Short Communication

Notes on the Breeding Ecology and Behavior of Japanese Martens on Tsushima Islands, Japan

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(Accepted 24 September 1993)

Reproduction in mammals is characterized in general by having seasonally related breeding behaviors such as mating, copulation, pregnancy, parturition, lactation, and dispersion. Breeding ecology is one of the most crucial aspects of mammalian life, and one of the most important to understand (Bronson 1989). Surprisingly few studies, however, have been made so far of the breeding ecology of the Far East Asian mustelids. It is a matter of great importance, therefore, to describe fully the breeding behavior of poor-known species in order to advance field studies of Asian mustelids.

The Japanese marten (Martes melampus) is widely distributed on the Japan Islands, and on the Korea Peninsula (Anderson 1970). The Tsushima marten (M. melampus tsuensis), which has a rather darker colored pelt than the martens on Japan's main islands, is recognized as an endemic subspecies occurring only on the islands of Tsushima lying between Kyushu and the Korea Peninsula (Abe and Ishii 1987). Previous studies of Tsushima martens have been concerned with their natural history and conservation (Asahi and Okuhama 1971, Urata and Yamaguchi 1976, Tatara 1988, Urata 1991). Recently Tatara and Doi (1991a, 1991b), and Tatara (in press) have reported details of the ecological status of Tsushima martens including their distribution, home range use, activity patterns, behavior and diet, and have proposed conservation plans for the Japanese marten on the Islands of Tsushima. The breeding pattern of the Japanese marten, however, has never been examined, though it is thought likely to resemble those of the American marten (Martes americana), the Eurasian pine marten (M. martes), and the sable (M. zibellina) because these four boreal forest Martes species are recognized as belonging to a "superspecies" (Anderson 1970, Powell 1982).

The purpose of the present paper is to clarify aspects of the breeding ecology of the Japanese marten on Tsushima, drawing on previous fragmentary information and recent observations on the breeding biology of the species. Observations of copulating behaviors of the Tsushima marten are also described. Furthermore, the physical and behavioral developments of hand-reared juvenile martens in captivity are reported.
The Annual Breeding Cycle

During previous home range studies of Tsushima martens, individuals were trapped so as to fit radio transmitters to facilitate tracking (Tatara and Doi 1991a, 1991b, Tatara, in press). Various measurements were made including those of testicle size of adult males. Testicle volumes were then estimated. The testes were found to start to enlarge during April, to regress again during November, and to show a peak in volume during July, presumably the most active rutting season (Fig. 1). During August, captured adult females sometimes had raw scratches on their backs. These were considered to have been made by males during copulation. In addition, adult females captured during this season were sometimes found to have the vulval enlargements and haemorrhages. Although more detailed physiological and veterinary methods (e.g., blood progesterone or testosterone levels) are required in order to establish the exact mating season of mammals, the fact that copulatory behaviors were observed during July and August serves as important evidence for late summer being the mating season of the martens. It is assumed that martens on Tsushima paired and copulated from late-July until mid-August (Fig. 2). Tsushima martens are likely only to copulate on a few days during this period, because estrus in most female Martes spp. continues for only 1-7 days (Mead 1991).
The mating season for the boreal forest marten species has been identified as occurring from early-June to late-August (Mead 1989, in press). The extent of the variation may be as a result of the seasonal variation in food availability and in the length of winters in different habitat types (Powell 1982). It is thought that the Japanese martens may also show a cline in mating season by latitude in relation to variation in local food resources and in the severity of the climate from the northern part of its range to the south.

The apparent gestation period was extremely prolonged, lasting approximately 235–250 days (Fig. 2). This is presumably due to long delay in implantation. The physiology and evolution of delayed implantation in mustelids have been discussed in detail by Mead (1989). The timing of blastocyst implantation in the Japanese martens may be controlled, as in other boreal Martes species (Mead 1991), by increasing photo-period. The post-implantation period (i.e., actual gestation) is likely to be approximately 28–30 days, as estimated from the body weight of the new-born at parturition (Imaizumi 1986).

All known births have occurred between mid-April and early-May (Fig. 2). Most Martes give birth to an average of three young (range 1–8) (Gittleman 1989, Mead 1989). However in the case of the Tsushima martens, all litters studied to date (n=9) and some other reported cases (e.g., Urata 1991) have involved only two young, although a lactating female has been captured with four enlarged nipples. The growth patterns of Japanese martens under natural
conditions have not been studied yet, but the development of hand-reared young is described below.

Young martens may become independent during the summer just before the mating season (Fig. 2), although some observations (Tatara unpubl. data) indicate that they may stay in the maternal home range until the winter. The details of the dispersion of young martens have not been studied.

**Copulatory Behavior**

In the early evening of 10 August 1987, two adult martens were fortuitously observed copulating at the side of a farm track in the Tanohama area on the northwest coast of Tsushima. The martens were observed successively for 17 minutes from 17:52 to 18:09 with the aid of binoculars (×9) from inside a vehicle at a distance of approximately 15 m.

One of the martens, the presumed male, was estimated to be 1.5 times larger body size than the other, the presumed female. Studies of captured Tsushima martens, showing that males are significantly larger in body weight and in head and body length than females (Tatara and Doi 1991a; Fig. 4), support this assumption. When first observed the pair were already copulating, with the male mounted on the back of the female. The male was grasping the nape of the female with his mouth, moving his groin vigorously against the female's buttocks (Fig. 3a). During copulation the female was vocalizing, making "Grrr..., grrr..." noises.

The animals changed their position at 18:01, turning to face away from each other while still joined at the groin (Fig. 3b), adopting a posture that resembled the "copulatory tie" that is found widely among canids (Mech 1981). They continued to move, gradually dragging themselves in the direction that the female was facing. Eventually they separated, the female ran into the forest and was followed by the male. This change in behavior may have occurred as a result of disturbance caused by the observer, and the "tie" may have occurred accidentally because of the existence of a long, thick baculum found among male martens (Powell 1982).

In the early morning of 28 July 1990, in the Uchiyama area of south-central Tsushima, copulation was again observed by chance. On that occasion the copulatory behavior continued for 14 minutes and ended in a similar way to the first observation described above (Fig. 3a, 3b). Powell (1982) described that matings between fishers (Martes pennanti) on fur farms commonly lasted from one to seven hours. In considering this information, it is likely that the duration of copulation of Japanese martens is considerably longer than so far observed. However, the two observations reported here represent the first detailed descriptions of copulatory behavior of wild Japanese martens.
Juvenile Growth

Three male and four female young martens were obtained from Tsushima and reared in captivity. They were estimated to range in age from new born (days 0–1) to 25 days old when brought to me. Their ages were estimated by comparing their body weights against growth curves, obtained from both sexes, demonstrating successive developmental patterns from new born to asymptotic size (Fig. 4). The body weights of new born young were approximately 25–30 g for both sexes \( (n=4) \). New born martens were almost naked, covered with only fine, light gray hair, and had a white patch on the throat. They were completely helpless, and their eyes and ears were tightly closed. Their eyes opened on 13–22 days of age, and their ears opened on 10–28 days of age \( (n=5) \).
First tooth eruption of the upper incisors occurred on 17–23 days of age in all cases ($n=5$). Over the same period, the pelage changed to a brownish black color on the back and the hair on the throat patch turned creamy yellow. The deciduous canines erupted on 23–35 days of age ($n=6$). The young captive martens were completely dependent on milk (processed milk; "Esbilac", Borden & Co., Ltd.) until approximately one month old. Weaning of both sexes took place on 40–50 days of age ($n=6$; Fig. 4). Young from the same litter are presumably weaned simultaneously at approximately this age.

Sexual difference in body weight was already noticeable and pronounced by 60–80 days of age, after which males weighed significantly heavier than females. Both male and female juveniles acquired sufficient mobility for arboreal dwelling on 90–100 days of age ($n=3$). Young males grew asymptotically to reach the body size of adult males (ca. 1.5 kg, Tatara and Doi 1991a) by approximately 140 days, while young females reached adult weight (ca. 1.0 kg) by approximately 130 days of age (Fig. 4). All tooth eruptions and replacements were completed, and pelts attained the appearance of adult summer pelage by the time the individuals reached adult weight.

The young martens seemed not to require parental instruction in order to learn proper killing techniques. The hand-reared young were able to kill the prey they were given (e.g., insects, chicks, and mice) using typical adult–like techniques even when live prey was first presented to them. The young
attained the ability to forage for and kill prey on approximately 100–120 days of age, thus in the wild they might become independent from their parental cares as early as summer. Even after this season, however, the young remained fond of playing with their litter mates or even with live preys. Aggressive behavior among siblings and against other individuals appeared when they were around five months old, even where foods were abundant. Judging from the increasing conflict among individuals, it is presumed that young martens are likely to disperse from their maternal home range at least until the winter.

Mammalian breeding behavior is recognized as exhibiting flexibility under differing environmental conditions, thus, the details of the breeding ecology and behavior of Japanese martens may differ in other part of Japan, however, broad similarities may exist. In addition, factors affecting the occurrence of delayed implantation in the martens and its advantages deserve further examination from not only an ecological but a physiological point of view.

Acknowledgments

Special thanks go to Prof. Y. Ono, Dr. T. Doi, and other members of the Department of Biology, Kyushu University, for their helpful support and critical advice during this study. I also thank the many residents of Tsushima for their kindness and helpfulness during my field work. This study was partly supported by a Grant-in-Aid for Scientific Research (Nos. 03804053 and 05454615), and by the Studies for Natural Monuments on Tsushima Islands (1988–1990) from the Ministry of Education, Science and Culture, Japan.

References


