論文名

Social structure of male sperm whales (*Physeter macrocephalus*)

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Males sperm whales (*Physeter macrocephalus*) seem to form the rare type all-male group consisting of unrelated non-reproductive males. Investigation of the social structure of male sperm whales, which is unique among mammals, contributes not only to understand the social structure of this species but also to examine how ecological factors other than reproduction and kinship affect the formation of society. However, little information about the social structure of male sperm whales has been reported after the end of modern commercial whaling. My dissertation aimed to reveal the social structure of male sperm whales using a large photo-identification dataset from two study areas: Nemuro Strait, Hokkaido, and Goto Submarine Canyon, Nagasaki, Japan.

In Chapter 1, to obtain the background information for social analyses, I investigated the trend in residence patterns and the abundance of male sperm whales in the Nemuro Strait. The best model for a lagged identification rate suggests that residence time around the strait is 2.1 years, with individuals staying in the strait about 48 days each year. These findings, along with previous studies, suggest that males move from one feeding area to another neighboring area every several weeks, shifting their home ranges gradually over a period of a few years.

In Chapter 2, I examined association patterns (preference and temporal patterns of association) to reveal whether social relationships exist among male sperm whales in Nemuro Strait. The results suggest that male sperm whales, which were thought to be solitary and asocial previously, have preferred associations lasting for at least 2.7 years, 5 years maximum. Since the timing of dis-association approximately coincides with the residence time in one foraging area, thus, male relationships may actually persist for 5 years or more. Such associations may function to enhance foraging or combat predation in pelagic habitats.

In Chapter 3, I examined the correlation between body length and association indices and network measures of individuals to reveal the change in relationships with male's age. I found that young males smaller than 13 meters show high association indices comparable to those of female groups, while these measures rapidly decrease between body lengths of 13 and 14 meters at around attaining sexual maturity. The imbalance between the benefits and costs of forming a group due to the growth spurt after puberty may be the main cause of this decline of sociality.

This study found that male sperm whales, which were previously thought to be solitary and asocial, have long-term relationships lasting for at least several years. Such relationships may contribute to their survival until sociological maturity through cooperative feeding and anti-predation behavior and drive the formation of non-reproductive male groups. The costs from competition for resources may outweigh the benefits from cooperation in foraging and protection against predators for larger animals, and which may reduce male's sociality following the spurt of secondary growth with sexual maturity.