


# CORPORA ALBICANTIA AND PLACENTAL SCARS IN THE HOKKAIDO BROWN BEAR

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*Abstract*: The ovaries and uteri of 25 wild adult female Hokkaido brown bears *(Ursus arctos yesoensis)*, killed by hunters during the March-May period from 1982 to 1986 in Hokkaido, Japan, were observed macroscopically and histologically for the presence of corpora albicantia (CA) and placental scars (PS). The numbers of CA, PS and young were compared. The female bears were classified into 4 groups: solitary females, females accompanied by their cubs, yearlings, or 2-year-old young. CA were classified into 3 types (I, II or III) based on the degree of degeneration. Of the 3 types, only Type I CA were regarded as formed recently. PS were classified into 2 types (new or old) according to size. The relationship among numbers of Type I CA, PS and young was examined for each group of females. Type I CA and new PS were observed in some solitary females. These findings may mean the occurrence of embryo loss during delayed implantation, abortion after placentation, and/or death of young after birth.

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The age of sexual maturity and the reproductive rate are factors influencing population dynamics. Although some of these data have been published for the Ursidae (Hensel et al. 1969, Craighead et al. 1976, Herrero 1978), few reports exist on this topic for Hokkaido brown bears.

Examinations of the reproductive organs provide important information on the reproductive functions of animals (Japanese serow, *Capricornis crispus*: Kita et al. 1983; Columbian black-tailed deer, *Odocoileus hemionus columbianus*: Thomas and Cowan 1975; fur seal, *Callorhinus ursinus*: Yoshida 1982; Uganda defassa waterbuck, *Kobus defassa ugandae*: Spinage 1969; wildebeest, *Connochaetes taurinus albojubatus*: Watson 1969; African elephant, *Loxodonta africana*: Laws 1969) In female brown (*Ursus arctos*) and black bears (*U. americanus*), many examinations of the reproductive organs have been reported (Wimsatt 1963, Erickson and Nellor 1964, Hensel et al. 1969, Kordek and Lindzey 1980).

In this study, we observed corpora albicantia and placental scars and discuss the relationship between the number of these and accompanying young. Hensel et al. (1969) confirmed that placental scars remained as evidence of birth in the uterine lumen of grizzly bears. Erickson and Nellor (1964) also stated that the number of young carried to term could be determined during the following lactation and post-lactation period by the presence of recent placental scars, which provided a means of measuring reproductive success in bears. However, corpora albicantia have not been observed in detail on bears. The purpose of this study was to resolve how frequently the success or failure of reproduction occurred in wild conditions by comparing the numbers among corpora albicantia, placental scars and young in Hokkaido brown bears.

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## MATERIALS AND METHODS

Ovaries and uteri were collected from 25 wild adult female Hokkaido brown bears killed by hunters during the March-May period from 1982 to 1986 in Hokkaido, Japan. When hunters called, we went to some regions to get the cranial bones and reproductive tracts. We also gathered information on shooting site, date and time of death, presence or absence of young, age of young and so on. The age of individual bears, including young killed with their mothers, was determined by examination of the canine teeth following Yoneda's (1976) method. Female bears were classified into 4 groups according to the presence or absence and the age of young: solitary females, females accompanied by their cubs, yearlings, or 2-year-old young. The ovaries were fixed in 10%

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formaldehyde and embedded in paraffin wax. Thereafter, they were sectioned longitudinally at 5 μm every 2 mm and stained with Haematoxylin – eosin and Weigert's resorcinfuchsin – Masson trichrome for histological observations. The endometrium of both uterine horns was observed macroscopically to determine the presence or absence of placental scars.

## RESULTS

Corpora albicantia (CA) were classified into 3 types by structural components: Type I, the presence of degenerating luteal cells, septum and numerous blood vessels surrounded by many layers of elastic fibers; Type II, the disappearance of the degenerating luteal cells from the above components; Type III, the presence of only the numerous blood vessels. The degenerating luteal cells present in Type I CA stained green with Masson trichrome and were characterized by concentration or collapse of the nucleus. However, the whole shape of the CA remained that of the corpus luteum and was separated from adjacent tissues by a distinct boundary. The septa were stained green with Masson trichrome. The elastic fibers, increasing in the wall of the blood vessels in the corpora albicantia, stained purple with Weigert's resorcinfuchsin. The mean number of Type I CA per individual was 1.64 in 14 females that had at least 1 CA.

Red-brown placental scars (PS) were observed in the uterine horn of 16 females. They were classified into 2 types according to their width: new (about 5-10 mm) or old (about 2 mm). The mean number of PS per animal was 1.76 for those animals that had at least 1 PS. Bears that had both new and old placental scars were considered to have had 1 cub birth in 2 parturitions.

The numbers of Type I CA, PS and young are shown by each group in Table 1. In solitary females, Type I CA were present in 8 of 10 bears and new PS were seen in 2 of the 8 females. In females accompanied by their cubs of the year, the number of Type I CA, new placental scars and young coincided with one another in 4 of 6 bears examined, but 1 (No. 16) of these 4 females had an old PS; in No. 13, an extra Type I CA was present, while in No. 14 no Type I CA were found. In the females accompanied by their yearlings, Type I CA were absent (Type II CA were present) and the numbers of old PS and young coincided with each other in 4 (Nos. 18, 19, 21 and 23) of 7 bears. More PS than the number found in yearlings were detected in 2 (Nos. 17 and 20) of the remaining 4 bears. The remaining female (No. 22) had no PS. Female No. 23 showed the presence of Type I CA as well as Type II. In 2 females accompanied by their 2-year-old young, old PS were seen in one (No. 24) but not in the other (No. 25).

## DISCUSSION

The characteristics of corpora albicantia (CA), which have been described in previous reports (cow: Miyagi 1966; pig: Yamashita 1959; fur seal: Okamoto 1969; Japanese serow: Kita et al. 1983), were the change of luteal cells, the increase of elastic fibers in the walls of blood vessels and the presence of septa. CA that had similar characteristics were observed in Hokkaido brown bears. However, in the present study, CA that did not show the change of luteal cells or the presence of septa (Type II and III) were observed, too. Three types of CA showed differences in the degree of degeneration, which was demonstrated by the disappearance of luteal cells and

**Table 1. The number of corpora albicantia, placental scars and young in adult female Hokkaido brown bears.**

| Classification of female bears | Bear No. | Age | No. of corpora albicantia[a] | | | No. of placental scars | | No. of young |
|---|---|---|---|---|---|---|---|---|
| | | | I | II | III | new | old | |
| Solitary | 1 | 2 | 1 | + | - | 0 | 0 | 0 |
| | 2 | 4 | 2 | - | - | 0 | 0 | 0 |
| | 3 | 4 | 1 | - | - | 0 | 0 | 0 |
| | 4 | 4 | 2 | - | - | 2 | 0 | 0 |
| | 5 | 4 | 1 | - | - | 1 | 0 | 0 |
| | 6 | 5 | 0 | + | - | 0 | 0 | 0 |
| | 7 | 6 | 2 | + | - | 0 | 0 | 0 |
| | 8 | 8 | 2 | + | - | 0 | 0 | 0 |
| | 9 | 8 | 2 | + | + | 0 | 2 | 0 |
| | 10 | 22 | 0 | + | + | 0 | 0 | 0 |
| Accompanied by cubs | 11 | 5 | 1 | - | - | 1 | 0 | 1 |
| | 12 | 5 | 2 | + | + | 2 | 0 | 2 |
| | 13 | 8 | 2 | + | - | 1 | 0 | 1 |
| | 14 | 9 | 0 | + | + | 2 | 0 | 2 |
| | 15 | 11 | 2 | + | + | 2 | 0 | 2 |
| | 16 | 14 | 1 | + | + | 1 | 1 | 1 |
| Accompanied by yearlings | 17 | 6 | 0 | + | - | 0 | 2 | 1 |
| | 18 | 10 | 0 | + | - | 0 | 2 | 2 |
| | 19 | 11 | 0 | + | + | 0 | 3 | 3 |
| | 20 | 11 | 0 | + | + | 0 | 2 | 1 |
| | 21 | 12 | 0 | + | + | 0 | 2 | 2 |
| | 22 | 17 | 0 | + | - | 0 | 0 | 2 |
| | 23 | 23 | 2 | + | - | 0 | 2 | 2 |
| Accompanied by 2-year-old young | 24 | 18 | 0 | + | + | 0 | 2 | 2 |
| | 25 | 25 | 0 | + | + | 0 | 0 | 1 |

[a] The presence (+) or absence (-) is shown for Type II and III corpora albicantia.

septa. Type I CA were suspected to be the remnants of the corpora lutea formed during the last mating season, and to become Type II with the disappearance of luteal cells. Similarly, Type II CA may become Type III with the disappearance of septa. The exact length of time during which these changes take place is not yet clear.

Type I CA were not observed in 1 (No. 14) of 6 females accompanied by their cubs. The date of death of this female was similar to that of the other females. Although the date of parturition was not investigated, corpus luteum may have degenerated rapidly and changed into Type II CA at the time of death (Type II CA (+): Table 1). The individual differences in the degenerative rate of CA should be further investigated.

We concluded that new placental scars were formed during the most recent conceptive period while older scars resulted from pregnancies that occurred 1 or 2 years before the bears' death. New PS were observed in the uterine horns of the females accompanied by cubs of the year and old PS in the uterine horns of females accompanied by yearling or 2-year-old young. No old placental scars, however, were observed in 1 (No. 22) of the 7 females accompanied by their yearlings or in 1 (No. 25) of the 2 females accompanied by their 2-year-old young. The dates of death of the 2 bears were similar to those of the other bears. In these bears the PS probably disappeared rapidly.

Type I CA but no PS were observed in 6 of 10 solitary females. Also, in 1 female (No. 13) accompanied by her cubs, there were extra Type I CA in comparison with the number of new PS and young. In these bears, the ovum may have been lost before the placenta was formed, or an abortion may have occurred before the placenta had developed sufficiently to cause the formation of PS. The phenomenon of ovum loss might relate closely to the reproductive physiology of bears with the unattached embryo lying free in the uterine lumen for considerable time because of delayed implantation in the Hokkaido brown bear (Tsubota et al. 1987). In the 6 solitary females with CA but no PS, we hypothesize that embryo loss may have occurred during the delay period between fertilization and implantation.

In 2 (Nos. 4 and 5) of 10 solitary females, Type I CA and new PS were present and their numbers coincided with each other. The cubs of these 2 females might have died after parturition, or abortion might have occurred after placentation. In 2 females (Nos. 17 and 20) accompanied by their yearlings, a larger number of PS than yearlings was noted. In these 2 females, abortion after placentation might have occurred, or the young might have died within a year postpartum.

Both new and old PS were observed in a female (No. 16) accompanied by her cub. In this female, parturition may have occurred 1 or 2 years before the investigation. If it occurred 1 year earlier, the young presumably died, and during the mating season of the year of death, ovulation occurred and resulted in the birth of a cub. Otherwise, if parturition occurred 2 years earlier, the young probably died or was weaned by the mating season of the next year, when the female copulated again.

Two Type I CA and 2 old PS were present in a female (No. 23) accompanied by her 2 yearlings. Generally, no copulation occurs during the period when bears are accompanied by their young (Hensel et al. 1969, Craighead et al. 1969). Type I CA were absent in the 6 other females accompanied by yearlings. It is considered that ovulation is hormonally inhibited by the stimulation of lactation in the females accompanied by their young. In female No. 23, the ovulation was probably not inhibited since her young (yearlings) had already been weaned and had eaten wild food.

We concluded that the number of Type I CA indicated the number of ovulations. The mean number of ovulations was 1.64 in 14 females in which Type I CA were observed. The number of PS corresponded to the number of implantations. In 16 females in which new and/or old PS were observed, the mean number of implantations was 1.76. The mean number of young was 1.67 in the 15 females accompanied by their young.

In the present study, the age of Type I CA could be determined but not Type II and III. If the time during which the corpus luteum degenerated into Type II and III CA were known, the reproductive cycle would be better understood. Our observations suggested the occurrence of embryo loss during delayed implantation, abortion after placentation and/or death of young after birth. The occurrence of these phenomena in wild populations may have a strong influence on realized reproductive rates and is a subject for future investigations.

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