Shiretoko
Otter Reintroduction
Feasibility Study

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Shiretoko Museum and Shiretoko Nature Foudnation
2017

Contents

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Preface

This report is the result of a five-year project, lasting from 2011 to 2016, which in turn is part of a reforestation project called the Shiretoko 100 Square Metre Forest Trust. This trust aims to restore the original forest that existed before cultivation, setting goals for 100-200 years in the future. In view of such a long term project, we need to consider not only the near future, but also long-term changes in the ecosystem.

In Chapter 1, we review the background history of this study, especially the Shiretoko 100 Square Metre Movement launched in the 1970s. In Chapter 2, we evaluate our project in relation to IUCN guidelines, which provide a systematic approach for practical reintroduction. In Chapter 3, we focus on the possible habitat after reintroduction to evaluate whether it is an appropriate environment for otters in Shiretoko and surrounding areas.

In Chapter 4, we considered possible impacts on the current ecosystem and local industries. This is important in relation to consensus building. In Chapter 5, we show the results of a genetic study, important for deciding possible source populations for reintroduction. In Chapter 6, we explain other issues that must be considered.

Chapter 7 includes comments by otter specialists who visited Shiretoko in the autumn of 2014. They visited and investigated both within and outside Shiretoko National Park to evaluate the potential for otter reintroduction. Chapter 8 offers some conclusions, though obviously not our final decision on reintroduction.

We hope this report will be an important reference not only for considering otter reintroduction, but also for reevaluating the future of the Shiretoko 100 Square Metre Forest Trust.

Finally, we wish to acknowledge the contributions of the following individuals: Mikio Abe, Hiroaki Amagata, Motokazu Ando, Yasuto Furukawa, Machshkov B. Gennady, Dmitry Y. Gorshkov, Chris Greenwood, Tsuyoshi Hirakouchi, Masumi Maruo Holledge, Simon Holledge, Tsuyoshi Ishinazaka, Addy de Johng, Ato Kakiuchi, Mioko Kano, Kazuyo Kato, Hyeonjin Kim, Kunio Kimura, Hans-Heinrich Kruger, Toshiaki Kumaki, Sergey S. Makeev, Ryuichi Masuda, Yasushi Masuda, Ryota Matsubayashi, Isao Matsuda, Yoshio Mishima, Taku Morimoto, Christina A. S. Mumm, Yu Nagata, Toyohiro Nishimoto, Takahiro Nobetsu, Alexey Y. Oleynikov, Lukas Polednik, Vladimir Roslyakov, Keisuke Saito, Hiroshi Sasaki, Kaoru Shindo, Anna Suzuki, Svetlana V. Styrina, Tomonari Takahashi, Yu Takashima, Yu Taneishi, Diana Tarasova, Gen Terayama, Daisuke Waku, Gordon Wyness, Satoru Yamada, Mamoru Yonemura, Yoshiyuki Umatani, Kodai Umeda, Masami Yamanaka, Grace Yoxon and Paul Yoxon, and Andrey I. Zdorikov, and the following institutions:

Abashiri City Folk Museum, The Archives of Hokkaido, The Far East Division of the Russian Academy of Sciences, The Government of Sakhalin Oblast, Graduate School of Science of Hokkaido University, Hokkaido Archaeological Operation Center, Hokkaido Museum of Northern Peoples, Hokkaido prefectural library , International Otter Survival Fund (IOSF), Otter Zentrum in Hankensbuttel, Rausu Town Folk Museum, Salmon hatcheries in Sakhalin, Shiretoko Nature Foundation, Shari Town Office, Shiretoko Museum Supporters Society, The Sikhote-Alinsky Biosphere Reserve, Tokoro Buried Cultural Property Center. and Zov Tigra National Park.

This study was supported financially by Daikin Industries Ltd.

Chapter 1. Reasons for the otter reintroduction feasibility study: history of the 100 Square Metre Movement and otter extinction in Japan

A. History of the Shiretoko 100 Square Metre Movement

Our feasibility study for otter reintroduction is a part of a long term reforestation project called the Shiretoko 100 Square Metre Movement. The town office in Shari, Hokkaido, Japan, is promoting this project for the recovery of the forest ecosystem in the Shiretoko National Park, a natural World Heritage Site (Fig. 1-1).

Some areas in Shiretoko were cultivated for agriculture from the early 1900s. However, by the end of the 1970s, all cultivation had been abandoned (Fig. 1-2). This led to real estate agents trying to buy the land for future exploitation and development. The Mayor of Shari town was concerned about the impact of this on Shiretoko's natural beauty, so in 1977 Shari began a Shiretoko 100 Square Metre Movement to buy back abandoned farm land, using contributions from citizens. This movement was inspired by the National Trust of England, Wales and Northern Ireland.

Currently, Shari has been able to buy back all the abandoned fields, and is trying to recover the forest ecosystem (Fig. 1-3). The new goal of the Shiretoko 100 Square Metre Forest Trust is to restore forest growth and biodiversity, within a time frame of 100 to 200 years (Ishigaki 2005). In this context, we are studying the feasibility of the reintroduction of the river otter (*Lutra lutra*).

B. History of otter extinction in Japan

Why is the river otter extinct in Japan? The animal was distributed throughout Japan as late as the end of the 19th century. However, intensive trapping for fur caused a sharp decline in the otter population. Sasaki (2016) reported that the final remnant population in Kochi and Ehime prefectures was distributed on islands where the hunting pressure was low.

Also from the early to mid 20th century, environmental changes caused by economic development reduced otter habitat. Ando (2008) stated that the main cause of otter extinction was intensive trapping, but that habitat loss might have disadvantaged remnant populations.

In Hokkaido, otter numbers declined sharply from the late 18th to early 19th century (Fig. 1-4). Although otter populations seemed very low in the early 19th century, there were no hunting regulations until 1928. Between 1905 and 1911, more furs were taken in eastern than western Hokkaido, with the exception of Hakodate, which was the main trading port in Hokkaido (Fig. 1-5). Between 1912 and 1920, the fur trade declined throughout Hokkaido (Fig. 1-6). This must reflect a crash in otter populations.

Among collections at the Shiretoko museum, there is the fur of an otter caught in 1955 at Akinokawa river, Shari town (Nakagawa 2016). This is the final official record of the otter in Hokkaido. Since the 1950s, agriculture in lowland areas has changed river systems, while the use of pesticides could have cause a deterioration of water quality in Shari. These factors would also have accelerated the extinction of otters.

Historically, there has been a controversy on the species of otter in Japan (Ando 2008). Some scientists stated that it was a distinct species, Lutra nippon (Imaizumi and Yoshiyuki 1989). Recent DNA study revealed that extinct otter in Japan contained the endemic haplotype as a distinct species (Waku et al. 2016). However, extinct otter in Hokkaido was considered to be different from other population in Japan (Ishii 2014). Thus, we consider that extinct otter in Hokkaido was a subspecies of Eurasian otter, Lutra lutra.

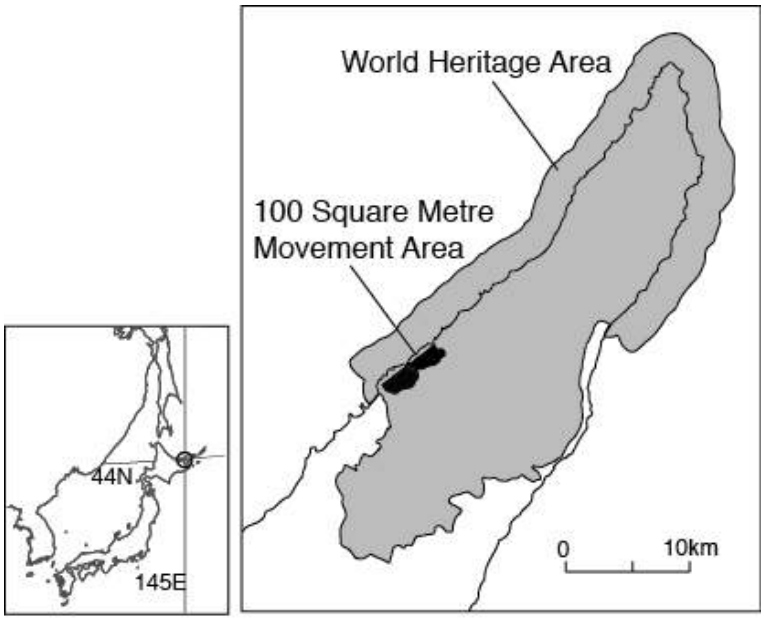

Fig. 1-1. A map showing the location of the 100 Square Metre Movement in the Shiretoko World Heritage Site

Fig. 1-2. Farmland in Iwaubetsu before the start of the 100 Square Metre Movement (photographed in 1963)

Fig. 1-3. Growing conifer trees in the 100 Square Metre Movement area

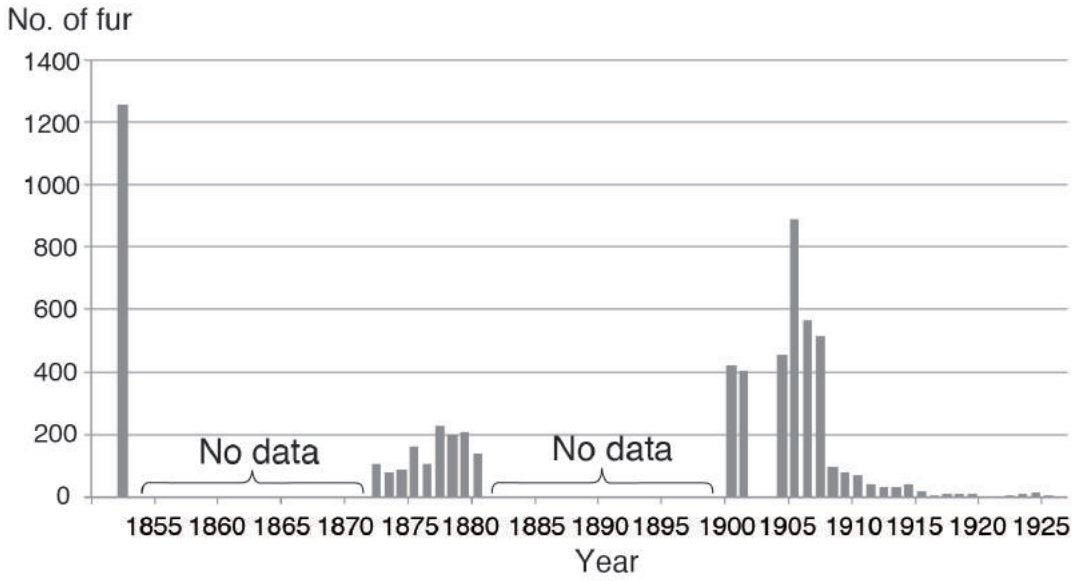

Fig. 1-4. Numbers of harvested otter furs in Hokkaido between 1850 and 1930 (based on Kawai 1997)

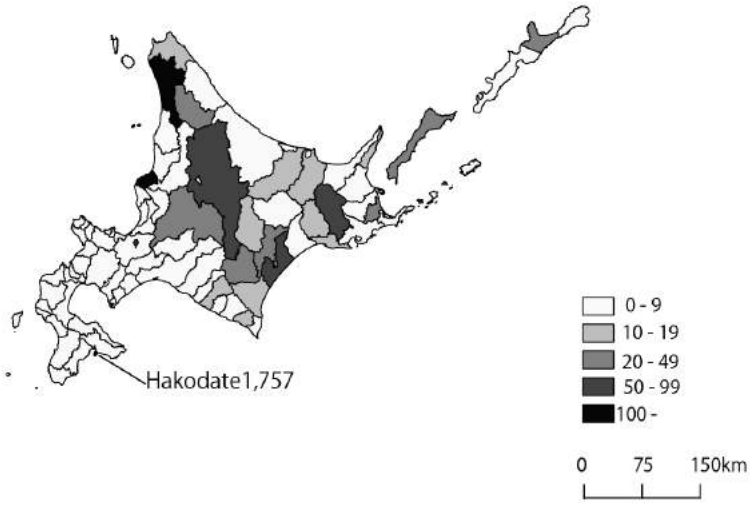

Fig. 1-5. Otter furs harvested in each district in Hokkaido between 1905 and 1911.

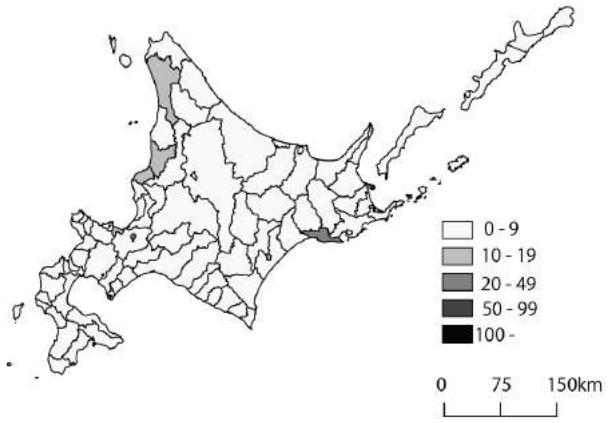

Fig. 1-6. Otter furs harvested in each district in Hokkaido between 1912 and 1920.

Chapter 2. Evaluating our project in relation to the IUCN guideline

The IUCN (International Union for Conservation of Nature and Natural Resources) provides a guideline for species reintroduction (IUCN/SSC 2013). In order to evaluate our project, we have referred to this guideline.

According to Section 2 (Definition and classification) of the guideline, our project is categorised as a “conservation translocation” and “population restoration”. Conservation benefit is a primary objective of our project. If we can translocate the otter, we hope it will benefit not only the otter, but also the ecosystem. This is consistent with one objective of the 100 Square Metre Movement. However the feasibility assessment should also consider the balance of the conservation benefits against the costs and risks of the translocation. There are ecological, social risks and economic interests involved. We should consider past causes of population extinction. Potential new threats may also have arisen.

In order to achieve the required conservation benefits, we need to specify goals, such as desired size and numbers of populations (Section 4.1). It is important to decide what evidence to use to measure progress towards meeting translocation objectives and, ultimately, success or failure (Section 4.2). We need information about the requirements of the biological and non-biological habitat (Section 5.1.2). The indigenous environment may no longer be suitable habitat because it may have changed during the extinction period. The founders (i.e. source population) should be compared with the original population from genetic, morphological, physiological, and behavioral points of view (Section 5.1.4). Animal welfare, such as reducing stress, and possible disease should be considered in conservation translocations (Section 5.1.5, 5.1.6).

When we plan the translocation, we should pay attention to social impacts. Without adequate measures to mitigate concerns, we should not proceed with translocation (Section 5.2). Successful translocations may yield economic opportunities, such as through ecotourism, but negative economic impacts may also occur. Potential impacts should be assessed in an early stage of the translocation process (Section 5.2). A conservation translocation may need to meet any relevant regulations at international, national, regional or sub-regional levels (Section 5.3). Any translocation entails risks, such as undesirable impacts on regional ecosystems. A risk to the source population is also possible (Section 6). Socio-economic risks are one of the concerns in Shiretoko. (The IUCN guideline also refers to “release and implementation”, and “monitoring and continuing management”.)

In this report, we evaluate our project from the above-mentioned aspects.

Chapter 3. Is it possible for otters to live in Shiretoko?

A. Is there sufficient food for otters in Shiretoko?

We should examine whether Shiretoko contains enough quality habitat for otters. In particular, food resources are necessary for a sustainable population. The otter diet includes fish, amphibians and crustaceans. However, food habits vary according to habitat. For example, in the Shetland Islands of northern Scotland, otters mainly depend on marine fish such as eelpout *Zoarces viviparus*, rockling, *Cilata spp*. and sea scorpion *Taurulus bubalis* (Kruuk and Moorhouse 1990). In Finland, cyprinids, perch *Perca fluviatilis* /*Acerina cernua* and pike *Esox lucius* are major food items (Sulkava, R. 1996).

Accordingly, we should consider otter food habits in similar habitats to Shiretoko. In this respect, the Russian Far East has very similar fish fauna to Shiretoko. Otters there mainly eat small salmonids, minnows *Phoxinus sp*., and cyprinids (Oleynikov 2013). In Shiretoko, small salmonids, such as Dolly Varden *Salvelinus malama* (Fig. 3-1) or Masu trout *Oncorhynchus masou* are major river fish. So they could be an important otter food if there was a reintroduction.

Otters eat a large amount of fish. Kruuk (2006) reported that captive otters ate 11.9% to 12.6% of their weight, while wild otters ate 15% of their body mass. He also showed that the density of salmon in one river in an otter habitat was 9.2-14.4 g/m2. Regarding Shiretoko rivers, the Hokkaido Regional Forest Office (2014) reported the average density of Dolly Varden in rivers with various dam density. This was 56.3 fish/ 100 m2 in low density dam rivers, while 3.9 fish/ 100 m2 in high density dam rivers. Takenaka (1997) estimated the biomass of Dolly Varden in Shiretoko from their length by using the following equation: Y=0.0044x2 -0.5247 x+18.786, where Y is weight and x is length of fish.

According to the Hokkaido Regional Forest Office (2015) report, the mode of a histogram of the length of Dolly Varden in Shiretoko was 12.5 mm for a high density dam river, while 5-23 mm for a low density dam river. Thus, estimated density values for Dolly Varden, applying Takenaka's (1997) equation, are approximately 0.86 g/m2 for high density dam rivers, and 2.0-73.7g/m2 for low dam density rivers.

This means that the quantity of Dolly Varden, in high density dam rivers, will not be sufficient as a food resource for otters. As we do not have enough data on the abundance of other fish, we need to evaluate the potential food resources of high density dam rivers. In addition, with a few exceptions, most rivers in Shiretoko are relatively short. Thus lakes and coastal areas will be also important habitats for

otters in Shiretoko. In those areas, we also need to evaluate factors such as water depth, and the availability of resources for otters.

B. Habitat requirements other than food resources

Otters not only need food resources, but also couches, dens (holts) and freshwater pools along coastal areas (Fig. 3-2, Scotland). Otters use couches and holts as resting sites (Kruuk et al. 1998). A couch is a resting place above ground and it has various types. Holts, which are underground or in a cavity, are also important as resting or natal sites. Kruuk (2006), studying the density of holts around the Shetlands, reported that otters preferred gently sloping peaty coasts with limited disturbance. Yoxon and Yoxon (2014) mention that fresh water is important for otters living in the sea, in order to wash salt off their fur, as salt reduces thermal insulation in their coats.

The riparian area in Hokkaido has been altered to become agricultural fields, residential areas, and artificial shores. So we need to check the status of the riparian environment before reintroduction.

C. Potential otter habitat estimation

In order to evaluate potential habitat, we also reviewed historical data about otters. We looked at two kinds of record, ancient remains and fur trade numbers.

Regarding ancient remains, we searched articles containing “otters” in the database at the Hokkaido Archaeological Operations Center. In addition, we investigated research reports that contained analysis of faunal remains. Among approximately 150 reports, we found 43 reports that found otter bones among researched archaeological sites (Fig. 3-3). Except for the central part of the island, otter bones were found from many sites in Hokkaido. Although some of the remains might have been moved from the site of trapping to be used in a religious ceremony or in trade, they roughly reflect their ancient distribution.

Fur trade records in Hokkaido between 1905 and 1920 (Fig. 1-2 and 1-3) also showed that otters were distributed throughout the entirety of Hokkaido at that time. In Sakhalin today, otters are also distributed along the entire area of the island (Sakhalin State 2013, Fig. 3-4). This reflects the fact that otters can live in various habitat types, such as rivers, lakes, and coastal areas. However, we should not only consider geographical characteristics, but also resource availability as mentioned in the previous section. We need to consider how food resources have changed in Hokkaido after otter extinction, also how the food supply differs between Sakhalin and Hokkaido. More research is needed to answer these questions.

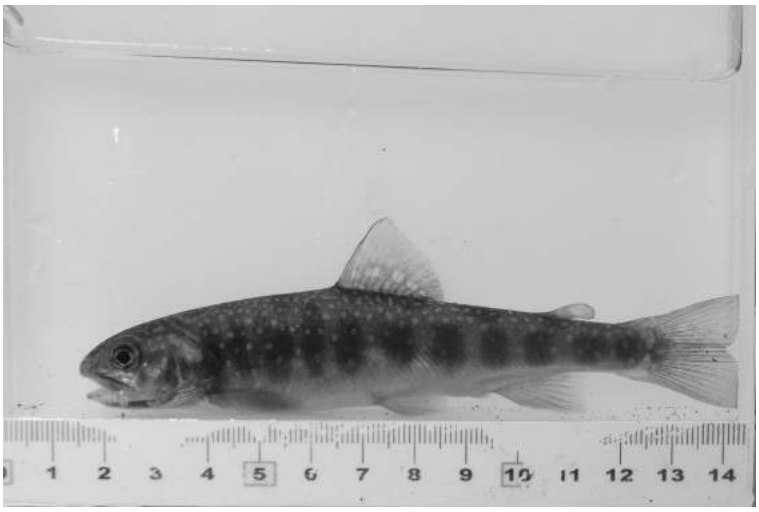

Fig. 3-1. Dolly Varden *Salvelinus malama* caught in Shari River.

Fig. 3-2. Freshwater pool along coastal areas used by otter as holt.

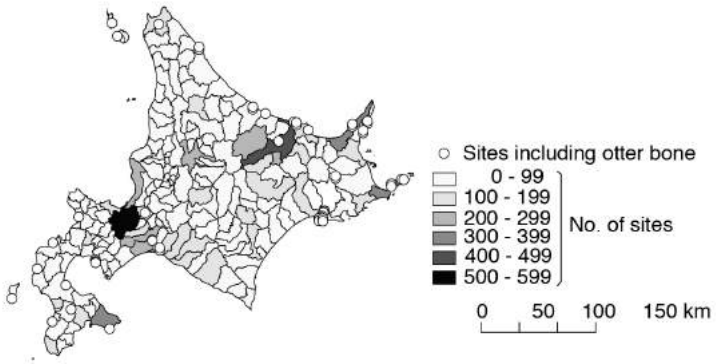

Fig. 3-3. Distribution of archaeological sites where otter bones have been unearthed (Dots indicate references listed in Appendix 1). Grey scale gradation reflects the number of sites in each city and town in Hokkaido.

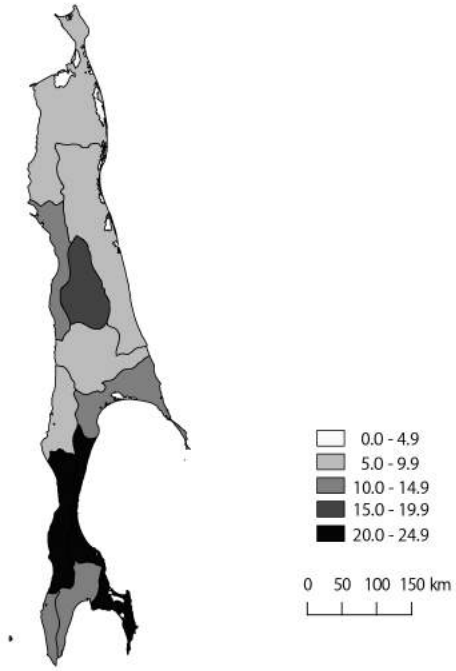

Fig.3-4. Otter density index (Otter percentage per area) of each district in Sakhalin Island, calculated from Sakhalin State (2013).

Chapter 4. Potentially harmful impacts on nature and human society following otter reintroduction

A. Possible effects on the current ecosystem

Some 60 years have passed since the last (1955) record of otters in Hokkaido (Nakagawa 2016). During these years, the riparian ecosystem has changed dramatically. Some aquatic animals such as Sakhalin taimen, *Hucho perryi,* Siberian salamander, *Salamandrella keyserlingii*, and the Japanese crayfish, *Cambaroides japonicus* have decreased and they are now listed in the Japanese RDB.

Some ecologists are concerned that a otter reintroduction may accelerate the pace of the disappearance of these species. However otters originally coexisted with them. The decrease in numbers of endangered species is the essential problem. We should set our goal to be the recovery of the entire ecosystem including the restoration of endangered species.

In addition, otter reintroduction may improve ecosystem function. For example in the UK, Bonesi et al.2004 noted that resources available to the introduced American mink, *Neovison vison*, were restricted by otters. In Hokkaido the American mink, also introduced in the early 20th century, has spread over the whole of Hokkaido (Suzuki and Kurumada 2007; Kurumada 2001). So otter reintroduction might have the benefit of suppressing mink behavior. It will be important to record the current status of the American mink population and their impact on the ecosystem. This will help us to grasp the problems of the current situation.

B. Possible effects on fisheries

Fish is the basic diet for otters, but it is also one of the most important foods for Japanese people. We need to consider the possible impacts on fisheries caused by otter reintroduction. In particular, chum salmon *Oncorhynchus keta* and pink salmon, *O. gorbuscha*, which are the two major species for fisheries in Hokkaido. In 2013, we visited nine salmon hatcheries in Sakhalin and conducted field studies to look at possible impacts on them. Based upon questionnaires answered by 13 hatcheries, Oleynikov et al. (20XX) reported that no salmon hatchery claimed the loss of juveniles (Table 4-1).

On the other hand, hatchery owners noticed that otters eat salmon juveniles after release (Table 4-1). Accordingly we analyzed otter diet around salmon hatcheries. In the summer of 2012 (June, July and August) and 2013 (June), we collected 56 fecal samples from around salmon hatcheries in southwestern Sakhalin.

We washed each sample, using 1 mm and 5 mm sieves, and analyzed the remnants. We calculated frequency occurrences (%) for each food item and its relative percentage of the entire sample. Table 4-2 is the result of this diet analysis. Cyprinids, salmonids, and amphibians were the three major food items. Among the 13 fecal samples that contain salmonids, nine samples were juveniles. Some of them might have come from the stomachs of larger fish eaten by otters. However, there were several samples that contain only juvenile salmons. This means that otters may eat salmon juveniles around hatcheries. Currently, hatchery owners do not notice otter predation on salmon juveniles. However, we should take the possibility of predation into consideration.

Table 4-1. Results of the questionnaire given to salmon hatcheries in the Russian Far East (translated from Oleynikov et al. 2015).

Question	Yes	No	Uncertain
Do otters live around the hatchery?	10	4	-
Do otters concentrate around your hatchery during the juvenile release season?	1	13	-
Do the otters eat released juveniles?	6	8	-
Are there any measures to control the population of otters around the hatchery?	5	9	-
Do otters affect the production of salmon juveniles?	-	13	1

Table 4-2. Results of otter diet analysis derived from fecal samples collected around salmon hatcheries in Sakhalin. (Number of juveniles in parenthesis.)

	Number	Percentage instances	Relative percentage
Cyprinid	28 (2)	63.6	28.3
Salmonid	13 (9)	29.5	13.1
Coleoptera	6	13.6	6.1
Insect	9	20.5	9.1
Crustacean	6	13.6	6.1
Fish bone	6	13.6	6.1
Amphibian	12	27.3	12.1
Mammal	1	2.3	1.0
Cottidae	2	4.5	2.0
Cobitidae	1	2.3	1.0
Wood	4	9.1	4.0
Pebble	4	9.1	4.0
Soil	1	2.3	1.0
Plant	6	13.6	6.1
Total samples	44		100

Chapter 5. The genetics of otter reintroduction

If the Hokkaido otter population was a very unique one, reintroduction from another population would be inappropriate. Thus, it is important to evaluate the similarity between the source population and the original Hokkaido population. Considering genetic aspects, we selected possible source populations from the Russian Far East. There was no land bridge in the Tsugaru Strait between Hokkaido and Honshu in the last glacial period of about 10-70 thousand years ago (Ohshima 1990). However about 12,000 year ago, there was a land bridge across the Soya Straits between Hokkaido and Sakhalin, which were joined during this period (Ohshima 1990).

We extracted DNA from 82 fecal samples collected in Sakhalin, Primorsky Krai and Khabarovsk Krai. The 362 bp of mitochondrial DNA control region was PCR amplified and sequenced. We also tried to extract DNA from five historical specimens of otter from eastern Hokkaido (Table 5-1). Among these, we could not PCR amplify DNA from the fur (No. 1). (DNA of this fur may have fragmented during the tanning process.) For other historical samples, we were able to PCR amplify 116 bp of mitochondrial DNA control region. There are five haplotypes for these samples (Table 5-2). Places where these specimens were collected is shown in Figure 5-1. Type 1 and 2 haplotypes were found only in Sakhalin. On the other hand, continental samples include all five haplotypes. Although the sequence of Hokkaido samples is too short to compare with fecal samples, it seems there is little difference between Hokkaido and the Russian Far East, but we need further genetic analysis of the former Hokkaido population.

Even if we could confirm a close genetic relationship between Hokkaido and the Russian Far East populations, we also need to compare their ecological similarity. If the population has evolved to use a specific habitat, it will not be desirable as a source population. For example, some otter populations depend chiefly on coastal areas and other populations lives along streams. We need to evaluate differences in habitat and behavior.

In addition, we need to consider the status of the source population. Currently, the otter population in the Russian Far East is relatively stable (Sakhalin Governor 2013). However, we should breed otters before reintroduction to ensure that we have enough animals. The survival of captive bred carnivores which have been released into the wild is not considered to be very high. Thus, we should care sustainability of released population.

Table 5-1. A list of historical specimens of Hokkaido otter

Sample Name	Type	Localities	Time period	Note
#Fur	Fur	Shari town, 43.86382N, 144.697773E	Aug. 1955	Nakagawa 2016
#TK29	Canine	Sakaeura No.2 site 44.127043N, 144.03420E	Okhotsk culture	Nishimoto and Sato 1995
#MOYO-2	Canine	Moyoro Shell Mound 44.025197N, 144.26781E	Okhotsk culture	Nishimoto and Umeda 2009
#1	Canine	Otafukuiwa Cave 43.991564N, 145.16617E	Okhotsk culture	Nishimoto and Sato 1991
#2	Canine	Otafukuiwa Cave 43.991564N, 145.16617E	Okhotsk culture	Nishimoto and Sato 1991

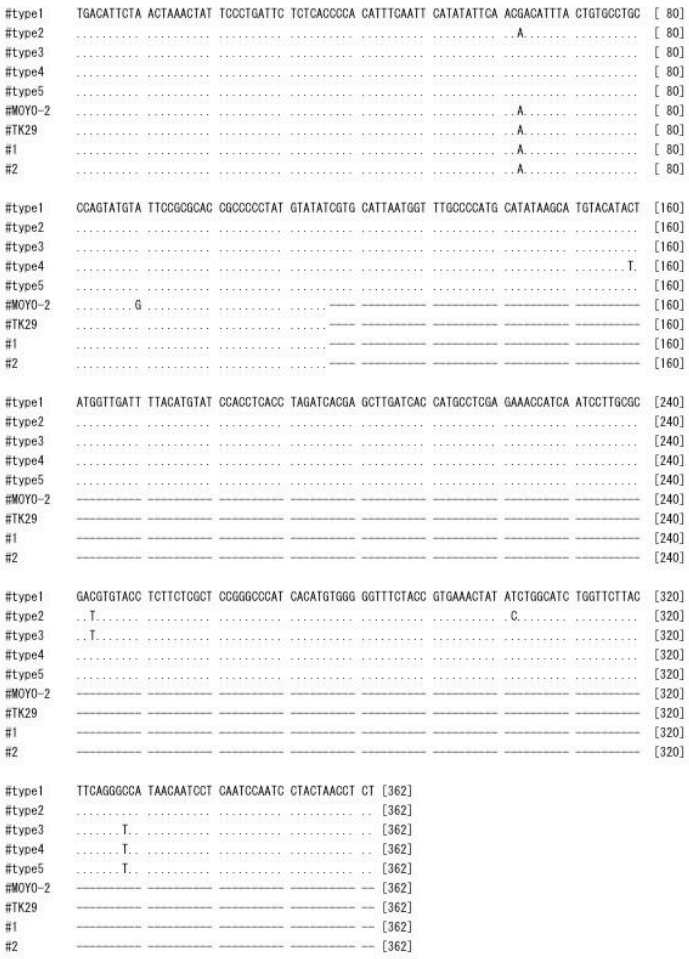

Fig. 5-1. Haplotypes of analysed otter samples. Type 1 to Type 5 are derived from fecal samples collected in the Russian Far East. Other samples are archaeological and their names are correspondence with Table 5-1.

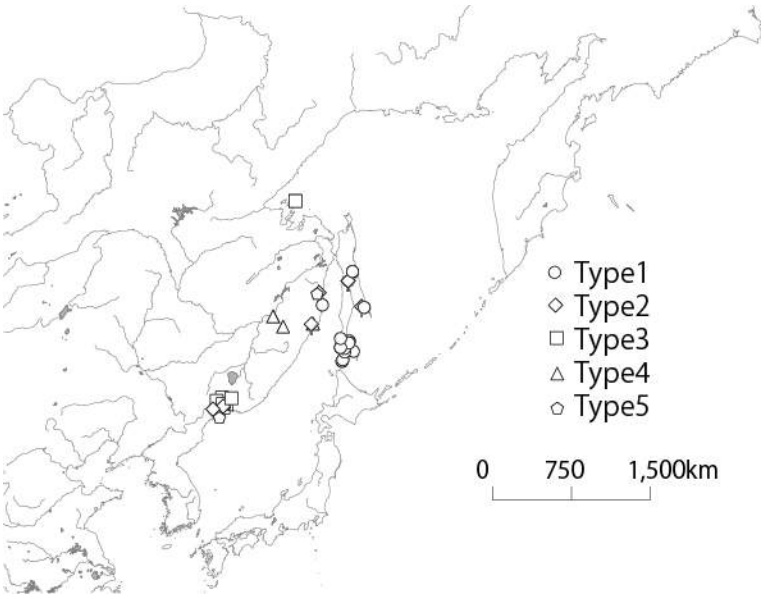

Fig. 5-2. Locations of five haplotypes from otter fecal samples collected in the Russian Far East. Base map is drawn by “OpenStreetMap contributors”.

Chapter 6. Other issues to be determined in advance of a decision on otter reintroduction

We have several other issues to be resolved before reintroduction.

First, we should consider the possibility of road kills. In 2013, during our field survey in Russia, we found the carcass of a road-killed otter (Fig. 6-1). The accident spot was a road with heavy traffic crossing a river. Polednik et al. (2011), analyzing the cause of otters' deaths in the Czech Republic, found that 75.6% of otters died through collision with vehicles. Similarly, Philcox et al. (1999), analyzing otter road casualties in Britain, revealed that 62.5% of casualties occurred within 100m of freshwater. In Hokkaido, there are many roads that pass over rivers (Fig. 6-2). So road casualties will be inevitable if there are no preventative measures. There are various ways of preventing otter road deaths. Road warning signs are one of the most traditional methods (Langton 2015). Roadside warning reflectors have also been manufactured (Rees 2002). Improvement of road structures can also be an effective solution (Yoxon and Yoxon 2014). In the Czech Republic, there are some corridors for otters under bridges (Fig. 6-3). Other methods which can be used include pontoons under bridges which rise and fall with the water level (Madsen 1996). We have to prepare these preventative measures before reintroduction.

Second, it is necessary to take measures against bringing any disease or parasite into the area through otter reintroduction. These could spread through the otter population and cause reintroduction to be unsuccessful. In addition, some of the diseases or parasites could also be harmful to other wildlife, humans or domestic animals. For example, Chadwick et al. (2013) revealed that 39.9% of inspected otters in England and Wales were *Toxoplasma gondii* positive. This parasite is very common throughout the world, but sometimes infection causes serious symptoms. Various helminth species are found from wild otters or their fecal samples in southwestern Europe. They are *Phagicola sp.* (*Trematoda*), *Aonchotheca putorii, Eucoleus schvalovoj, Strongyloides lutrae, Anisakis* and *Dirofilaria immitis* (*Nematoda*), and *Gigantorhynchus sp.* (*Aanthocephala*) (Torres et al. 2004). Some diseases from those parasite species could cause severe damage to the otter population, other wildlife, and humans.

Third, we should consider the impact of otter reintroduction on tourism. This will probably be positive. In Scotland, otter watching tours are a major tourist attraction. Skye and the Shetlands receive 129,000 and 80,000 tourists a year respectively (Mr. Chris Greenwood, personal communication). We do not have direct data correlating tourist numbers and otter watching, however at least four companies conduct nature watching tours of which the main target is otter (IOSF, Dr. Paul Yoxon & Ms. Grace Yoxon, personal communication).

In Shiretoko, 1.2-1.7 million tourists visit annually (statistics by Shari town office). Currently, at least 27 companies provide nature guide services. (We calculate this number from the websites of the Shiretoko Guides Council, Shiretoko Shari-cho Tourist Association, Shiretoko Rausu-cho Tourist Association, and Shiretoko Goko Field House). These companies arrange hiking in the forest, mountaineering, cycling, sea kayaking, scuba diving etc. Although, tourists can already see wildlife, such as bears, deer, foxes and birds, otters should be a big attraction. So otter reintroduction may increase tourism in Shiretoko.

Nevertheless, tourism also has negative impacts with problems such as traffic congestion, litter, sewage disposal, soil erosion, and feeding to wildlife. Tourist agencies, local community members and management authorities in Shiretoko have repeatedly discussed solutions to these problems. We need to continue these discussions to minimize potential impacts.

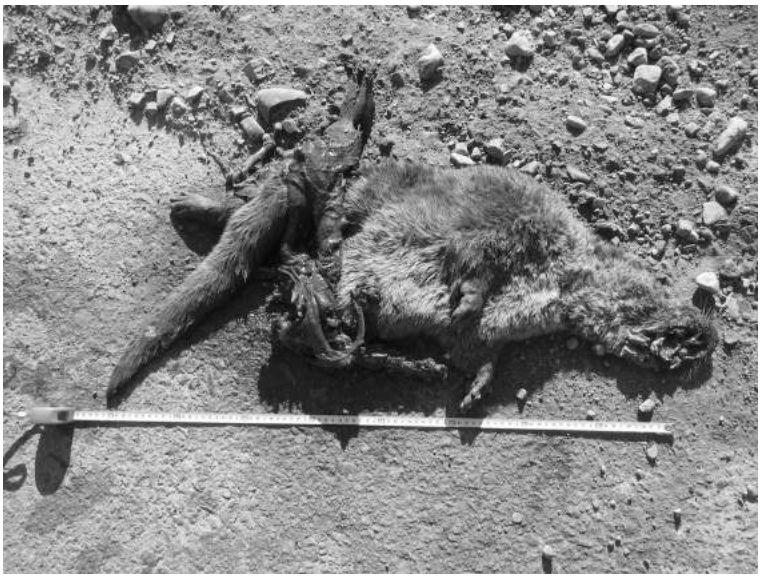

Fig. 6-1. The carcass of an otter killed on the road

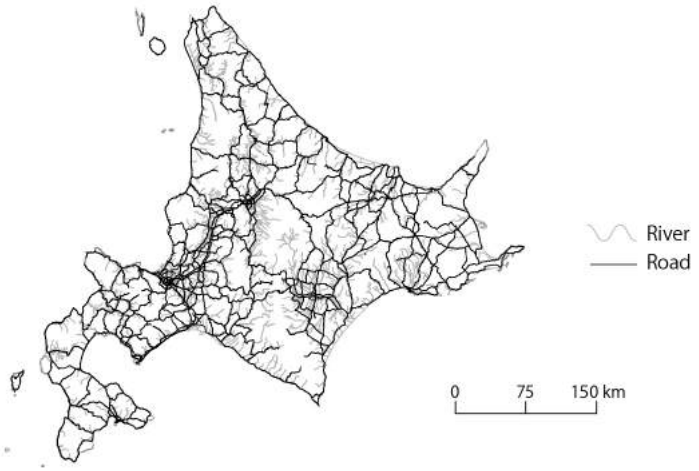

Fig. 6-2. River and road network in Hokkaido.

Fig. 6-3. Corridor for otter movement under bridge in Czech. It reduce otter casualties by vehicle.

Chapter 7. Opinions from otter specialists

In this chapter, specialists who attended the Shiretoko Conference in 2014, give their personal comments for the feasibility study.

7-1. Problems to be solved for otter reintroduction in Shiretoko

Ando, Motokazu (Yamazaki Gakuen University)

1. Public acceptance of reintroduction

The most important task is to explain the reasons why we want to reintroduce otters. We need to talk about this, not only to stakeholders in Shiretoko, but also to people all over Japan. Reintroduction will not be possible without an initiative from the Ministry of the Environment. The wolf and the otter are the two main extinct mammals in Japan. As the otter became extinct relatively recently, they should not be forgotten and we should educate the public about the need for reintroduction.

2. Genetic aspects of the possible source population

According to recent studies (including unpublished ones), there is little genetic variation between the otter populations of Sakhalin, China, Korea or even Europe. Thus, from this point of view, there may be no problem of dissimilarity between the Hokkaido population and the possible source populations. However, there is still no genetic study of the former Hokkaido population. This study should be done as soon as possible. Regarding to Japanese otter, except for Hokkaido population, it has been revealed that they had a unique genetic characteristics (Waku et al. 2016).

Home range requirement

Although there are 85 rivers in Shiretoko, they are too short for otters to use as a stable habitat. The average length of Shiretoko rivers (6.8 km) is much less than the national average (70km). Most of them are characterized by small volumes of water and rapid streams. As the otters generally have a home range of 6-10 km or longer and riparian food resources change seasonally, it would difficult for them to stay on only one short Shiretoko river. Their range may need to encompass several rivers and coastal areas. As the rocky seashore provides abundant food, the otters may depend mainly on that coastal area even if they were released in rivers.

Population capacity of Shiretoko

According to scientific studies, the population density of Eurasian otters varies between 0.02-2.6 animals/km (one otter per 0.4-50 km) in a river habitat while there can be 0.03-1.8 animals/km (one otter per 0.03-1.8 km) in a coastal habitat. Some papers report that the animals are territorial, but generally they have reduced home ranges in densely populated areas with abundant food resources. In such rich habitats, occasionally 1 animal per 1 km can be found. As the total length of Shiretoko rivers is 518.5 km and as natural coast length is 83.3 km, the otter population could be over 100 in Shiretoko. It may be possible to keep a minimum viable population (MVP). In Korea, otters inhabit a small island with an area of 2.5 km2, 18 km away from other island. As there are probably less than 10 otters there, it may be possible to sustain a very small population.

Possibility of dispersal

If otter reintroduction was successful, the animals will spread beyond the Shiretoko Peninsula. However, as the ordinary coastal areas in Hokkaido are sandy beech, they would not be suitable otter habitats. When the otters in Hokkaido were distributed along the coast, their extinction in those areas was faster than in the mountains. It is unclear whether this was due to different hunting pressures or caused by habitat preference.

Current status of the four northern islands (Kunashir, Iturup, Shikotan and Habomai)

I have heard, during the conference, that otters in these islands became extinct before World War Two. However, further research of past distribution and current status is still needed. If otters still exist there they could represent the nearest natural distribution to Hokkaido.

Possible conflicts with fishing industry

Released otters will appear along the coast and they will probably cause damage to the fishing industry. However, otters eat a smaller amount of smaller fish than the sea lion. In addition, we need to study whether they eat fish caught in fixed nets in areas remote from the coast. I recommend a compensation system for otter damage to fishery. I am not sure whether the otters would eat sea urchins, like the sea otters in Cape Erimo. If so, the damage could be more expensive.

Hunting pressure

Poaching for fur will not occur, because the attitude towards wildlife in Japan has changed drastically during these past several decades. In Shikoku, otters were slaughtered using wooden sticks before extinction, but this will not occur again.

Resource for tourism

The otter will be a positive factor for tourism.

7-2. Problems involved in reintroduction: Ideas from Shiretoko excursion and conference in 2014

Sasaki, Hiroshi (Chikushi Jogakuen University)

Removal of factors caused extinction of otters

There are four main reasons why otters became extinct in Japan.

1. Decrease by excessive hunting and further decrease by poaching: Currently, they will not be a target species for hunting. In Japan, awareness of nature conservation has been raised and there is little risk of hunting and poaching.

2. Habitat change: There is the possibility of habitat deterioration such as the reclamation of wetland and the decrease in numbers of natural riparian and coastal habitats. In Shiretoko, possible habitats are relatively protected, but we should be aware that the distribution of reintroduced otters could be enlarged.

3, Chemical pollution: agricultural chemicals may have polluted the water. Pollution could reduce availability food resources for otters as well as damage the otters directly. However, there have been few studies made in Hokkaido, so we cannot estimate impacts. We need research on current pollution in the reintroduction area.

4. Nuisance or unintentional kills: A major factor for otters in Japan was conflict with stakeholders, such as fishermen, who suffered otter damage to gillnet or farmed fish. In Shiretoko, conflict with stakeholders could be a big problem. Discussion with stakeholders is necessary. Public awareness is important for the reintroduction of otters into Shiretoko.

Source population

The source population should be of the same species and of a closely related population with genetic similarities. In general, it would be reasonable to use the population from a neighbouring area as a source for reintroduction.

Genetic studies of Japanese otter have progressed and it has been revealed that the animal has unique genetic status (Waku et al. 2016). However, as Waku et al.(2016) did not study a Hokkaido population, further study is needed to analyze the relationships between the Russian Far East, Hokkaido and other Japanese otter populations.

Environment in Shiretoko

If the otters use rivers, their range will be over 10 km along them. Accordingly, they may not remain just along the rivers, but also adopt a coastal habitat. As it is unclear if they can find enough food during the sea-ice season, they may go beyond this area in winter. Released otter may disperse from Shiretoko one after another, just as in the case of the white stork, *Ciconia ciconia*, and the Japanese crested ibis, *Nipponia Nippon*. So we should remember that a reintroduction to Shiretoko could mean reintroduction to the whole of Hokkaido.

In a coastal area, it is possible to have high densities, such as one otter/km as in the Scottish Shetland Islands. They need some streams and coast where they can eat fish. It would be possible to protect salmon hatcheries from otter invasion by using electric fences or other counter measures. However, conflicts with gillnet or fixed net fishing will be a big problem. In fact, many Japanese otters in Shikoku were caught and died in gillnets. On the other hand, otters could possibly eat fish caught by gillnet or fixed net like seals do. In order to have a successful reintroduction, it will be necessary to remove factors causing otter death and solve the issue of possible damage to commercial fishing. It will be important to study habitat relationships and human dimensions in an environment similar to Shiretoko. It would help to imagine the possibility of coexistence with otters in Shiretoko, and in Hokkaido.

7-3. Comment

Makeev, Sergey (Aniva Watershed Council, Sakhalin Rybvod)

The stated purpose of otter reintroduction is to restore the Shiretoko ecosystems as part of the 100 Square Metres Movement. The purpose of our participation is to restore a natural habitat of the Eurasian otter to secure a ‘lock’ to insure against the disappearance of the animals in our own country, if their preservation is endangered.

Likewise we can say that the Japanese owe a historical debt to Hokkaido and the surrounding islands where the otter disappeared. However we agree not to pursue this further. We need to help this project for the sake of the otter!

My personal impression is that participants in this project may overestimate the potential opposition from the local community. Unfortunately I am unable to read the review on this subject published in the *Bulletin of the Shiretoko Museum*, No. 26, entitled 'Can we see wolves and otters again on the Shiretoko Peninsula? A study of the sociological and legal aspects of the reintroduction of extinct species'(Kato 2005). Here is a fragment from the abstract: "From the social tolerance point of view, reintroduction can be considered as the release of an alien species. People fear predation on livestock or human injuries. In conclusion, considering legal and social conditions, there would be a lot of problems with the reintroduction of the wolf and the otter. The present situation isn't yet suitable for proceeding with the reintroduction of locally extinct species to a practical stage".

Perhaps it's worth repeating this kind of research by other methods. If found to be true, we should begin carrying out a special public campaign to change public opinion regarding reintroduction. Actually since our arrival this campaign has already started. I remember our visit to the mayor who is the representative of fishing community. He didn't say anything negative about reintroduction. During Paul's lecture there were some questions on this subject, but I didn't feel any sharp opposition.

As for our own observations, we can once again repeat that we don't note any harmful effects of otters either on fisheries, or on fish breeding. Our hatcheries release juveniles weighing up to 1 g. According to the optimal foraging theory (McArthur, Pianka, 1966), an effective predator like the otter won't spend time and energy to search, capture and process such small fish. Rather than catch 200 pieces of 1 gram each, it is better to catch 1 piece weighing 200 g. Moreover the otter actually eats many predators of salmon juveniles, benefitting the fisheries.

We also know that an otter is a very dynamic, mobile animal. It can move between the rivers and the sea, and use different sources of forage during different seasons. Therefore the existence of safe otter corridors is very important. We know there is a risk of death on roads, but at least there are no hunters and stray dogs.

We believe the otter can become an important attraction for tourists together with bears, salmon, Sakhalin taimen, and fish owls etc. However in one particular place, the Kami-no-Ko Pond, we could see that otters might not benefit tourism. If they are present in a place where Dolly Varden are the attraction for tourists, the behavior of the fishes will soon change.

I suggest a strategic project plan, beginning with a simple SWOT analysis. Here is a partial version, which participants here can add to.

SWOT	Helpful	Harmful
Internal	Strengths	Weaknesses
External	Opportunities	Threats

S – strengths of the project:

High level of professionalism of the main team
Serious, deep preparation and planning
Sufficient time allocated for implementation of the project
Leading organization – Shiretoko Fund
Main project – 100 square metres
Design territory – natural park, World Heritage Site
Team of the best experts (I don't mean myself, of course!)
International standards and development (IUCN Manual)

W – weaknesses:

Less than optimal habitats on Shiretoko peninsula
Insufficient food resources at many sites
Lack of safe corridors for migrations
Lack of objective research on public attitudes
Lack of preparation in the donor country

O – opportunities:

Otters can migrate to the best places
Otters can use alternative diets, such as frogs and insects, instead of fish
Creation of coalition of government, business, scientific and public organizations
Public campaign to involve supporters
Possibility of involving Mitsui (with interests in Sakhalin) in support of the project
Possibility of transferring the project to other areas (for example, to the basin of the Sarufutsu River, where the Oji Paper Company supports preservation of itou, the Sakhalin taimen)

T – threats:

Deaths of otters on roads and in ground traps

Unproved assertion that locals will be against the project
Possibility that the government won't finance the project because the reintroduction of the oriental white stork was too expensive
Political problems between Japan and Russia

7-4. Comment

Oleynikov, Alexey (Institute of Water and Ecological Problems, Russian Academy of Sciences)

The reintroduction of the otter is possible on Shiretoko Peninsula. However the capacity of the land to support otters is quite limited. According to our assessment no more than 20-25 otters can live in this territory (based on comparison with habitats on Sakhalin Island).

The rivers of the peninsula are short, have flash floods and are covered with ice in winter. The home ranges of otters here could be large. (The home ranges of males are 30-40 km long). In these conditions the seashores are of greater importance than rivers. The rivers of the national park can be regarded as small watercourses with a limited number of predated species and low abundance. Otters may only use the mountain river headwaters during short visits and migrations. However despite water control structures (some of which could be obstacles for fish migration), the preservation of habitats and the protective properties of the land make it quite suitable for otter dwellings.

Undoubtedly, the establishment of fish passes, reduction in the number of dams, and restoration of the natural state of the rivers could play a positive role in improving the habitat. At the same time larger rivers with a greater variety of habitats and possible food items (including the preferred types of fish) such as the Shibetsu River, Shari River, Poh River, and Churui River would be preferable for the release of otters. The number of fish species in these rivers vary from 17 to 33 (Appendix 1).

As the otter (*Lutra lutra*) is predominantly a solitary animal, territorial individuals have substantially extended home ranges. In order to settle, they need to migrate freely along waterways and the seacoast. All sorts of fences, settlements, roads, fish trap constructions, and channelized river beds can be obstacles. According to the results of studies on the coast of the Sikhote-Alin Reserve, estuarine areas of the rivers are crucial for otters.

In order to clarify reintroduction opportunities, additional studies of the seashore zone should be undertaken. Depth near the coast, the character of the bottom, presence of kelp thickets, the abundance of small and medium-sized fish near the shore in shallow water, and other food items at the seaside (crustaceans, birds, mollusks) are important for otters.

The predominant use of the seashore by otters should be taken into account when selecting animals for reintroduction. Animals for release should be caught near the sea shore as the population groups of otters living on the coast, and those living only

on rivers, may have different behavioral strategies in placement, migration, foraging methods etc.

The trapping of otters on the seashore with similar environmental conditions should be carried out. The current population on Sakhalin Island is stable. The number of otter according to the official data is about 2000 individuals. Live trapping of about 30 animals per year could possibly be carried out without damage to the population.

Since the otter will have trophic connections with the sea ecosystem, it is necessary to study the accumulation of heavy metals and chemical compounds (mercury et al.) in the otter's body. (Such data are available for the arctic fox in the Russian Pacific, Bocharova N. et al., 2013).

Extra attention should be given to factors that might potentially cause deaths of otters on the Shiretoko Peninsula:

• to identify possible migration routes and the intersections of highways; to make recommendations to reduce potential animal deaths on the roads.

• to get more information about the types of traps used in the seaside of Shiretoko Peninsula and the depth of their installations. This is necessary in order to ensure that otters will not perish in bottom fishing traps. (According to data obtained by researchers 98% of forage otter dives are not more of 8 metres, Nolet et al., 1993, and the single maximum recorded dives in the sea in Scotland were 14 or even 15 metres, Kruuk, 1995).

Recommendations should be made to reduce possible damage to the salmon hatcheries. It will be necessary to protect perimeters with electric fencing, to install grilles on fish passing facilities, to enable permanent control during the raising and release of salmon fry.

It would be advisable to create a center for the breeding and reintroduction of otters with bloodstock from Sakhalin. The center could be planned as a part of the tourist site, but preparations for the release of young, as part of a special program, should be done with minimal human contact, and with an annual release of trained offspring. The center should be located in areas suitable for this release.

7-5. Comment

Yoxon, Paul and Yoxon, Grace (International Otter Survival Fund)

Firstly we would like to compliment you on the excellent workshop and the positive attitude of all the participants. We believe otters can be reintroduced to Hokkaido

where they will improve and enhance the environment and add to the very precious ecosystem.

However, there have to be some further investigations and considerations.

1. Reasons for extinction – Pollutants

More information should be obtained on why the otters did not survive despite the fact that they were protected in 1928. Otters were not protected in the UK until 1978 (England and Wales) and 1984 (Scotland). They were also hunted although more for "sport" than fur. However the biggest problem was the use of chemicals in the 1960s which decimated the population in England, Wales and Western Europe (Jefferies, 1989). The otters in the southwest of England and north and west of Scotland were largely unaffected and so could be translocated to help the recovery in the rest of England. You do not have this luxury in Japan so it has to be a complete introduction.

It is therefore essential that base-line data on the levels of pollutants in Hokkaido are taken into account including organochlorines, heavy metals and PCBs, etc. It is also important to look at the new chemicals, such as PCBDs and also endocrine disrupters. If levels are high any reintroduction is unlikely to succeed.

In Switzerland there were two attempts at an otter reintroduction in 1976 (Weber, 1997) and both failed due to pollution, even though the rivers appeared clean. In 1997 WWF looked into the feasibility of reintroducing again in Switzerland but this did not go ahead due to high levels of PCBs. Should you need assistance on any of the chemical work, we can put you in touch with Cardiff University Otter Project. They are currently working on various projects including ectoparasites and endoparasites, pollutants (lead, PCBs, PBDEs), and hormone disrupters. (Their general website is: http://www.cardiff.ac.uk/biosi/staffinfo/chadwick2.html.)

2. Potential release sites

Otters need rivers considerably longer than 2-3 km, and if this is all that is available they would also have to use the coastal zone. The rivers we saw in the park area were too short, although there was a lot of available prey. However we do feel they would still need to use the coastal zone as well as the rivers. The coastline to the northeast of Rausu has a lot of fishing activity and netting which we believe could pose a threat to the otters.

Shari river is much longer and appeared to be prime otter habitat with suitable areas for holts. So this should be looked at seriously for this reintroduction.

Although they can dive to depths of up to 15 m this is unusual and they generally do not dive more than 4-5 m. Following the workshop we went on a boat trip along the coast to the northeast of Utoro. Here there are some extremely steep cliffs which continue down into the water with no shoreline area. This area is not really suitable for otters as they could not hunt here and there are no holt sites or shoreline where they can come out to eat large prey. Looking at your historical data on trapping, this area is unlikely to have ever had a healthy population.

In coastal areas on the west coast of Scotland the main prey species are small eel-like demersal fish. There are five main prey species which accounted for over 75% of the diet - viviparous blenny (*Zoarces viviparus*), five-bearded rockling (*Ciliata mustela*), butterfish (*Pholis gunnellus*), sea scorpion (*Taurulus bubalis*) and saithe (*Pollachius virens*). The first four species are all small benthic fish but saithe is free-swimming. Studies have already apparently been carried out into the fish available in the coastal area of Shiretoko and it would be useful to know more about what species there are, in comparison to what has been found in the otter diet in Scotland, and also to what the otters in Sakhalin take. It would also be useful to know if there is any information on the prey species taken by otters in Japan in the past.

We did not see the area beyond the end of the road on either side of the peninsula but even if it was suitable the otter population would be cut off from the rest of Shiretoko and Hokkaido.

On the west coast of Scotland, otters that feed in the sea need freshwater pools so that they can wash the salt out of their fur – otherwise it quickly loses its thermo-insulation properties. Yoxon (1999) showed that factors which encouraged the presence of otters were the presence of freshwater pools for washing and a gently sloping coastline as otters do not dive to great depths. We have found that rather than using streams the otters seem to prefer small pools, although they will use streams if there is no alternative. We did not see pools in Shiretoko and so the otters would have to use the streams there. This would therefore present more of a risk of them crossing roads.

3. Source otters

Although we discussed the issue of DNA for the source of the otters, we consider it is more important to look at the habitat and climate of the area from which the otters are taken. It is clearly impossible to replace the extinct otters with exactly the same DNA. So we believe it is more important that the otters come from similar rivers or coastline with a similar prey fauna and climate. This will make the translocation much easier for the animals and enable them to adapt to their new environment much quicker. This again points to Sakhalin as the source area.

We have found that otters from a freshwater habitat generally behave differently to those from the coast. Freshwater otters tend to be more nocturnal whereas those which live on the coast are active throughout the day and night and go through periods of activity and feeding following by sleeping right through 24 hours. This seems to be natural as when orphaned cubs are received they fit into the expected behaviour pattern once they are weaned. So it is important that otters are sourced from the appropriate habitat.

4. Trapping methods

Methods for trapping should minimise potential injuries to the otters. In UK and Pennsylvania trap-related injuries included damage to teeth and paws and some had to be euthanised because of these injuries. This is clearly not acceptable. If otters need to be anaesthetised extreme care should be taken. Ketamine is relatively safe and effective but does have limitations with poor muscle relaxation and acute hyperthermia. It is also essential to administer an antidote to bring the animal out of the anaesthetic rather than just coming round normally. If this is used the otter body temperature should be monitored at all times with a normal range of 37.5 to 40 C.

5. Parasites and Disease

Any animals to be introduced must be screened to make sure that they are not bringing in any problems through disease, parasites (including micro-parasites), etc. We can give you the contact for a vet who can assist with this.

6. Recording breeding success and mortality

Re-introduction programmes need to work out a minimum viable population (MVP). MVP consideration should include demographic, environmental and genetic diversity.

In England, 117 otters were released into the wild from 1983-1999. In the early years it was easy to record accidental deaths and breeding success as they were the only otters in the area – this will also apply in Japan. Up to 1993, 55 animals were released in England and it was found that 6 died on the road, 2 were trapped in nets and 1 died as a result of fighting. The report notes 70 otter deaths (in addition to the 9 mentioned above) throughout the whole release area since the start of the programme in 1983 and all but 4 were road casualties. 55 incidents of breeding were recorded from 36 of the release groups up to the end of 1996. (Jefferies et al 2003).

In Pennsylvania they worked out that the reintroduction of 20-30 individuals per site was sufficient to establish a breeding population. Since 1982, 153 individuals

were introduced in seven different water systems (Serfass et al 2004). Some otters died in traps but reproduction has been recorded in two sites.

7. Predation at hatcheries

It is important to establish good relations with fishery people right at the beginning to avoid any negative publicity in the future which could cause problems. In the UK otters do take fish from hatcheries and fencing should be put up to stop this impact, as it will be very bad for public relations. In the Pennsylvania re-introduction in the 1980s, a survey conducted at the 21 hatcheries in the area showed 47.6% of them had otter attacks (Serfass et al 2004). The owners stated that otter depredations were sporadic and lasted only a few days. A protocol was established where fencing was installed to aid the hatchery owners. This developed a working relationship and increased local support for the reintroduction.

8. Public awareness

As we discussed, public awareness and education is vital if the project is to succeed, as it is important to have the support of the local communities. There is a huge fishery industry and the people involved need to be shown that otters and fishing can go on side by side. They already have fish predators in the form of bears, sea eagles and owls and these seem to have no significant impact on the fish stocks, so it is unlikely that otters will either. Eurasian otters do not go around in large groups, but are largely solitary. The female holds the territory and the male will visit several females. We receive reports of “lots” of otters in our area but these are false and people are just reporting the same animal several times!

9. Threats to the otters

Roads and fisheries have already been discussed and there will have to be effective mitigation to keep otters off the roads and out of nets.

Possible predators of otters will include seals (the grey seal, *Halichoerus grypus*) and also include bears and also sea eagles and maybe even owls on young cubs.

10. Post-release monitoring

This was not discussed in detail due to lack of time but it is also important to consider as it will need to be included in any budget for the programme. Various methods for post-release monitoring have been used for otters:

•Intraperitoneal radio-transmitter implantation and monitoring. This is an intrusive method requiring veterinary intervention, and the risk of infection. Experience in

America has shown that it has a significant death rate due to post-operative infection and we would not therefore recommend it.

•Glued-on transmitter. Very small transmitters can be glued to the underfur on the back of the neck. This method has been used by IOSF and the transmitters did stay on for 3-4 weeks. This is enough time to check that the animal has integrated into the wild successfully but will probably not be enough for long-term monitoring.

•A company is in the process of developing a minute transmitter which can be placed under the skin and can be tracked using GIS. This has the best potential as it is non-invasive and can be used for long-term monitoring.

•Application of harmless dye in different patterns to e.g. the tail end so that they can be readily identified on camera traps or if seen in the wild. This is non-invasive, and will last until the otters moult. This simple method has been used very successfully but again it is more appropriate to shorter monitoring programmes.

•Camera traps can be used around the release habitat but will not identify any movement of animals.

Any dead otters found should be given a post mortem and samples collected for toxicological analysis.

11. Possible benefits of reintroducing otters

Otters are a great indicator of a healthy environment and so they will “advertise” that Hokkaido has a good ecosystem.

Ecotourism is growing. People already come to Hokkaido for the beautiful scenery and to see birds and also the bears. Otters are a very popular animal and they would definitely be an added interest to such visitors. Even though the otters may not be easy to see, the fact that they are there would be an added attraction.

Chapter 8. Conclusion: the future of the riparian ecosystem in Shiretoko

Our goal is to evaluate the possibility of otter reintroduction in Shiretoko. In our view, otter reintroduction is not possible if restricted to Shiretoko. However reintroduction is possible, if we accept a wider distribution over Hokkaido as a whole. This would be beyond the scope of the 100 Square Metre Movement.

First, the environment in Shiretoko does not satisfy the necessary conditions for the otter habitat. The fish fauna of Shiretoko rivers overlaps considerably with that of Russian Far East rivers, however in Shiretoko fish abundance is poor. The rivers are too steep and too short to be successful feeding sites for otters. So if they are released in Shiretoko, they must use coastal areas. As these on the Shiretoko Peninsula are mainly rough cliff or steep seabed, they are also not ideal habitats for the otter.

On the other hand, in other areas in Hokkaido, there are many rivers and coasts that could provide suitable habitat. Accordingly released otter may become dispersed outside Shiretoko and re-colonize in those locations. This means that the reintroduction project should be broad in outlook to include areas surrounding Shiretoko, or indeed Hokkaido as a whole. Considering the distribution of archaeological and fur production data, we conclude that the otter must once have been distributed all over Hokkaido. However, a long time has passed since the otter became extinct in the island. Since then, the riparian, lake and coastal habitats have geatly changed. As road networks have developed, accidents involving vehicles are likely to occur. So improvement of environment should be a precondition for reintroduction.

Second, there is the difficulty of deciding on the source population. In this study we conducted a genetic analysis of the former Hokkaido population, to compare it with the present Russian Far East population which is a candidate to be our source population. However we could only compare a short part of the Mitochondrial DNA. We need to analyze longer sequences using more samples. Furthermore, even though there apparently is sufficient similarity between Russian and Hokkaido populations, we need to make a comparison of ecological similarity. Negotiations with the Russian government may also not be an easy matter. We need special permission for the reintroduction, because the otter is listed in Appendix I of the Convention on International Trade in Endangered Species of Flora and Fauna (CITES).

Third, it may take a long time to get agreement for otter reintroduction. The main stakeholders are fishermen, nature conservationists, tourist agencies, and related authorities. In the Russian Far East, which has a rich aquatic ecosystem, there is a little damage to the fishing industry. The otter is even appreciated by salmon hatchery owners as a natural enemy of the dace that eat a lot of juvenile salmon. In

Germany and the Czech Republic, the otter sometimes takes from traditional fishing ponds, but this doesn't seem to be much of a problem because of government compensation. There are a lot of salmon hatcheries in Hokkaido rivers, however they are not in rich otter habitat areas. So we can prepare preventative measures before otter reintroduction and compensation systems. For example, in Yellowstone National Park in the USA, livestock losses caused by the reintroduced wolf, *Canis lupus*, are compensated by nongovernmental organizations. On the other hand, compensation for fishermen in parts of Europe has led to further problems. Compensation was offered in Austria but it was found that some people gave false information to claim the money (Paul and Grace Yoxon, personal communication). Instead of the compensation it would have been better to offer financial assistance to help keep otters out of fisheries.

Regarding Japanese conservationists, there seem to be two different attitudes. Those in favour consider reintroduction to be a recovery of a lost natural relationship, while those against consider it would be a disturbance of the existing ecosystem. Regarding tourism, the otter reintroduction could be positive, but we should be careful not to allow it to be intrusive.

If we can solve the issues listed above, otter reintroduction could be a possibility. However, these efforts would be a departure from the original aims of the 100 Square Metre Movement. Donors hope for the recovery of the Shiretoko forest ecosystem in formerly abandoned farmland. However in order to have a successful otter reintroduction, we would need to recover the ecosystem of a much broader area. This would need significant funds and an effort beyond the current framework of the 100 Square Metre Movement. For example, we would need further studies on preferable habitats, population dynamics, and the veterinary requirements of the otter. We also need to discuss with many authorities, fishermen and conservationists to make agreements regarding otter reintroduction. In order to carry out this work, it would need significant funds. We would also have to take responsibility for an unsuccessful result or for any negative impacts of otter reintroduction. This would not be compatible with the original aims of the 100 Square Metre Movement.

However, and on the other hand, it would be reasonable to work to recover a potential habitat for otters in the area of 100 Square Metre Movement. We are currently trying to improve the riparian ecosystem, including the presence of salmon.

In conclusion, our current goal is to recover sufficient resources for the otter in 100 Square Metre Movement area, imagining a time in the future when otters can be reintroduced.

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