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IMPACT OF WHALE RESOURCE MANAGEMENT RESEARCH ON SIKA DEER MANAGEMENT

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Abstract

Sika deer population management in Hokkaido has been strongly influenced by whale resource management research in monitoring frameworks and management approaches. The whale survey consisted of five pillars: catch statistics, visual observations, tag-recovery surveys, biological surveys from whaling, and special catch surveys. In references to the whale monitoring, sika deer monitoring was constructed involving capture information (SPUE, CPUE), visual observations (spotlight census, aircraft survey), radio telemetry surveys, genetic surveys, and biological surveys from hunting and culling for assessing age structure and the reproductive characteristics of female deer. We adopted the Revised Management Procedure (RMP) for whaling to Hokkaido sika deer population as feedback management because there was uncertainty in estimating population size. Feedback management incorporated into deer management in the eastern part of Hokkaido became the pioneer of science-based wildlife management in Japan. It influenced the establishment of the Specified Wildlife Conservation and Management Plan by amending the Wildlife Protection and Hunting Act in 1999. Feedback management is almost synonymous with adaptive management in a broad sense. The large-scale feedback management of sika deer in Hokkaido is a practical example of adaptive management of deer ahead of the world.

Key words: Adaptive management, feedback management, revised management procedure, sika deer, monitoring, whale.

Introduction

Hokkaido Government established the Hokkaido Institute of Environmental Sciences (HIES) in 1991, when I started to work as a researcher for sika deer (*Cervus nippon*) management. Until then, monitoring of terrestrial large animals was not carried out except for Japanese serow (*Capricornis crispus*), a species designated as a nation's Special Natural Monument. Sika deer population management in Hokkaido has been strongly influenced by whale resource management research in monitoring frameworks and management approaches. As a result, it has played a leading role in science-based wildlife management in Japan.

Review

Monitoring

In 1991, when I was planning sika deer monitoring all over Hokkaido, Dr. Hidehiro Kato kindly sent me a book entitled "Study on Whale Stock Management" (Sakuramoto *et al.*, ed. 1991). This

book, covering all aspects of whale resource management involving theory and practice, attracted me very much. The whale resource management research was ideal for researchers on large mammal population dynamics. Dr. Seiji Ohsumi reviewed the method and its system in Chapter 1 (Ohsumi, 1991), which was particularly useful for constructing the baseline of sika deer monitoring.

The whale survey consisted of five pillars: catch statistics, visual observations, tag-recovery surveys, biological surveys from whaling, and special catch surveys. The biological surveys were conducted for three purposes: genetic analysis for separation of lineages, estimation of biological parameters, and elucidation of cetaceans' ecosystems.

In references to the whale monitoring, I constructed sika deer monitoring using capture information (SPUE: Sighting per Unit Effort, CPUE: Catch per Unit Effort) per each 5 km×5 km grid, and visual observations (spotlight census, aircraft survey) over a wide area to grasp the rough population trend. To determine the management unit for sika deer, my research team and I conducted radio telemetry surveys and genetic surveys in Eastern Hokkaido. We also worked on age determination from the individuals captured by hunting and culling and analyzed the reproductive characteristics of female deer.

Seasonal migration, the genetic structure of populations

To determine management units for sika deer population, we examined seasonal migration and habitat use by installing dozens of VHS radio transmitters in the deer population in eastern Hokkaido (Uno and Kaji, 2000, Igota *et al.*, 2004). We also studied changes in the populations' genetic structure in recovering the distribution from near extinction (Nagata *et al.*, 1998) and expanding the distribution to the saturation period (Ou *et al.*, 2014). These findings were significant for considering the management unit for developing sika populations in Hokkaido.

Population dynamics: its processes and mechanisms

As model survey sites for closed habitats, I chose Nakanoshima Island in Lake Toya, where deer have been artificially introduced, and Cape Shiretoko, where deer colonized. I set up two places for an open environment: Onbetsu town and Ashoro town in Eastern Hokkaido. The population survey method depended on the region; drive count method on Nakanoshima Island, aerial survey at Cape Shiretoko, spotlight count at Onbetsu town, and cohort analysis by age determination of a total of 17,549 individuals captured in Ashoro town over 12 years. Then, we analyzed the process and pattern of population fluctuation and its mechanism.

These studies revealed that the natural increase rate of sika deer was around 20% without harvesting or predator, that explosive increases occur, even when they are introduced into the island or naturally colonizing, and even in settled populations with original habitat. Large-scale population crash repeatedly occurred in closed habitat (Nakanoshima Island and Cape Shiretoko) (Kaji, 2018). Thus, in the absence of predators and harvesting, the populations would not be in equilibrium with plants and substantially impacted the vegetation. These clearly showed that aggressive culling for female deer was necessary to reduce the overabundant sika deer population.

Feedback Management

From the hunting season in 1994, female deer hunting was allowed in Hokkaido for the first time in 72 years. However, there were many objections in fear that overharvesting in the Meiji era would lead to extinction. We recognized the increasing trends of the deer population in eastern Hokkaido. However, there was uncertainty in estimating population size, so it was impossible to determine how many deer we should harvest at that time.

We invited Dr. Hiroyuki Matsuda, an expert in mathematical ecology and fishery resource management, as a lecturer and held a resource management study session for sika deer to consider breakthrough measures. Dr. Matsuda proposed feedback management of sika deer (Matsuda *et al.*, 1999) following the Revised Management Procedure (RMP) for whaling (Tanaka, 1982). Feedback man-

agement incorporated into deer management in the eastern part of Hokkaido became the pioneer of science-based wildlife management in Japan. It influenced the establishment of the Specified Wildlife Conservation and Management Plan by amending the Wildlife Protection and Hunting Act in 1999. The Ministry of the Environment adopted a Feedback management approach in the deer management manual.

Towards adaptive management

Adaptive management is suitable for managing wildlife populations and natural resources that obtain insufficient and uncertain data and continuously improves management policies and practices through adaptive learning and feedback management (Walters, 1986). On the other hand, feedback management is a management policy for sustainable use at the optimum level based on uncertain information on natural resources (Tanaka, 1982), which is almost synonymous with adaptive management in a broad sense.

Adaptive management is considered the best way to solve the biological and policy dilemma of deer management in US national parks; however, there are limited cases in practice (Porter and Underwood, 1999). In France, adaptive management using indicators of ecological change is adopted for the management of small scale and well-defined population of roe deer (Morellet *et al.*, 2007). Therefore, the large-scale feedback management of sika deer in Hokkaido is a practical example of adaptive management of deer ahead of the world.

Conclusion

On October 25, 2001, I had the opportunity to report on the feedback management of sika deer in Hokkaido at the Institute of Cetacean Research seminar. Dr. Shoichi Tanaka, who advocated feedback management, and Dr. Ohsumi, the Institute of Cetacean Research director, attended the venue.

In the seminar, I explained that the deer management goal in Europe and the United States was maintaining maximum sustain yield (MSY) by managing the population around K/2 of the MSY curve. However, K/2 was too high to prevent damages to agriculture and forestry and ecosystem of cervid populations with weak density dependence like sika deer (Kaji *et al.*, 2010). Avoiding severe deer damages, maintaining the population considerably lower than the carrying capacity was required. The sika deer management goals of our program were: (1) to keep the population at moderate density levels preventing population irruption, (2) to reduce damage to crops and forests, and (3) to sustain a reasonable yield of hunting without endangering the population. We developed a threshold harvesting approach as feedback management involving three threshold levels of relative population size, four levels of hunting pressure, with a choice of four corresponding management actions by sex-specific hunting, based on the estimates of relative population size (Matsuda *et al.*, 1999).

I concluded that harvesting was the only operational experiment, essential for population abundance estimation and density dependency detection. Hunting was a large-scale ecological experiment since it was impossible to conduct repetitive experiments in nature and manipulate the natural environment. Drs. Ohsumi and Tanaka were pleased to listen to my presentation, which encouraged me to progress science-based wildlife management for sika deer.

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