Development of Young and Parental Care of the Raccoon Dog
*Nyctereutes procyonoides viverrinus* TEMMICK, in Captivity*

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Abstract.
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Studied on the growth of young and parental care of the raccoon dog, *Nyctereutes procyonoides viverrinus* TEMMINCK, in captivity. Offspring weaned at 30 days old and developed their behaviour from 30 to 80 days old under parental care. Body weights of offspring reached adult size at 150 days old. They lived relatively independent at this time. The male took part of pup caring up to 80 days from delivery, but the female played a greater part of it.

Introduction

There are some studies of physical and behavioural development in the raccoon dog particularly on the sub-species, *Nyctereutes procyonoides ussuriensis*, in Ussurie and its European region (SEITZ, 1955; NOVIKOV, 1956; BANNIKOV, 1964; BARUBU, 1972). Very little, however, is known for the sub-species, *N. p. viverrinus*, in its original range. Recently, several studies have been published on the life-history pattern and the social organization among Canids (BEKOFF & JAMIESON, 1975; KLEIMAN & BRADY, 1978; BEKOFF et al., 1981). In these studies, it was suggested that the timing of independence of offspring and parental behaviour were closely related to the species' social organization.

Parental care of the offspring by both sexes was reported also on the raccoon dog by NOVIKOV (1956) and OKUZAKI (1979). However, the development of offspring and the length of pair bond have not been clarified yet. In this study, physical and behavioural development of young and some aspects of parental behaviour have been studied in captivity.

Methods

This study was made on one pair of the raccoon dog, both of which were captured in the wild range respectively at the age of 8 weeks (male) in 1978 and 4 weeks (female) in 1979, and reared in the separate cages. The pair was kept together in 6 m x 6 m outdoor enclosure surrounded by a wire fence since January, 1980. The enclosure was placed in the experimental field of the Kyushu University, Fukuoka, western Kyushu. A pet cage (60 cm x 43 cm x 43 cm) made of a wire mesh with a sliding door was attached to one side of the enclosure as a nestbox. Chicken meat was fed once every day at late afternoon. Commercial pet food (Vita-one, Japan Pet Food

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Co.), mice and liver were sometimes provided as supplemental foods.

Observations on the pair and the litter were made through the window of the keeper’s house or from the outside of the enclosure. A video-recorder (Hitachi Electric Co.) was also used for observation. Measurements of body weight and lengths of body parts of offspring were made at about weekly intervals after the time of delivery and the developmental changes in physical features e.g. eye opening, tooth eruption, day of weaning, etc., were recorded. Additional information on these and behavioural development was provided also from the litter of the other pair which was kept in another enclosure.

Results and Discussion

I) Physical Development of Offspring

Two males and three females were born to the pair as the first brood on May 15, 1980. One male and one female in this litter were separated from the parents at 42 days old on June 25 for hand rearing. The remaining three offspring were also separated from the parents in January, 1981 at the age of 9 months for accelerating successive breeding of this pair. In the next year, five offspring were born from the same pair on May 16, 1981. One offspring died one day after delivery with sex unknown and remaining four pups were two males and two females. Two males were born on May 20, 1982. Another pair gave birth also on June 18, 1981 to three males and one female.

a) Litter size, body weight and sex ratio

The data for these offspring are shown in Table 1 in comparison with other author’s findings. Sex ratios of the litters are about the same and it is not significantly different from unity, except for the data by OKUZAKI (1979). The body weight at birth was heavier, while litter size was smaller, in this study than those of the other studies. The body weights of the female at the time of delivery in the first and the second brood were 4.7 and 4.6 kg, respectively. Mammalian litter size tends to increase in number at higher latitude even within species (LOAD, 1960; SADLEIR, 1969). The difference in the litter size between present study and the others may be a reflection of this phenomenon.

b) Growth pattern

Measurements of body parts from birth up to 200 days old for three offspring

Table 1. Comparison of the litter size, body weight and sex ratio in two sub-species of raccoon dogs

<table>
<thead>
<tr>
<th>Sub-species</th>
<th>Litter size</th>
<th>Birth weight (g)</th>
<th>Sex ratio (♀/♂)</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. p. viverrinus</td>
<td>2- 5 (4.0)</td>
<td>105-115 (109.1)</td>
<td>1.46:1</td>
<td>present study</td>
</tr>
<tr>
<td></td>
<td>3- 5 (3.7)</td>
<td>—</td>
<td>2.75:1</td>
<td>OKUZAKI, 1979</td>
</tr>
<tr>
<td>N. p. assurienis</td>
<td>Original range</td>
<td>5- 7 (60- 90)</td>
<td>—</td>
<td>NOVIKOV, 1956</td>
</tr>
<tr>
<td></td>
<td>Introduced range</td>
<td>6- 8 (60- 90)</td>
<td>—</td>
<td>STROGANOV, 1962</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6- 7 (60-110)</td>
<td>1.04:1</td>
<td>BANNIKOV, 1964</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6-12 (9.0)</td>
<td>1.16:1</td>
<td>BARBU, 1972</td>
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</table>

( )=average
born in 1980 were fitted to the logistic equation initially. In this case, measurements of body weight and head and body length were not well fitted to the logistic equation because the body weight increased rapidly and head and body length increased rather slowly after 150 days old. So, the measurements up to 134 days old were applied for the analysis as the initial growth pattern of the offspring.

Fig. 1 shows the growth curve of body weight and the equation. The value of the logistic equation for the other body parts are shown in Table 2. Ratios of the values at the birth to the estimated K were 5.40, 18.18, 19.37, 23.17 and 30.39% of body weight, ear length, tail length, hind foot length and head and body length, respectively. The body weight as cubic measurement showed the smallest value than the other lengths of body parts as linear measurement.

The relative value in each age was plotted against age to compare the relative growth pattern of these body parts each other (Fig. 2). Head and body, hind foot and tail lengths showed similar growth pattern. Although ear length started with the smallest value among four body parts, it increased rapidly and exceeded the other three parts at the age of 35 days. Previous to this date, ear, head and body, hind foot and tail lengths exceeded a half of the K value (at about 30 days old). Body weight

![Fig. 1. Growth curve of body weight for three offspring of the raccoon dog. Dots show the measurements for each offspring. Growth curve was drawn by the estimation with the logistic equation.](image)

<table>
<thead>
<tr>
<th>Table 2. The values of the logistic equation for each body parts of the raccoon dog.</th>
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<tr>
<td>r</td>
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<tr>
<td>------------------------</td>
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<tr>
<td>Body weight</td>
</tr>
<tr>
<td>Ear length</td>
</tr>
<tr>
<td>Hind foot length</td>
</tr>
<tr>
<td>Head &amp; body length</td>
</tr>
<tr>
<td>Tail length</td>
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</table>
showed growth pattern similar to ear length. All of the body parts exceeded 90% of the K value at about 80–85 days old.

c) Eye opening, tooth eruption and the other developmental changes

Eye opening of the offspring occurred at 8–12 days old at about 250 g of weight. Tooth eruption began from upper incisor at 18 days old and all the milk teeth erupted at 20–30 days old. The milk teeth were changed with permanent teeth at about 100 days old. Weaning took place at the age of 30 days, nearly the same time of tooth eruption, while lactation lasted until 80 days. The data obtained in this study are in good agreement with other findings except for the lactation period (Table 3).

The offspring were born soft and blackish fur. This coat changed to both clear guard hair and under fur at the age of 30–40 days just at the time of weaning. Also the typical dark facial mask appeared at this age. The color pattern of the coat, cross-shaped pattern on the anterior part of the back and so on, appeared at the age of 50 days.

Play behaviour among the litter mates was observed to start after 20–25 days old initially, play was a form of biting each other. Before this first indication of play, the offspring were climbing on each other's and parents' body. Playing became more active and escalated day after day; running, jumping, wrestling and chasing each other.

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**Table 3. Day of eye opening, tooth eruption, weaning and lactation period in two sub-species of raccoon dogs.**

<table>
<thead>
<tr>
<th></th>
<th>Eye opening</th>
<th>Tooth eruption</th>
<th>Weaning</th>
<th>Lactation period</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>N. p. viverrinus</em></td>
<td>8–12</td>
<td>18–20–30</td>
<td>30</td>
<td>80</td>
<td>present study</td>
</tr>
<tr>
<td><strong>♀</strong></td>
<td>9–10</td>
<td>14–16–30</td>
<td>21–30</td>
<td>45–60</td>
<td>Bannikov, 1964</td>
</tr>
</tbody>
</table>
The offspring emerged from the nestbox on the same day (25 days old). Behaviour related to prey-capturing was observed after 35 days old, the young began to bite objects, shake their heads sideways and sometimes throw up the objects. This behaviour was followed by the raising up the tail, arching the back and then jumping onto the object. This was directed towards the litter mates at first and then later towards the parents. However this was observed infrequently in adults as Seitz (1955) also has reported already.

The raccoon dogs deposited their feces at certain sites, termed latrines (Ikeda et al., 1979), similar to animals like badger (Kruuk, 1978), dwarf mongoose (Rasa, 1973) and civet (Ewer & Wemmer, 1974; Bearder & Randall, 1978). Only one latrine was used by the mated pair in the enclosure. In early stages after birth, the offspring’s urine and feces were consumed by the parent. At the age of 47 days, offspring began to deposit the feces at the same latrine of their parent. The common use of latrine by parent and offspring lasted until the offspring were separated from the parents. The litter born in 1981 and 82 showed the same behaviour. Continued usage of the same latrine by both parent and litter appears to be a species-specific habit of the raccoon dog.

Fig. 3. An example for the interchanging of position of the parent at the nestbox in 1982. Horizontal lines show the time duration of the animal continued to stay inside or outside of the nestbox. Vertical lines show the animal went out or came into the nestbox. Arabic numerals in the figure are shown the age of offspring in day.
ii) Parental Care

Both female and male were observed to take care for their offspring. The male was standing and guarding the female at the time of delivery. When a pup was delivered, he licked the body of the newborn, and the female simply looked at the male licking the newborn. During the early days after delivery, the female stayed with the newborn young while the male brought food to her. Male usually sit in front of the nestbox during daytime. When female left the nestbox to take food for herself and/or other behaviour, male entered the box and took care the offspring (Fig. 3). Parent interchanged their position in case of the caring, and they did not leave their offspring alone till 30 days after delivery.

Amount of time for caring in the nestbox is shown in Fig. 4. Male took part of pup caring likewise female, but the degree of caring by male varied by day depending on weather conditions. Participation in caring for pup by the male also reported by Novikov (1956) and Okuzaki (1979). After when the pup emerged from the nest, both male and female took caring such as guarding and grooming. Frequency of grooming to pup by parent decreased after 80 days old of pup, and also association among the pups decreased remarkably at this time (unpubl. data). However the parent and offspring joined together for resting during the day even after this period, and offspring could remain with their parents till the next breeding season.

Thus the development of the offspring is composed of three stages. The first stage is the suckling from birth to 30 days old. Physical development takes place in this period. The next stage is the infant from 30 to 80 days when behavioural repertoires develop under parental care. And then there is the sub-adult stage. These three stages of the offspring correspond well to the developmental process of the crab-eating fox (Brady, 1978).

Fig. 4. Participation for caring by the parent calculated in percentage by time spent with offspring in the nestbox. Arabic numerals in the figure are shown the age of offspring in day.
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References

