Early mortality of sika deer, *Cervus nippon*, on Kinkazan Island, northern Japan

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It is important for animals to survive until sexual maturation. For most animals, it is plausible that offspring mortality is high because of their small body size, incomplete physical abilities, and vulnerability to disease. However, evidence is quite limited because it is difficult to observe the offspring of wild mammals immediately after parturition (Gaillard et al. 1997). Meanwhile, some mammals have developed sexual dimorphisms related to mortality and consequent differences in demographic parameters. Cervids are one example, with longevity and mortality pattern often differing between the sexes (Clutton-Brock et al. 1982a). It is therefore necessary to determine the mortalities of males and females separately. Unfortunately, such information is limited (but see Gaillard et al. 1997).

From a life history perspective, it is important to investigate the mortality pattern of offspring and to determine which factors affect it. Offspring mortality is also important in terms of lifetime reproductive success (Clutton-Brock 1988; Gaillard et al. 1997) because if an offspring dies before sexual maturity, that offspring is not counted as a “success” in the calculation of the mother’s lifetime reproductive success. In fact, Clutton-Brock et al. (1982a) regarded only two year old deer (not one year olds) as survivors. If one year old deer are included as survivors when calculating lifetime reproductive success, the result would differ greatly and would be incorrect. It is therefore quite important to track the mortality of offspring for as long as possible.

We have studied variations in the lifetime reproductive success of sika deer, *Cervus nippon*, in relation to individual characteristics for approximately 20 years (Minami 2008; Minami et al. 2009a, 2009b, 2009c). We have shown that high mortality was concentrated during the period of immaturity in both males and females (Minami 2008; Minami et al. 2009c).

Predation is expected to be an important mortality factor for ungulates (wapiti, *Cervus elaphus canadensis*: Schlegel 1976, mule deer, *Odocoileus hemionus*: Unsworth et al. 1999, see also Linnel et al. 1995 for a review). Individuals that survive to the age of maturity under predation must be truly successful individuals (Clutton-Brock et al. 1982a). Predation risk is also expected to vary greatly with the species of predator, individual (deer) age, and the situation of predation. Therefore, predation may confound attempts to determine how the abilities of an individual deer affect survival and reproductive success. In fact, mortality patterns will vary depending on whether predation occurs from wolves or ravens. Hence, examining mortality in the absence of predation allows a suitable analysis with fewer complicating variables.

On Kinkazan Island, there are no predators of sika deer, with the exception of Jungle crows, *Corvus macrorhynchos*. Sport hunting is prohibited on the island for religious reasons. The island is therefore a suitable site to study mortality factors of sika deer in the absence of significant predation. Information obtained under such conditions could then be compared with mortality factors and patterns from populations experiencing predation.

The objective of this research was to determine the mortality and factors related to the mortality of sika deer fawns living on an island that has no strong predation pressure.