centralized network with a particular actor who has power to influence other actors is advantageous in decision making (Bodin and Crona 2009). It is assumed that a highly centralized, heterogeneous network without structural holes is an ideal network structure to facilitate decision making in this case.

The whole network showed good performance in "cooperation between different organizations or sectors." Past research pointed out that a closed network facilitates cooperation (Bodin and Crona 2009, Carlsson and Sandström 2008). The density and centralization of the whole network is moderate of the three networks; i.e., the network is moderately closed. In addition, CBE is higher; i.e., the network is heterogeneous. High heterogeneity in addition to moderate closure contributed to the good performance. The conservation activities are implemented by the actors with diverse sectors, and thus heterogeneity is a very important factor for connecting them. The whole network with high heterogeneity, that is, bridging social capital, facilitates connecting the actors in different organizations or sectors. Accordingly, a highly heterogeneous network marks good performance because it encourages cooperation between actors in different organizations and sectors in this large network. Consequently, heterogeneity plays an important role in facilitating social capital in a large network with actors belonging to diverse organizations and sectors.

Why do these differences in performance emerge? Next, I examine this question. The Alpine Flowers Council was established in 1983, and 20 years have passed between its establishment and the time I conducted the survey. Most members of the Alpine Flowers Council are living in Rebun Island; moreover, staff members of the MoE, the Forest Agency, and the Hokkaido Government, who are working in Wakkanai, which is as distant as two hours from Rebun Island by ferry, are joining the Council. Normally, these staff members move every two or three years, whereas other members do not move frequently. Though staff members of Rebun Town move their positions once every several years, new staff members in charge may have known several members of the Alpine Flowers Council because the staff is living on the Island, and they have had chances to meet them. It is no exaggeration to say that these circumstances contribute to forming social capital in the Alpine Flowers Council. That is, relationships formed through monitoring and patrolling activities on a daily basis have been fostering bonding and bridging social capital within the Council.

On the other hand, the arena to collect stakeholders for the Rebun Lady's-Slipper Program was set up in 1997, and and only 10 years have passed between its establishment and the time I conducted the survey. In addition, meetings have been held only twice in a year: once in Rebun Island and once in Sapporo, which is the capital of Hokkaido. Staff members of Rebun Town, the MoE, the Forestry Agency, and the Hokkaido Government and researchers are joining in the meetings. However, many in the MoE and Forestry Agency are working in Wakkanai, and thus opportunities to make contact between members are limited compared to the Alpine Flowers Council. Moreover, researchers are involved in restoration activities of Rebun Lady's-Slipper habitats using artificial culture as well as an ecological survey of the habitats. However, researchers are not living on the island and visit the island only a few times a year. These circumstances made it difficult to foster bonding social capital in the Rebun Lady's-Slipper Program.

The CBE score of the Rebun Lady's-Slipper Program is low, indicating that actors in the same organizations or sectors are connecting with each other. This suggests that actors in different subgroups have few connections, which makes information and knowledge diffusion and resource exchanges from one subgroup to another difficult. As described earlier, the meetings of the Rebun Lady's-Slipper Program are held only twice a year, and there are few relationships in daily fieldwork such as patrolling and monitoring. In addition, the network is separated into two subnetworks in the Rebun Lady's-Slipper Program, which makes information and knowledge diffusion difficult among members in the network. Moreover, staff members of the MoE, Forestry Agency, and Hokkaido Government move once every few years. In conclusion, relationships between the members are weak in the Rebun Lady's-Slipper Program because of its short history and frequent move of official staff members, making it difficult to foster both bonding and bridging social capital. In addition, there is weak leadership. The network structures under these conditions obstruct self-organization of the governance of Rebun Lady's-Slipper conservation (Yamaki et al. 2011).

6. Conclusion

This study examined the relationship between the performance of conservation activities and the social network structure of co-management in Rebun Lady's-Slipper conservation. It revealed that the performance of natural resource governance is determined by the social network structure, which supports the results shown in past research (Sandström and Rova 2010a, 2010b). The results suggested that bonding social capital formed by a closed network structure is beneficial to routine activities such as patrolling and monitoring, whereas lack of leadership caused by a decentralized network structure prevented the setting of policy direction for conservation activities. It also demonstrated that a heterogeneous network structure produced rich bridging social capital, which is essential to natural resource governance where many actors are involved. These results support past findings concerning

the performance of natural resource governance (Bodin and Crona 2009). However, this research dealt with only a single case. More research is necessary to validate the findings. Moreover, a comparative study between several case examples would be useful to understand the extent to which network cohesion, centralization, and heterogeneity influence the performance of natural resource governance. In particular, we need to explore better forms of governance to conserve endangered species that are unique and non-substitutable resources.

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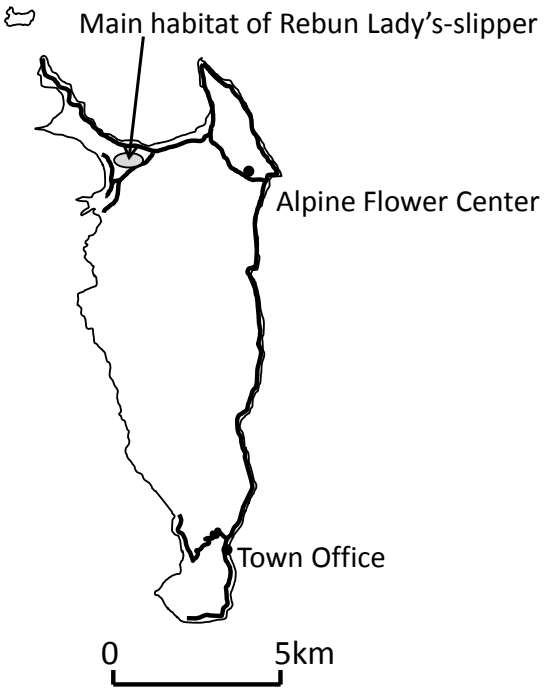
Table 1. Social Network Indicators

			bonding SC	bridging SC	
	Network size (No.)	Density	Centralization (%)	Actors' diversity (No.)	Cross-boundary exchange (%)
Rebun Lady's-slipper Program	16	0.13	30.48	5	37.50
Alpine Flowers Meeting	23	0.17	36.15	8	58.14
Whole network	38	0.11	27.93	10	58.75



Small numbers of Rebun Lady's-slippers are also living in the southern part of the Island.

Figure 1. Habitats of Rebun Lady's-slipper

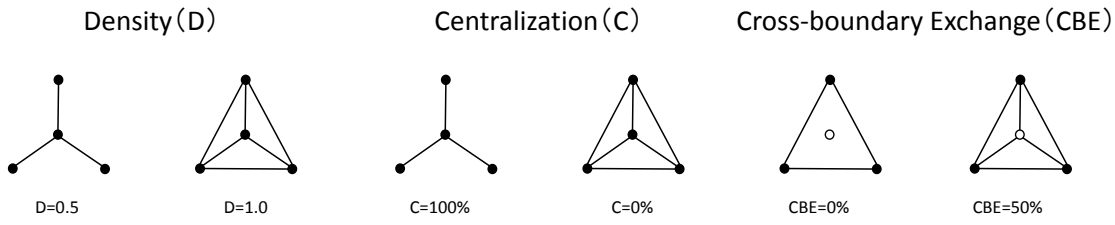
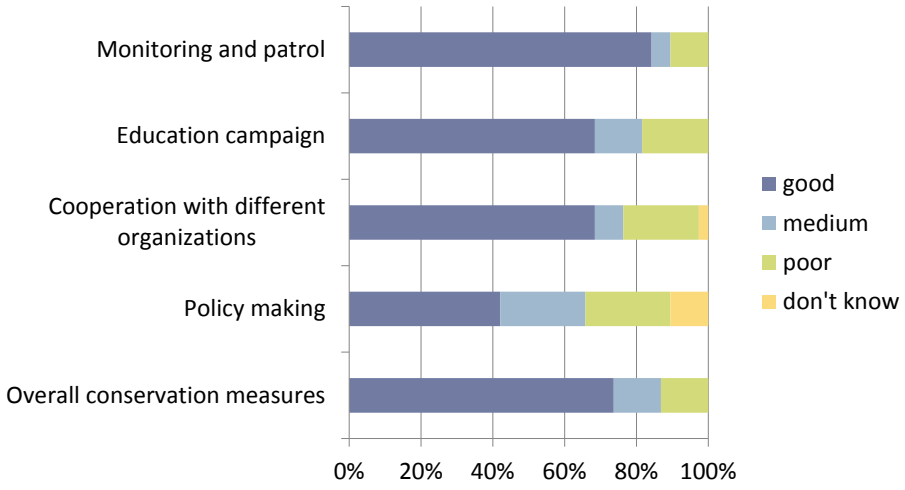


Figure 2. Structures of Social Network Indicators



Evaluation of policy making is significantly lower at 1 % level.

Figure 3. Assessments of conservation activities

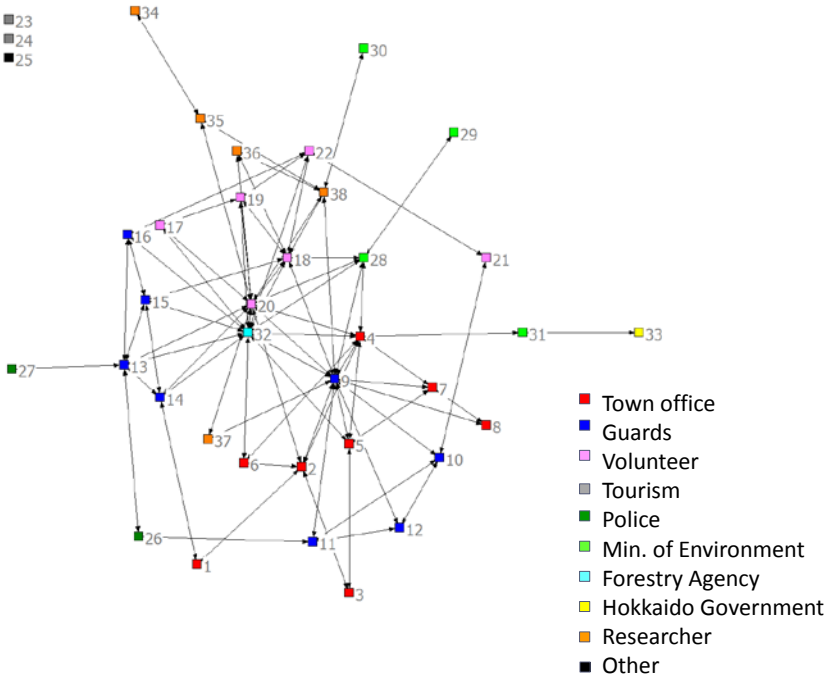


Figure 4. Whole network of the respondents

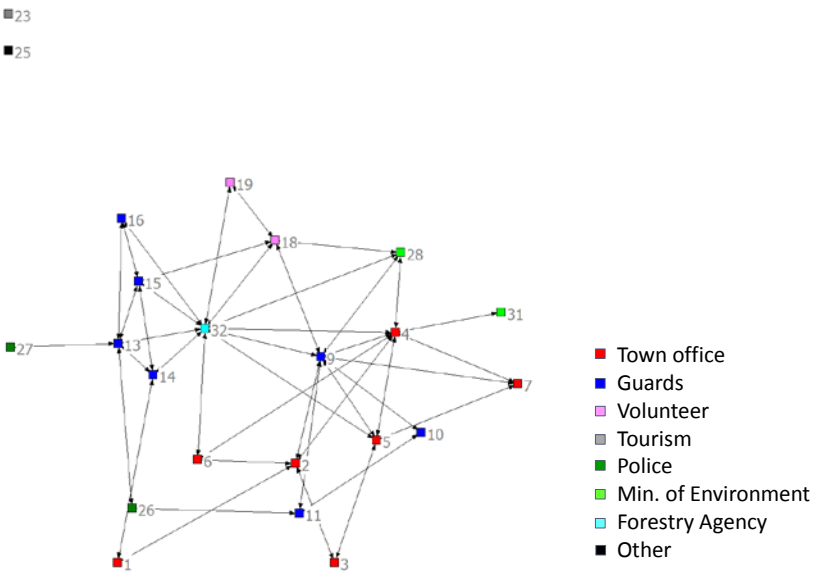


Figure 5. Network in Rebun Town Alpine Flowers Meeting

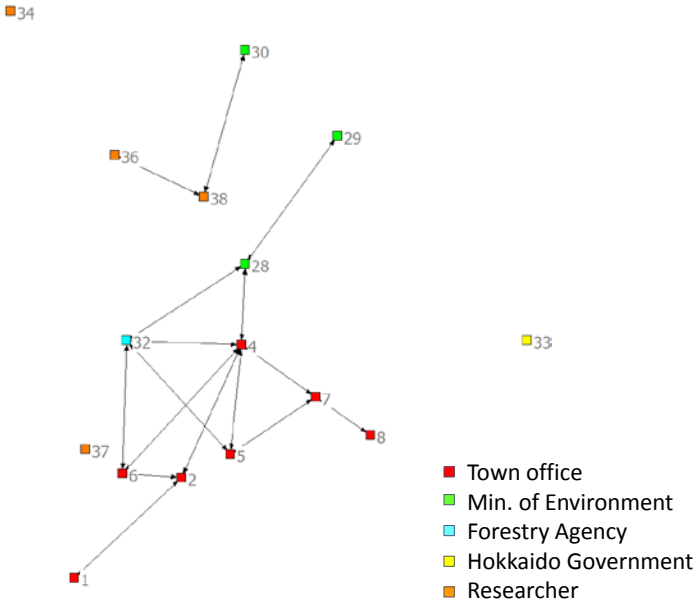


Figure 6. Network in Program for Rehabilitation of Natural Habitats and Maintenance of Viable Populations