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# Some Observations on the Reproduction of the Taiwan Ferret Badger (*Melogale moschata subaurantiaca*) in Southern Taiwan

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**Kurtis Pei and Ying Wang (1995)** Some observations on the reproduction of the Taiwan ferret badger (*Melogale moschata subaurantiaca*) in southern Taiwan. *Zoological Studies* **34**(2): 88-95. Taiwan ferret badgers (*Melogale moschata subaurantiaca*) were collected every month from 1991 to 1993 in southern Taiwan with a total of 238 specimens altogether. Post-mortem examination showed that their reproductive systems are typical of the Canoideas group and are symmetrical. Most adult males produced sperm from February to September, and almost all pregnant females were found between March and October. Newly independent males were collected between August and January. A weak synchronization in females' reproductive rhythm was observed. Litter size for the species is two, and evidence suggests that they breed once a year.

**Key words:** Breeding season, Lactation period, Litter size, Mustelidae, Reproductive system.

Ferret badgers (genus *Melogale*) are small-sized carnivores belonging to Family Mustelidae, which is distributed widely in southern China and south-eastern Asia. The genus is now being divided into three species, i.e., *M. moschata* (the small-toothed or Chinese ferret badger), *M. personata* (the large-toothed ferret badger), and *M. everetti* (the Borneo ferret badger). They are all fossorial and live in preexisting holes rather than digging new ones themselves (Taylor 1989). They are nocturnal and feed primarily on small animals such as insects, earthworms, snails, frogs, and, sometimes, carcasses of small birds and mammals, eggs, and fruits (Chian and Sheng 1976, Long and Killingley 1983, Ewer 1985, Neal 1986, Chuang 1994).

Widespread deterioration of the natural habitat and possibly also intensive rodent control programs during the past few decades have significantly reduced the number of native predators in Taiwan. This, in effect, has magnified the importance of the Taiwan ferret badger (*M. moschata subaurantiaca*) in lower to middle elevation forests, for, unlike other carnivores, this species is still common in these areas (Wang 1986). The local Aborigines reported that this species breeds during June-July and females give birth to two young in September-October (Kano 1929). However, the Chinese ferret badger is reported to breed in March and give birth in May and June in mainland China with a usual litter size of two to four (Zheng 1987) or four to five (Lu 1964, Deng 1984, Shie et al. 1988). This report documents some preliminary observations on the reproductive biology of the ferret badger inhabiting southern Taiwan.

## MATERIALS AND METHODS

Two hundred and thirty-eight Taiwan ferret badgers were trapped from Shih-tzu Hsiang, Ping-tung County, between 1991 and 1993 (Table 1).

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**Table 1.** Numbers of Taiwan ferret badger (*Melogale moschata subaurantiaca*) collected from Shihtzu Hsiang, Pingtung County, Taiwan, from 1991 to 1993

| | Month | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Total |
| Adult males | 12 | 5 | 5 | 18 | 32 | 13 | 11 | 4 | 4 | 1 | 2 | 5 | 112 |
| Immature males | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 3 | 5 | 5 | 21 |
| Females | 15 | 4 | 5 | 14 | 16 | 10 | 5 | 1 | 6 | 7 | 6 | 16 | 105 |

Carcasses were wrapped in plastic bags and kept frozen at −24 to −28°C until they were defrosted and examined at room temperature. Body weight was measured to the nearest 0.5 g for each specimen. The nipple status of females (regular or enlarged) was recorded, and the scrotal length of males (the distance from the anterior end of the baculum to the posterior end of the scrotum) was measured to the nearest 1 mm. A preliminary analysis showed that the increase in body weight of male Taiwan ferret badgers began to level off when scrotal length reached 30 mm. Therefore, males with scrotal lengths shorter than 30 mm were considered to be immature in this study.

The length and width of the uterine horns and genital tracts (from the tip of the septum in the corpus uterus to the external vaginal orifice) of females, except for pregnant or post-partum individuals, were measured in situ to the nearest 0.02 mm. Ovaries were weighed to the nearest 0.001 g. Ovaries were measured to the nearest 0.02 mm in three directions (length, width, and depth) perpendicular to one another, and the product of these three measurements was used to represent the ovarian volume. In this report, a "pregnant" female represents an animal which had a fetus(es) or had a significantly swollen reproductive tract; a "post-partum" female represents an animal with enlarged nipples (greater than 4 mm in length) and/or a loose uterine horns. Post-partum females were either lactating or had just weaned their young.

Testes (with epididymides attached) were weighed and measured as described above for the ovaries. In addition, 59 males (50 adults and 9 immatures) were selected randomly for microscopical examination for the presence of sperm. The testes and epididymides were fixed in AFA solution (5 parts glacial acetic acid, 5 parts 40% formaldehyde, and 90 parts 70% ethyl alcohol; Mosby and Cowan 1969) immediately after measurement and sectioned later serially at 6-8 microns and stained with Hematoxylin and Eosin (Humason 1979).

## RESULTS

### Males

The accessory glands of male's reproductive system are lacking in seminal vesicles and Cowper's (bulbo-urethral) glands. The penis is attached to the abdomen along its longitudinal axis with the distal end pointing forward, and the baculum is covered only by a thin layer of muscular erectile tissue. The glans is smooth without horny spines. The baculum is pyramidal, thick at the proximate end narrowing gradually toward the distal end, and it diverges into 3 stamen-like branches at the tip (Fig. 1). The baculum size and the degree of ossification at the proximate end, as well as the conspicuousness of the divergences, increase as the animal grows older.

No significant differences exist between the right and left testes either in weight ($t = -0.84$, $df = 254$, $p > 0.1$) or volume ($t = -0.87$, $df = 254$, $p > 0.1$). In adult males, the sizes of testes of sperm-producing individuals were significantly greater than those of sperm-free individuals (Table 2). However, there was also considerable overlap in testes size between these two groups. For example, the smallest sperm-producing testes, collected in September 1992, weighed 1.43 g (weight ratio = 1.60), while the largest sperm-free testes, collected in May 1991, weighed 3.85 g

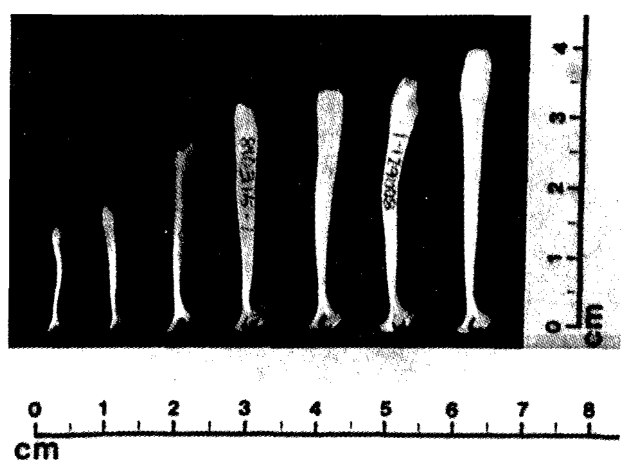


**Fig. 1.** Baculums of the Taiwan ferret badger (*Melogale moschata subaurantiaca*). Notice the changes in size and the appearance of both ends.

(weight ratio = 5.41). The scrotal lengths for these two males were 45 and 49 mm, respectively. Therefore, testes size by itself is not a good indicator of the spermatogenic activity of testes in this species.

The average testis size showed significant monthly changes for adults (ANOVA, $df = 11, 115$; weight ratio: $F = 32.4$, $p < 0.001$; volume ratio: $F = 23.3$, $p < 0.001$). Monthly averages of both the weight and volume ratios for the testes of adults began to increase significantly in February and continued to increase slightly afterwards until May. The size decreased noticeably in August-September, reached the lowest level in October and maintained this level until January (Fig. 2). Parallel results were derived from the microscopic examination of adult testes, i.e. sperm-producing males were found from January to September. Moreover, 86% of males (6 of 7) examined histologically in the period between October and January were sperm free, while only 7% (3 of 42) examined between February and September were sperm free.

Immature males (i.e., scrotal length shorter than 30 mm, $n = 21$) were found exclusively between August and January, and fifteen (71%) of these were concentrated in November to January (Fig. 3). None of the testes of the nine immature males examined histologically contained sperm.

## Females

There are two pairs of nipples located in the abdominal area in this species. The uterus is bipartite, and the placenta is the zonic type. The average length and width of the genital tract for 65 females were 31.87 mm (SD = 4.85) and 3.96 mm (SD = .80), respectively. Other measurements of the female reproductive tract are given in Table 3. The right uterine horn is significantly longer than the left horn.

The sizes of the right and left ovaries were not significantly different for any females regardless of their reproductive status (Table 3). There were

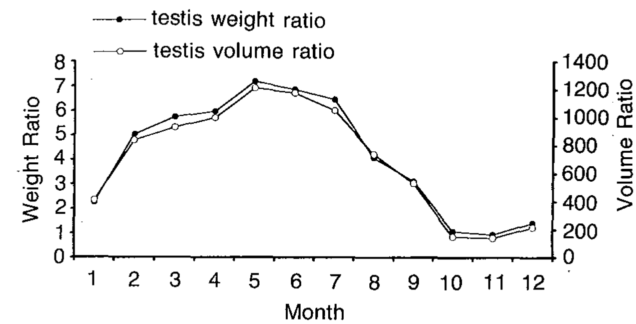


**Fig. 2.** Monthly changes of the average weight ratio and volume ratio of the testes of adult Taiwan ferret badger (*Melogale moschata subaurantiaca*) in southern Taiwan. Sample size for each month is given in Table 1.

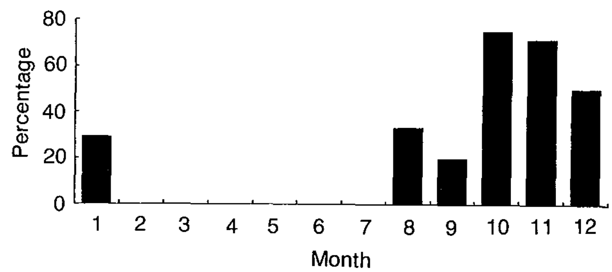


**Fig. 3.** Frequency distribution of immature male vs. total male Taiwan ferret badger (*Melogale moschata subaurantiaca*) by month in southern Taiwan. Sample size for each month is given in Table 1.

**Table 2.** Comparison of testicular sizes between sperm-producing and sperm-free males of the Taiwan ferret badger (*Melogale moschata subaurantiaca*)

| | sperm-producing ($n=39$) | | sperm-free ($n=9$) | | |
|---|---|---|---|---|---|
| | mean | SD | mean | SD | $t$-value[a] |
| Testis weight (g) | 3.65 | .83 | 2.03 | .88 | 5.22*** |
| Testis volume ($mm^3$) | 6,159.2 | 1,625.5 | 3,056.8 | 1,520.1 | 5.30*** |
| Testis weight ratio[b] | 4.61 | 1.05 | 2.76 | 1.56 | 4.34*** |
| Testis volume ratio[c] | 77.8 | 20.7 | 40.8 | 23.6 | 4.71*** |

[a]Values generated by 2-tailed $t$-test; *** $p<0.001$.
[b](testis weight/body weight)×1000
[c](testis volume/body weight)×10

also no differences in ovarian dimensions between pregnant and non-pregnant females (Table 4). Furthermore, although both the average monthly weight and volume ratios of the ovaries showed two peaks in May-June and August-September (Fig. 4), the monthly changes were not significantly different (ANOVA, $df$ = 11, 92; weight ratio: $F$ = 1.84, $p > 0.05$; volume ratio: $F$ = 1.68, $p > 0.05$).

Pregnant females were found between January and October. Their numbers were relatively constant in proportion to the total monthly samples (range: 33%~50%) from March through September, except August (Fig. 5). The absence of pregnant females in August apparently was due to only one specimen being collected that month. Seventeen post-partum females were recorded in this study, of which fifteen (88%) were collected from August to December (Fig. 5). High proportions of non-pregnant females were found in every month except for August and September, when all samples collected were either pregnant or in the post-partum stage. The proportion of non-reproductively active females was highest in January-February (Fig. 5). Fetuses in different developmental stages were discovered in the uteri of five females and fetal litter size was two in

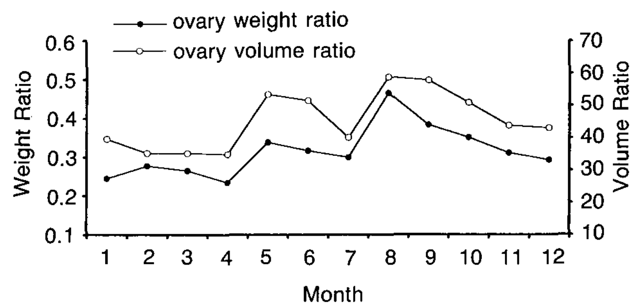


**Fig. 4.** Monthly changes of the average weight ratio and volume ratio in ovaries of the Taiwan ferret badger (*Melogale moschata subaurantiaca*) in southern Taiwan. Sample size for each month is given in Table 1.

**Table 3.** Measurements of the reproductive tracts of female Taiwan ferret badgers (*Melogale moschata subaurantiaca*)

| | | Right | | Left | | |
|---|---|---|---|---|---|---|
| | *n* | mean | SD | mean | SD | *t*-value[a] |
| Uterine Horn Length (mm) | 65 | 28.42 | 4.71 | 26.62 | 4.6 | 2.21* |
| Uterine Horn Width (mm) | 65 | 3.16 | .84 | 3.22 | .76 | −.40 |
| Ovary Weight (g)[b] | 72 | .0755 | .0299 | .0835 | .0308 | −1.58 |
| Ovary Volume ($mm^3$)[b] | 72 | 115.16 | 53.86 | 120.49 | 49.74 | −.62 |
| Ovary Weight (g)[c] | 32 | .0783 | .0252 | .0837 | .0281 | −.811 |
| Ovary Volume ($mm^3$)[c] | 32 | 117.93 | 44.72 | 131.66 | 54.88 | −1.10 |

[a]Values generated by 2-tailed $t$-test; * $p<0.05$.
[b]Ovaries of non-pregnant females.
[c]Ovaries of pregnant females.

**Table 4.** Comparison of the ovarian size between pregnant individuals and non-pregnant females of the Taiwan ferret badger (*Melogale moschata subaurantiaca*)

| | pregnant ($n$ = 32) | | non-pregnant ($n$ = 72) | | |
|---|---|---|---|---|---|
| | mean | SD | mean | SD | *t*-value[a] |
| Ovary weight (g) | .1619 | .0515 | .1589 | .0595 | −.246 |
| Ovary volume ($mm^3$) | 249.6 | 96.3 | 235.7 | 98.0 | −.673 |
| Ovary weight ratio[b] | .2093 | .0640 | .2104 | .0763 | .028 |
| Ovary volume ratio[c] | 3.2 | 1.1 | 3.1 | 1.2 | −.502 |

[a]Values generated by 2-tailed $t$-test.
[b](ovary weight/body weight)×1000.
[c](ovary volume/body weight)×10.

every case. Both uterine horns were used equally for fetus implantation ($t = -1.41$, $df = 8$, $p > 0.1$).

## DISCUSSION

The reproductive anatomy of the ferret badger resembles that of other members of the Canoideas group (i.e., dog-like carnivores). Male ferret badgers have a conspicuous bony structure (the baculum) within the penis and lack of the seminal vesicles and Cowper's glands, as well as a well developed prostate gland near the junction of the vasa deferentia and urethra. Females have a bipartite uterus and a zonary placenta. Furthermore, the development and function of the reproductive organs are bilaterally symmetrical. The present study determined that the right uterine horn is slightly longer than the left horn but this causes no difference in their function regarding fetus implantation. Since the uterine horns were measured in situ, the difference in length between the two horns may not be a true structural feature of the species, but may simply be due to a minor difference in the way the two horns are attached within the abdominal cavity.

Based on the information collected in the present study, the breeding season of the Taiwan ferret badger in southern Taiwan begins as early as January. However, according to the size of the testes and the proportion of pregnant females in the population , the population does not become fully reproductively active until February-March. Testes remained active in spermatogenesis until August-September but all male ferret badgers were in a reproductively quiescent phase from October to December. However, the majority of males exhibited a longer non-reproductive period from September to January (Fig. 2). During the quiescent period, spermatogenesis ceases and testes were about one-half the size as in the breeding season (Table 2). The period of active spermatogenesis also correlated closely with the occurrence of pregnancy in females, mainly March to October (Fig. 5). This is as expected, because, unlike many other Mustelidae, ferret badgers do not exhibit delayed blastocyst implantation or other developmental delays during the gestation period (Long and Killingley 1983, Mead 1989).

According to records on captive animals, the gestation period of the Chinese ferret badger is 57-80 days (Shie et al. 1988). Because the majority of pregnant females were found during March-October in the present study, the major parturition period for the studied population should therefore fall between May-June until November-December (a period as long as six to eight months). This period not only starts four months earlier but also persists much longer than what was previously reported by the Aborigines (i.e., September-October; Kano 1929). However, most Aborigines in Taiwan concentrate their hunting activities, hence the greatest opportunity for handling animals, is in the winter (Wang 1986). So, this difference probably does not represent an interpopulation variation, but is simply due to imperfect knowledge on the part of the Aborigines. On the other hand, there is no clear explanation so far for the significant

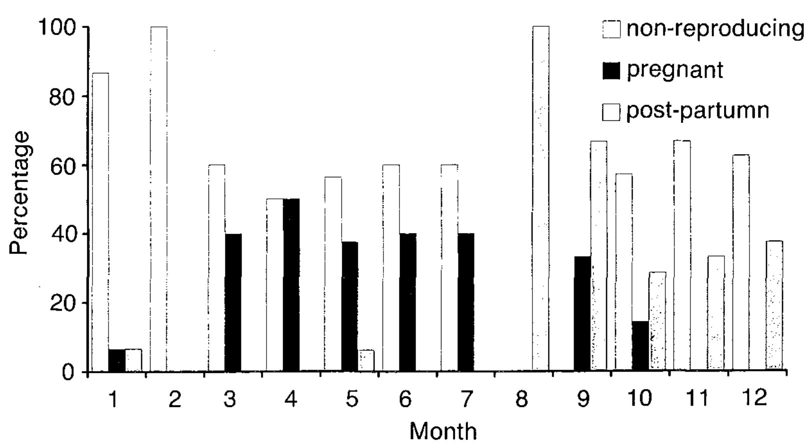


**Fig. 5.** Monthly distribution of the percentages of non-reproducing females, pregnant females, and the post-partum females in the population of the Taiwan ferret badger (*Melogale moschata subaurantiaca*) in southern Taiwan. Sample size for each month is given in Table 1.

difference between the parturition season reported here for the Taiwan ferret badger and that for the Chinese ferret badger in mainland China (e.g., Lu 1964, Deng 1984, Zheng 1987, Shie et al. 1988). Limited observations, as cited in the above mentioned references, for the Chinese ferret badger might partially explain such a difference.

Additionally, despite the seven- to eight-month breeding (= sperm-producing) season exhibited by males, as observed in the present study, and the short gestation period for the species, there is no evidence that females produce more than one litter per year. Furthermore, because the number of immature and sexually quiescent males in the population peaked once in October-December (Fig. 3), female ferret badgers apparently produce only one litter in one year, thus agreeing with observations from captive animals (Shie et al. 1988). The fact that only one-third to one-half of females were pregnant during each month of March-July and September, and probably also in August, indicates that there is only weak synchronization of the annual females' reproductive rhythm within the population. Since lactating or recently post-lactational females were found throughout the winter, followed almost immediately by initiation of reproductive activity in males, female ferret badgers can probably breed continuously without a long lasting non-reproductive period as in the male. The presence of reproductive females, including those bearing and nursing young, throughout the year also indicates that there should be only a limited seasonal environmental restriction on females' reproductive performance. However, because reproduction is an energetically expensive process for females (Gittleman and Thompson 1988, Oftedal and Gittleman 1989), it would be interesting to know whether or not the breeding history in the previous year has any influence on the breeding performance in the following year for females. Detailed studies on the ovarian cycle of the species are currently underway by the authors.

The reason for the existence of a non-reproduction season in males during winter is unclear, based on available information. Typically drought conditions prevail during the winter in southern Taiwan. This probably has a negative influence on the activity and abundance of insects, earthworms, and frogs (Hsueh-Wen Chang, per. comm.), thus decreasing the ferret badger's food supply and resulting in a lower nutritional and energetic level for the animal. This is one possible explanation for the cessation of sperm production during winter. Many studies have shown that there is a detrimental effect of food restrictions on spermatogenesis in immature, and, to a lesser extent, in adult male rats (Srebnik et al. 1978, Aguilar et al. 1984, Bazzarre 1984, Glass et al. 1984, Bronson 1989). Whether this is also true in male ferret badgers needs to be confirmed.

If seasonal malnutrition regularly occurs in males in winter, one might expect that females in this area should also cease their reproductive activity at the same time, since the energetic requirements for female reproduction are also great. However, as mentioned earlier, females' reproductive performance, as indicated by the present study, is not limited significantly by seasonal environmental (e.g., food) restriction. Other factors must be involved in this intersexual variation of the seasonality of reproduction of the ferret badger in southern Taiwan. Further studies on the ferret badger should not only examine the possibility of seasonal variations in their food intake, but should also provide information on other factors (i.e., behavior, physiology, photoperiod...etc.) which may influence their reproductive performance. Sexual dimorphism is a common feature in the Mustelidae (Harris 1968, Van Zyll de Jong 1972, Moors 1980, Roest 1985, Wiig 1986 1989, Estes 1989, Polecha 1991, Lynch and O'Sullivan 1993), and a significant difference in body size exists in the ferret badger (K. Pei, unpubl. data). Such intersexual size differences have been considered and indirectly proved to be driven partially by resource (i.e., food) partitioning between the two sexes (Kruuk and Moorhouse 1990, Lynch and O'Sullivan 1993). Therefore, the possibility of food partitioning exists between male and female ferret badgers, and its impact on reproduction should not be overlooked.

No effort was made in the present study to investigate the duration of lactation or parental care in this species. The fact that immature males, presumably having just been weaned or recently left their nests, occurred for first time in August (Fig. 3), which is two to three months after the initiation of the major parturition period estimated above, suggests that young of this species become independent at the age of two to three months. This is similar to what was reported for the Chinese ferret badger (Zheng 1987).

Litter size (= two) of the Taiwan ferret badger reported here is the same as that reported by Kano (1929), but it is lower or at the low end of the range for the Chinese ferret badger (Lu 1964, Deng 1984, Zheng 1987, Shie et al. 1988). More information is necessary before meaningful comparisons can be made.

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# 南部臺灣鼬獾(*Melogale moschata subaurantiaca*)生殖現象之初探

裴家騏[1] 王穎[2]

由1991到1993年，共檢視238隻在南部採集到的臺灣鼬獾(*Melogale moschata subaurantiaca*)。本種具典型的犬超科動物(*Superfamily Canoideas*)生殖器官，且左右對稱。資料顯示，大多數的成年雄性鼬獾在每年的二至九月間生產精子具生殖能力，而懷孕的母鼬獾則多出現在三到十月。由八月到隔年的一月可見到剛獨立生活的幼年雄獸。同一族群中雌性鼬獾的生殖週期無明顯的集中現象。台灣鼬獾每胎的產仔數爲 2，同時，證據也顯示本種應該是一年只產一胎。

關鍵詞：繁殖季節, 哺乳期, 產仔數, 貂科, 生殖系統。

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