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Author(s)	MIZUNO, Ayako W.
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-9 which was observed 6 h after X irradiation was significantly attenuated by CHX. SAPK/JNK was activated within 30 min after X irradiation. Interestingly, CHX did not inhibit the activation of SAPK/JNK but inhibited the expression of c-Jun and the activation of AP-1 existing downstream of SAPK/JNK. On the other hand, the expression of Fas, a tumor necrosis factor (TNF) receptor existing upstream of caspase-8, increased 2 h after X irradiation. However, neither a neutralizing antibody against Fas (ZB4) nor an agonistic antibody against Fas (CH-11) influenced X-ray-induced apoptosis, suggesting that caspase-8 activation was independent of Fas/ Fas-

ligand ligation. The DISC formation without the expression of Fas ligand was observed after X irradiation and CHX considerably inhibited it. Moreover, the reduction of  $\Delta\Psi_m$  and the release of cytochrome c from mitochondria to cytoplasm, which were known to be upstream of caspase-9 activation, occurred after X irradiation. These phenomena were also inhibitable with CHX.

The present results indicated that apoptosis induction was dependent on the activation of caspases regulated by *de novo* protein synthesis through SAPK/JNK activation and Fas was an important apoptosis factor in X-irradiated MOLT-4 cells.

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### Studies on population ecology of the spotted seal, *Phoca largha*, in the coastal waters of Hokkaido, Japan

Ayako W. Mizuno

*Laboratory of Wildlife Biology, Department of Environmental Veterinary Sciences,  
Graduate School of Veterinary Medicine, Hokkaido University, Sapporo 060-0818, Japan*

The spotted seal is a common sight in Japan. However, the conservation and management of this species has been inadequate. One of the principal reasons is lack of basic biological information. Therefore, the present study examined the spotted seal distribution patterns and abundance, cranial morphology and genetic features in the Hokkaido waters.

Seasonal/regional variations in spotted seal distribution were confirmed along the entire coastline of Hokkaido. Incidental harvests, damage control kills, and strandings were most common during salmon harvest season (fall), sea ice season, and the weaning period, respectively. Sub-adults and adults were

found in areas with seasonal sea ice, while immature seals were recovered from areas with little or no sea ice. The fewest seal sightings and no haul-out sites were reported from southern Hokkaido, probably because warm sea currents discourage seals from using this area.

Based on aerial surveys, the distribution and abundance of spotted seals were assessed in the breeding season off the Okhotsk coast of Hokkaido. The total abundance was estimated to be 13,653 seals (95%CI=6,167-30,252) in March, and 6,545 seals (95%CI=3,284-815,644) in April. The pack ice area off Hokkaido had higher densities (0.54 and 0.58

seals/km<sup>2</sup> in March and April, respectively) than those reported in eastern Sakhalin. A large number of pups suggest that the study area is an important breeding center.

A baseline for cranial features was obtained by examining the 23 measurements and 2 nonmetrical attributes of 152 seals collected at the Nemuro Strait, Hokkaido. The development of morphometrical characteristics of skulls ceased at 7.9 years and 11.9 years for males and females, respectively. The sutures were half ankylosed till approximately 10 years of age in both sexes. The sagittal crest appeared from about 5 years in

males. Large individual variations in the skull were noted in the feeding, breathing, and facial-expression apparatus.

In addition, genetic features of spotted seals in Hokkaido were investigated using mitochondrial DNA (mtDNA) sequencing. From 66 spotted seals, 57 haplotypes were identified. Phylogenetic trees did not indicate clear geographic differences between the Sea of Okhotsk and Japan coasts. It showed a high level of diversity in spotted seal mtDNA, and it is reasonable for the ecological features of this species to have a high mobile ability and be distributed over a wide range.

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## Studies on Genetic and Morphological Characteristics and Conservation of Red Deer (*Cervus elaphus*) in Xinjiang, China

Halik Mahmut\*

*Laboratory of Wildlife Biology, Department of Environmental Veterinary Sciences,  
Graduate School of Veterinary Medicine, Hokkaido University, Sapporo 060-0818, Japan*

*\*Life Science and Technological Institute, Xinjiang University,  
Urumqi, Xinjiang 830046, China*

Studies of genetic and morphological characteristics of red deer (*Cervus elaphus*), with implications for their conservation in Xinjiang, China.

This study was carried out based on the following four objectives :

1. To analyze the phylogenetic relationships among Chinese, European, and North American red deer.
2. To sample and analyze geographic variations of skull morphology in red deer of Xinjiang, China.
3. To assess genetic diversity of the Tarim red deer subspecies based on studies of mi-

cro-satellite DNA.

4. To suggest conservation measures to protect red deer populations, based on data of the present study.

The main parts of this dissertation are as follows :

1. Molecular Phylogeography of the Red Deer (*Cervus elaphus*) Populations in Xinjiang of China : Comparison with Other Asian, European, and North American Populations

To determine the phylogeography of red deer (*Cervus elaphus*) populations of Xinjiang,