

- ELLERMAN, J. R.; MORRISON-SCOTT, T. C. S. (1951): Checklist of Palaearctic and Indian mammals, 1758—1946. London; Brit. Mus. (Nat. Hist.).
- FRASER, F. C. (1966): Comments on the Delphinoidea. Pp. 7—31. In: Whales, dolphins and porpoises (K. S. NORRIS, ed.). Berkeley and Los Angeles. Univ. Calif. Press, 789 pp.
- FRASER, F. C.; PURVES, P. E. (1960): Hearing in cetaceans—Evolution of the accessory air sacs and the structure and function of the outer and middle ear in recent cetaceans. Bull. Brit. Mus. (Nat. Hist.) Zool. 7, 1—140.
- HERSHKOVITZ, P. (1966): Catalog of living whales. Bull. U. S. Nat. Mus. 246, 1—259.
- MIRANDA-RIBEIRO, A. DE. (1936): Notas cetológicas — (Os generos *Steno*, *Sotalia* e *Stenopontistes*) — Consideracoes sobre os generos "*Steno*" e "*Sotalia*". Bol. Mus. Nac. Rio de Janeiro. 12, 3—46 (in Portuguese and English).
- PILLERI, G.; GIHR, M. (1972): Contribution to the knowledge of cetaceans of Pakistan with particular reference to the genera *Neomeris*, *Sousa*, *Delphinus* and *Tursiops* and description of a new Chinese porpoise (*Neomeris asiaorientalis*). In: Investigations on Cetacea, (G. PILLERI, ed.). Vol. 4, pp. 107—162. Berne, Switzerland.
- SCHEFFER, V. B.; RICE, D. W. (1963): A list of the marine mammals of the world. U. S. Fish Wildlife Serv., Spec. Sci. Rep. Fish. 431, 1—12.
- TRUE, F. W. (1889): Contributions to the natural history of the cetaceans, a review of the family Delphinidae. Bull. U. S. Nat. Mus. 36, 1—191.

Author's address: ROBERT L. BROWNELL, Jr., Research Collaborator, Department of Vertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D. C. 20560, USA

Copulatory behavior, gestation and parturition of the tayra (*Eira barbara* L., 1758)

By I. POGLAYEN-NEUWALL

Receipt of Ms. 5. 8. 1974

Introduction

In the extensive literature on members of the family Mustelidae little has been published on the behavior and biology of the tayra, *Eira barbara* (KAUFMANN and KAUFMANN 1965; BROSSET 1968). Although this species is represented in most major zoo collections, captive breeding has been rare and nothing has been reported on sexual behavior, although tayras show some peculiarities not found in other mustelids.

Material

The Louisville Zoological Garden received a tame ♂, about 1½ years old on May 4, 1969, and on May 6, 1969, a semi-tame ♀, not fully grown, and estimated to have been about 7 months of age; the latter animal was collected in Columbia. Both animals were housed in an oval-shaped, modified corn crib (Behlen Mfg. Co., Columbus, Neb.) of 6.10×3.66 × 6.10 m. This cage-like enclosure is covered by a solid roof, has a concrete floor, climbing branches, a boulder (60×80 cm) and a concrete den with two partitions (71×92×71 cm

Table
Register of captive births

Location	Month/ Year	Number/ Sex	Survival	Reported
Birmingham, England	— 1966	0,0,1	—	JARVIS, Int. Zoo Yb. 8, 1968
	— 1968	0,0,1	—	LUCAS, Int. Zoo Yb. 10, 1970
Krefeld, Germany	11 1965	2,1	1,1	ENCKE, Int. Zoo Yb. 8, 1968
	8 1969	2,0	1,0	LUCAS, Int. Zoo Yb. 11, 1971
Lima, Peru	— 1971	0,0,1	—	DUPLAIX-HALL, Int. Zoo Yb. 13, 1973
Lincoln, Nebraska	7 1972	2,0	2,0	VAUGHN, in litt. 1972
	3 1973	1,1	1,1	VAUGHN, in litt. 1973
London, England	9 1878	0,0,2	?	CRANDALL, 1964
	6 1973	0,1,1,	—	BRAMBELL, in litt. 1973
London (GLC), England	8 1966	0,1	0,1	SAWYER, in litt. 1973
Los Angeles, Calif.	8 1968	0,0,1	—	CROTTY, in litt. 1973
	11 1969	0,0,2	—	" " " "
	8 1972	1,1	—	" " " "
Louisville, Kentucky	12 1972	1,1	1,0	POGLAYEN-NEUWALL, Int. Zoo
	3 1973	1,1	1,1	News, 20 (1 and 3) 1973
	10 1973	1,1	1,1	POGLAYEN-NEUWALL, Int. Zoo
				News 1974
San Diego, Calif.	7 1974	0,1	0,1	POGLAYEN-NEUWALL (unpubl.)
	5 1965	0,1	—	HILL, in litt. 1973
	9 1965	0,0,1	—	" " " "
	1 1966	1,0	—	" " " "
	9 1966	1,1	—	" " " "
	12 1966	1,1	—	" " " "
San Francisco, Calif.	11 1973	1,1,1	1,1	REYNOLDS, in litt. 1974
Tarpon Springs, Fla.	— 1969	0,0,2	—	JERKINS, pers. comm. 1972
	— 1970	0,2	0,2	" " " "

(1,1 = 1 ♂, 1 ♀; 0,1 = 1 ♀; 0,0,3 = 3 animals of unidentified sex)

each; inner dimensions). The dens are not heated in winter, but are tightly packed with hay which provides adequate insulation; the animals always den together which generates and preserves body warmth. Some protection from wind, driving rain and snow is afforded by a dense screen of tall juniper trees along the northern and western perimeter. The animals have survived without harm short spells of temperatures of down to -21°C with high relative humidity (POGLAYEN-NEUWALL 1970). They have been kept in this enclosure together continually except during the late stage of pregnancies and varying periods of postpartum when the ♀ or the ♂ was moved indoors.

Measurements of the mature animals are as follows:

♂ Weight: 5,954 g; head-body: 665 mm; tail: 353 mm; hind foot: 106 mm (+ 10 mm claw); ear: 37 mm; The ♂ possesses a large, pendulous but empty penis sheath (44.5 mm) with a subterminal slit; the penis is retracted into the body. The testes are large and very conspicuous (36 × 21 mm, measured on the live, anesthetized animal).

♀ Weight: 4,002 g; head-body: 598.5 mm; tail: 389 mm; hind foot: 97 mm (+ 9.5 mm claw); ear: 38 mm.

The animals are fed twice daily, in the morning 1 banana, $\frac{1}{4}$ apple or orange, 4 grapes; in the afternoon 400 g of a commercial meat diet (Zu/Preem, Hills Division of Riviana Foods, Topeka, Ks.), 1 skinned chicken neck and twice a week 1 egg and 1 chick or pigeon (rarely a rodent); all amounts are per animal. See also CRANDALL (1964) for additional comments on maintenance.

Tayras seem totally diurnal, and at least at the Louisville and Albuquerque Zoos, retire to their dens at dusk and rise as late as about 07.00 to 07.30 hrs on summer mornings. The animals display much activity (pacing, trotting, climbing — but no stereotyped locomotory patterns) interrupted only by brief periods (5–30 minutes) of dozing astride a tree limb



Fig. 1. ♂ in cooling bath

siderably later and re-enter it earlier. On very cold days, the den is only left for voiding and feeding. The dens are kept clean and defecation and micturition seem to occur randomly on the ground, although some preference is given to the top of the boulder; the lactating ♀, however, and later her young do use a common toilet area away from the den (POGLAYEN-NEUWALL and POGLAYEN-NEUWALL in preparation).

or on the flat roof of the den. In hot weather a tayra may enter a tub of water (diameter 60 cm, depth 25 cm) with its forefeet, and by alternating movements splash water onto its ventrum; less often an animal will completely enter the tub, circle 3–4 times, then rest in a sitting or crouched position and after 2–3 minutes leave the tub again. This is in contrast with other observations (BROSSET 1968; KAUFMANN and KAUFMANN 1965 pers. observ. at Albuquerque Zoo 1961–63) where tayras would not voluntarily enter any body of water. Activity on cold winter days is reduced; the animals leave the den con-

Chronology and description of sexual episodes

The earliest observation of any sexual interest of the ♂ were made on October 4 and 5, 1970, when the ♂ pursued the coy ♀, which resisted his advances with loud staccato “kecker” vocalisations. The next day the ♂ succeeded in mounting the ♀ several times, holding and positioning her by gripping the dorsal surface of her neck with his teeth. The ♀ was not submissive although her vulva was somewhat enlarged. The ♂ made several pelvic thrusts, but there was no intromission. Each of the attempted copulations lasted from 2–5 minutes.

The next sexual activity occurred from February 28 through March 3, 1971. Up to 13 mountings/day with two definite penetrations were reported.

From June 4 to June 12, 1971, intermittent mountings without intromission were noted.

The ♂ again pursued the ♀ between January 3 and 12, 1972 and April 9 and 16; of the same year without observed intromission.

On October 8, 1972, the ♂ mounted and held the ♀ with neck grip for 25 minutes, but did not penetrate and thrust. The ♀ showed a slightly inflated vulva. The following day ♂ and ♀ remained united for 22 minutes, the ♂ thrusting and uttering scratchy rasping sounds (= low-pitched segmented b-a-a-a call, KAUFMANN and KAUFMANN 1965). Intromission was not ascertained with certainty. Also on October 11, 12, 16 and 24 attempts at copulation without penetration were reported to the writer or observed by him. In each case the ♀ appeared distinctly coy. On October 25 at last, intromission was observed which lasted 35 minutes, and again on the 26th with a duration of 5 minutes. Another, unsuccessful, copulation took place on October 27 (10 minutes) and one with penetration of a few minutes, on October 28.

By December 26, symptoms of advanced pregnancy (enlarged rear of abdomen, extended teats) were clear; the ♀ was moved indoors and gave birth to twins on

December 30, about 15.00 hrs. The ♂ young was removed when a day old and the ♀ young was killed and consumed by the mother about 5 days later.

The adult ♂ was introduced to the ♀ on January 10, 1973. On January 11, he tried to mount, kept the twisting, loudly vocalising (rasping sounds and kecker) and fighting ♀ in the neck grip and thrusts with the ♀ in lateral position; penetration was unlikely. Once more, a few hours later, the ♂ attempted copulation, holding the ♀'s scruff of the nape with his teeth and dragging her a short distance. The ♀ continually growled and uttered high-pitched kecker and also released a strong smelling musky odor from the anal glands (noticed most often in young animals as fright and alarm reaction).

January 12: the ♂ failed again to mount and after neck bite and some dragging (50 cm) let the ♀ go. The ♀'s vulva was in diestrous condition.

Between January 12 and 17 open hostility of the ♀ toward the ♂ erupted, manifested in snorting, growls, high-pitched clicking and keckering and assumption of threat position: head stretched forward and held below the line of the spine, mouth slightly open, hairs of tail erected. The ♀ may lunge at the ♂ when he approaches to about 30 cm and she may lower her rear end (similar to micturition position) and turn on the spot always facing the ♂. The marking frequency of the ♀ was greatly increased (mostly with emission of a few drops of urine) consisting of 1–2 perineal drags, and often subsequent sniffing. The "threat face" of the tayra at strongest provocation (not occurring in the sexual context) consists, in addition to the above, of slight drawing back of the corners of the mouth, raising of the upper lip and nose whereby upper canines, incisors and gums are exposed and transverse folds appear on the ridge of the nose; the ears which have limited mobility are laid back. Sharp and loud staccato kecker and copious flow of saliva with formation of bubbles is striking.

On January 17 both animals were transferred back to their old quarters and in the afternoon the ♂ again mounted the ♀. He held her by the nape for 25 minutes, stimulating her with pushing motions of his wrists at her flanks, but without intromission. The ♀ remained silent, but the ♂ was very vocal, keckering and uttering rasping sounds. On January 18, four copulations, two possibly with intromission, were recorded, which lasted 3 and 8 minutes; the other two were probably disrupted by zoo visitors. The ♀'s vulva was only slightly swollen. January 19: one mounting



Fig. 2. ♂ mounting ♀; note nape bite and large scrotum



Fig. 3. Mounting of ♂ by ♀; note absence of nape bite

(16 minutes) was observed with stimulation movements and series of thrusts. Intromission was doubtful. January 20: a long lasting copulation (86 minutes) was seen during which the ♂ lost intravaginal contact once. The vulva of the ♀ was conspicuously swollen. On January 21 the ♀ struggled and thwarted the ♂, which broke off his attempts of mounting after 10 minutes.

On March 20 the obviously pregnant ♀ was removed from exhibition and parturition of two young was observed on March 25 at 15.26 hrs and between 15.50 and 15.56 hrs.

The ♀ was returned to her mate on July 4. As the animals met, they sniffed one another anally and the ♂ then tried to mount the ♀ which was not in estrus; he grasped her by the nape and threw her over on her side. After 5 minutes all sexual activity ceased.

The next sexual bouts occurred on August 21, when the ♂ repeatedly got hold of the ♀'s scruff and mounted once, without penetration. August 25: the ♀'s vulva was noticeably enlarged and the ♂ followed her round the cage continuously. The ♀ frustrated him by withdrawal and avoidance; when he succeeded to mount she dragged him over a meter. No intromission took place. August 26: upon my arrival at 07.30 hrs, a copulation in course broke up. Minutes later the ♀ followed the ♂, sniffed at him anally (scrotally?), mounted (without neck bite) and carried out "stimulation movements" with the wrists against the flanks of the ♂ while both held still for 20 seconds; then the ♀ dismounted. Stimulation movements may last from 2–7 seconds. Mountings by the ♀ were repeated 10 times in 45 minutes. Her vulva was extremely swollen, evidence of the condition of heat. For the following two hours the ♀ intermittently solicited the ♂, which culminated in a successful copulation.

Protocol

August 26, 08.19 hrs: ♀ climbs onto boulder, marks the top with anal drag (15 cm), descends and scratches on the concrete floor with both hind feet simultaneously four times; shortly afterwards she mounts the ♂ again, then urinates and performs the usual anal dab (also observed in ♂♂ after defecation/urination) and scratches again with both feet backward, this time only indicated by lowering and raising (flexing and straightening) the hind legs.



Fig. 4. Copulation. Note position of forepaws of the ♂

Scratching was observed strictly in the context of sexual situations (with one exception of the ♂ and one of the ♀), much more often in the ♀ than in the ♂; it may or may not be accompanied by the discharge of a few droplets of urine. The ♂ performs scratching with alternating movements of the feet as often as with simultaneous movements. While scratching with the hind feet, the animal may actually move forward with all four. Once the ♂ was seen after a successful copulation urinating with three short squirts and subsequent vigorous scratching.

09.40 hrs: ♂ approaches ♀, gets hold of the scruff of her nape, mounts and stimulates with rapid, quivering, pushing motions with the radial sesamoid bone of the wrists against the flanks of the ♀, followed by intromission. Every 30–120 seconds the ♂ carries out a brief series of quick pelvic thrusts of about 4–12 seconds. There may be 10–40 (average 20–30) thrusts per 5 seconds. During copulation, which takes place normally in standing or crouched position, the ♀ (or both animals) may roll to the side, for short periods of time, during which the copulation continues essentially unhindered. Both animals remain silent throughout, until about the last 5 minutes (of this 50 minute bout), when the ♀ begins to utter rasping cries and the ♂ snorts heavily. Whether or not it is the ♀ that eventually pulls away from him, or the ♂ that releases her is difficult to see.

August 27, 07.10 hrs: ♂ awakens, runs about the enclosure, then noticing the observer turns back and forth along the fence in a stereotyped manner, trying to arouse the observer's attention and elicit stroking.

07.30 hrs: ♀ gets up, leaves den, defecates, then trots around for several minutes, lowers rear, discharges a droplet of urine and scratches on floor. Vulva is still swollen as on previous day. She demonstrates increased intensity of lowpitched clicking sounds, specially when near the ♂.

07.45 hrs: ♀ smells at ♂'s anal region, mounts and briefly stimulates ♂, while keeping her head resting on his back; ♂ sits down, turns head to ♀ and grooms her



Fig. 5. Embrace. Both animals have rolled into lateral recumbency

nibbling on back and neck. Intention movement of mounting by ♂, ♀ utters low rasping sounds.

Within the next hour there were 12 more mountings by the ♀, mostly accompanied by grooming of the ♂ by the ♀ or mutual grooming (licking and nibbling); it was the ♀ that emitted frequent low-pitched rasping sounds during this interaction.

09.30 hrs: ♂ mounts ♀ with neck bite immediately following; until penetration is attained the ♀ loudly utters rasping cries. Copulation lasts one hour.

The ♂ mounted again in the afternoon, but it did not come to a penetration; after several minutes the ♀ was able to extricate herself. August 28: also on this day the ♀ frequently solicited the ♂, but the ♂ did not respond. Possibly again zoo visitors disturbed the animals and discouraged copulation. On August 29 the vulva of the ♀ was slightly less swollen and on the 31st it was reduced to normal size.

On October 30 again twins were born at 13.32 and 13.48 hrs. After the third litter, the ♀ was reunited with the ♂ on April 11, 1974, 165 days postpartum and entered her first estrus on April 30. Estrus lasted 13 days with copulations with intromission on the 5th, 6th and 8th day. On July 10 a single young was born between 18.00 and 20.00 hrs.

Protocol

June 30, 1973, 08.30 hrs: one young ♀ (96 days old, weight 1,814.4 g) exercising on the cage floor is taken by the mother by the nape (which is the typical carrying method of the young); she is trying to retrieve the rather heavy offspring to the elevated nest box. While still on the floor, she suddenly assumes lateral recumbency with the young (keeping up the grip at the nape) and stimulates the young with her wrists in an ambivalent male-like fashion. Stimulation movements are continued for 20 seconds and then again for 8 seconds, before letting the young go.

March 20, 1973: a young ♂ (80 days) raised by us, played often with a twisted piece of cloth, that was attached overhead and dangled to the floor. Every so often the animal grasped it between his wrists and quivered rhythmically and rapidly up to 80 seconds. This was the first observation of a behavior belonging to the sexual sphere. As this animal grew older, these actions became more frequent. GOETHE (1964) reports phenomena of puberty for juvenile ♂♂ of the least weasel (*M. nivalis*) in their 14th week.

Births

On March 20, 1973 the ♀ was transferred to an indoor enclosure (2.40×4×2.40 m) to have her second litter in a secluded and controlled (heated) environment. The enclosure was equipped with climbing branches and a nest box (40×50×50 cm) with half of the top covered and with an opening (17×18 cm) on a side. The box was attached 1.30 m above the cage floor. Hay was provided as nesting material, but soon discarded by the tayra.

Parturition took place on March 25. During the morning of this day the animal appeared restless, running about the cage, frequently uttering clicking vocalizations and rasping cries; her feces were rather thin and unusually black; the color of the feces remained dark also during the 24 hours postpartum. The restlessness of the animal grew after 13.00 hrs. At 15.20 hrs I was alarmed by a loud kecker-scream, followed by a prolonged growl. The ♀ circles three times in the nest box pivoting around herself, then settled down briefly. About one minute later she began to lick her vulva intensively and 5 minutes thereafter a fetus was expelled quickly in anterior (head-first) presentation. At 15.33 hrs the ♀ left the box for a couple of minutes to feed. At 15.50 hrs she growled loudly squatting in the nest box, lowering

and raising the ano-genital region and whipping with the proximal section of the tail up and down; strong contractions, between 6 and 10 per minute, were observed. The second fetus was expelled at 15.54 hrs, immediately followed by the delivery of the placenta. There was practically no loss of blood.

The third birth occurred on October 30, 1973. Since about September 25, the abdomen of the ♀ had become gradually enlarged and by October 11, also the teats, normally hidden in the fur, were noticeably lengthened while the abdomen had assumed a greatly inflated pear-like shape. On October 23 the animal was returned to the indoor cage in our house, where she immediately settled down.

Around 11.00 hrs of October 30 the ♀ showed increasing restlessness and at 13.00 hrs labor started, indicated by panting, rasping cries and occasional keckering and growling vocalizations. The animal moved around in her nest box, settled down again and at 13.10 hrs the first heavy contractions became noticeable; at 13.15 hrs a gush of amniotic fluid was released and the ♀ continued to press vigorously. At 13.24 hrs the tail of the fetus appeared outside the birth canal; the ♀ left the nest box at 13.30 hrs, climbed to the cage floor and began to walk in a tight circle; then she stood still, lowered her rear slightly and expelled one young and the placenta at the same time. The birth membranes, partly torn during parturition, were removed by licking and were ingested by the ♀; at this time also the umbilical cord was severed close to the belly of the neonate and eaten with the placenta. At 13.36 hrs the mother grasped the neonate with the teeth around the middle of its body and carried it up and into the nest box.

Renewed labor and contractions set in at 13.44 hrs and at 13.47 hrs the ♀ assumed a "sitting" posture on the small of her back, hind legs stretched and slightly straddling, forelegs braced to the floor of the box, laterally of the thighs. Shortly the head of the fetus emerged in the vaginal opening and the mother bent forward and grasped it with her mouth and pulled it out completely. At 13.49 hrs the ♀ took hold of the umbilical cord with her teeth and pulled the placenta, which she devoured immediately. Only now the ♀ began to lick dry the second young; this was continued for the next 6 minutes. The first suckling of a young was observed at 14.10 hours.

While the birth of the first young, a breech presentation, took 32 minutes from the onset of labor to the completed expulsion of the fetus, the birth of the other sibling lasted only 5 minutes. It was not possible to determine the end of the "dilation period" and the beginning of the "expulsion period" as defined by NAAKT-GEBOREN and SLIJPER (1970).

Discussion

All sexual activities and other social interactions between adults take place during daytime. KAUFMANN and KAUFMANN (1965) however, suspect some nocturnal mating. The pattern of sexual behavior of the tayra fits well into the one described for many mustelid species (especially the Mustelinae). The most notable distinction is the development of a radially located sesamoid bone of the wrist, especially prominent in the ♂ tayra. It is used for sexual stimulation of the ♀. A similar structure and function has been reported for only one other mammalian species, the kinkajou, *Potos flavus* (POGLAYEN-NEUWALL 1962 in press). It probably evolved independently in these two carnivores. In *Potos* stimulatory movements occur both before intromission and throughout copulation, whereas in *Eira* such movements serve only as a prelude to intromission and, penetration achieved, discontinue altogether. In *Eira* stimulatory movements are carried out with much greater speed than in *Potos*. In both species the plantar surfaces are directed outward while stimulating. It has not

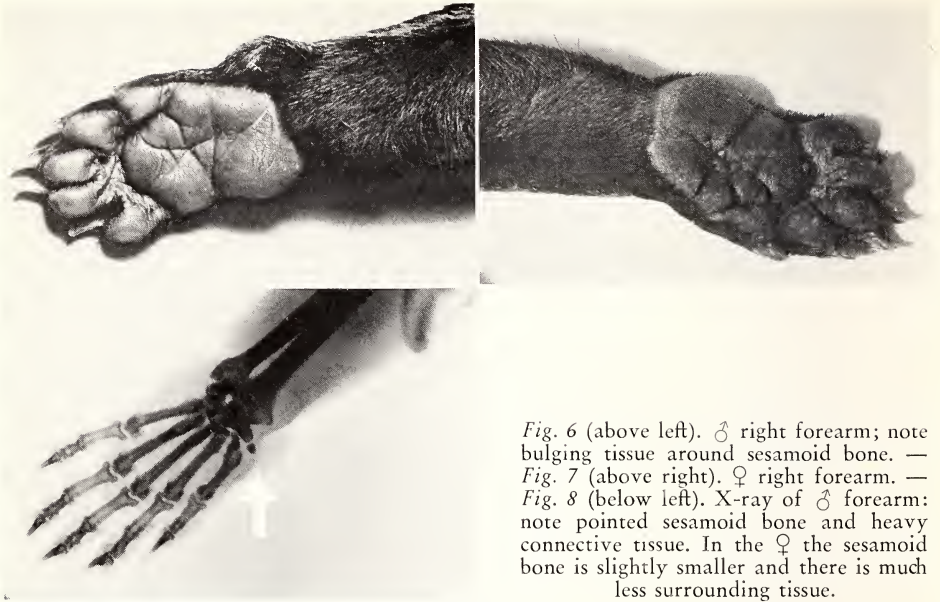


Fig. 6 (above left). ♂ right forearm; note bulging tissue around sesamoid bone. — Fig. 7 (above right). ♀ right forearm. — Fig. 8 (below left). X-ray of ♂ forearm: note pointed sesamoid bone and heavy connective tissue. In the ♀ the sesamoid bone is slightly smaller and there is much less surrounding tissue.

been observed in *Potos*, that in the ♀'s behavioral repertoire stimulation movements occur as well. They are incorporated in a behavioral sequence which I have called "solicitation" rather than "courtship", since the term courtship evokes the notion of strict ♂ behavior. This behavior pattern also occurs outside the heat period, coupled with mountings of a few seconds to 77 seconds duration. Only after the ♀ has reached full estrus, evidenced by both vulval enlargement and high intensity soliciting behavior, successful copulations do take place; nevertheless the ♂ may try to mount the ♀ well before she has attained the peak of her heat. Mounting intention movements by the ♂ and especially mountings with and without stimulation movements by the unestrus ♀ may also have a non-sexual social significance, such as submissiveness, dominance display by the ♂ or "greeting" after a time of separation. It should be added that the ♀ very rarely and only briefly uses the neck bite when in heat and never outside the heat. Sexual activity after varying periods of separation of animals of the opposite sex within hours or days on the part of the ♂ has occasionally been observed in other carnivores, e. g. kinkajous (POGLAYEN-NEUWALL 1962; CLIFT 1967), olingos, *Bassaricyon* (POGLAYEN-NEUWALL and POGLAYEN-NEUWALL 1965; POGLAYEN-NEUWALL, in press), and cacomistles, *Bassaris sumichrasti* (POGLAYEN-NEUWALL 1973; unpublished). The solicitation of the ♂ by the ♀ consists of brief anal sniffing, mounting, stimulation movements (which may or may not occur) and dismounting. A rasping sound is sometimes uttered by the ♀ (seldom by the ♂), and during the peak of the heat, the ♀ utters rapid high intensity clicking vocalizations, probably signifying (as in other contexts) low-level excitement and readiness for social contact. At least while in heat, at the end of the mount the ♀ initiates grooming (nibbling, licking) which the ♂ often reciprocates. Copulatory thrusts by the ♀ are not part of this behavior sequence and have never been observed. The fact that mounting by the ♀ is relatively often seen outside the heat period (though not nearly as frequently as during heat) leads me to interpret this as a hypertrophied behavior due to the influences of confinement.

The motivation of the ♀ stimulating her three months old ♀ young, must at this time remain obscure.

Stimulatory movements of our young ♂ on a substitute object like the dangling cloth or the arm of my wife, and of a juvenile ♂ of BROSSET (1968), considerably older than our ♂, are likely expressions of early onset of puberty, sexual frustrations or sexual mal-imprinting.

It is assumed that the sexual interactions between the Louisville Zoo's adult animals on October 4 and 5, 1970 may well have marked the first (weak) period of heat of the ♀ then about two years old. ENCKE's (1968) ♀ of known (estimated) age went through her first mating experience at almost three years of age.

BROSSET (1968) correctly assumes that the ♂ is ready for sexual interaction at any time of the year; he is, however, misinterpreting the "cramp-like vibrations of the body" ("Lorsque le pénis entre superficiellement en contact avec la peau humaine, le corps de l'animal est agité d'une série de tremblements spasmodiques..."), which actually can only be stimulatory movements of the wrists, whose vibrations do radiate over the entire arm also involving the shoulder region. It would be wrong to generalise BROSSET's statement that in his animal the testes descended into the scrotum as late as age 10–12 months. KAUFMANN and KAUFMANN (1965) quote the approximate age when the testes of their ♂ descended as 6 months. In one of our mother-raised young tiny testes could be felt for the first time at 37 days. In a young of another litter they could be palpated at 54 days (5 mm) and had grown intrascrotally to approximately 15×8 mm at 5 months; in the hand-reared individual they measured about 15 mm at 140 days and had increased to 23×15 mm at 8 months.

Copulations in the laboratory occur always on the ground, a habit which I believe to be true also in the wild. The animals are reported to be as much terrestrial as arboreal, and because of the nature of the copulatory behavior it can be presumed that it takes place mainly if not exclusively on the ground.

During attempted and more so during successful copulations, dragging of the ♂ by the ♀ or vice versa covers only short distances and frequently does not occur at all. In other species it seems that dragging of the ♀ by the ♂ is an obligatory prelude to copulation and of considerable duration, e. g. *Mustela furo*, *M. putorius*. In *Martes* pre-copulatory behavior may consist of mountings of the ♀ as well as the ♂. *M. putorius* and *M. erminea* also show sometimes a "change of roles" at the peak of the heat, including nape bite, mounting and nibbling of the back of the ♂ by the ♀ (GOETHE 1964; EIBL-EIBESFELDT 1956). The tayra's behavior differs from the foregoing not only in details (no nape bite; stimulatory movements), but it is present, though at much lower intensity, also outside estrus, when the ♂ does not respond in any way. VAUGHN (in litt. 1972) states that mating of his tayras took place at varying times of the day, "the ♂ holding onto the ♀'s neck and she would give out 'screech sounds'. Matings lasted often over 20 minutes and fighting would be rather violent during these times. The ♂ was often pursuing the ♀ for long periods of time".

The ♀ or both ♂ and ♀ lie on their sides during copulation for brief periods (up to 6 minutes) only, which according to GOETHE (1964) is characteristic for *Martes*. Vocalizations (rasping sounds, kecker, snorts) are uttered by one or both animals during unsuccessful copulations, i. e. when the ♀ has not yet reached full estrus or is passed full estrus. Eventually copulations become essentially silent as the ♀ becomes more submissive; shortly before the termination of the copulation, the ♀ begins to struggle and vocalise.

Martes, *M. putorius* and *M. nivalis* ♀♀ demonstrate their willingness to copulate by holding the tail straight up or at an angle above the back; *M. putorius* ♀♀ also

invite the ♂, uttering clucking sounds (which also the ♂ emits) and by offering nape and ano-genital region (EIBL-EIBESFELDT 1955); shaking of the ♀ by the ♂ reported by HERTER (1953) does not occur in *Eira*. The akinesis of the ♀ weasel to be caused by the nape bite is certainly far from complete in the tayra, as the ♀ continues for much of the time to crawl forward or in a circle; neither have we observed in the tayra the ♂ dragging the ♀ over distances greater than 1.5 m or so, unlike in *M. nivalis* (FRANK 1962, cit. in GOETHE 1964), or in the ferret, *M. furo* (pers. observation). As in *Martes tayras* also do not fall to the side in exhaustion at the end of the copulation, but rather quickly separate.

Scratching with the hind feet on the ground has been observed almost exclusively in sexual situations with tayras. HERTER and OHM-KETTNER (1954) who have observed similar behavior in both sexes of the pine marten (*M. martes*) in other than sexual contexts interpret this behavior as a threat gesture.

Duration and frequency of copulations may be species-typical. The compilation below follows GOETHE (1964) where not otherwise indicated:

<i>Martes</i> sp.	3 copulations, each about 5 minutes (observation in the wild)
<i>M. martes</i>	30—60 minutes (LANDOWSKI 1962)
<i>M. zibellina</i>	30 minutes
<i>Mustela putorius</i>	over 60 minutes
<i>M. furo</i>	over 60 minutes
<i>M. eversmanni</i>	2—3 hours
<i>M. nivalis</i>	1—48 minutes (HEIDT et al. 1968)
<i>M. nivalis</i>	2—3 hours; within 3—4 days 3—5 copulations
<i>M. erminea</i>	2—20 minutes; up to 5 copulations in short sequence (MÜLLER 1970)
<i>M. frenata</i>	2—3 hours (WRIGHT 1948)
<i>M. vison</i>	30—40 minutes
<i>Mephitis</i> sp.	5—20 minutes in sequences of 10 and more copulations

Estrus lasts in *M. eversmanni* 7 days, in *M. putorius* x *M. furo* 9 days (HERTER 1959, cit. in GOETHE 1964), in *Martes* sp. 1—3 days or more, with several copulations/day and up to four receptive phases per breeding season (SCHMIDT 1951). The mink (*M. vison*) is seasonally polyestrous (March—April), a cycle lasting 8—9 days with two days receptivity (ALTMANN and DITTMER 1964). Estrus in the grison (*Galictis cuja*) appears to have a duration of about 102 days, counting from the onset until the disappearance of the genital tumescence and exsertion (about 6 cm in length) of the ♀♀. Observations by the writer during two years on 2 ♀♀ of the Louisville Zoo revealed a recurrence of estrus in spring (March—July) of each year. If polecat ♀♀ have no opportunity to mate during their regular estrus (the reproductive period lasts throughout March) they may remain in heat until midsummer (REMPE 1957). This phenomenon may also be applicable to the grison and explain these prolonged periods of morphological estrus, since both ♂♂ were for unknown reasons reproductively inactive.

DEWSBURY (1972) in his comprehensive compilation of Mammalian copulatory patterns established a schema of patterns in which the tayra would occupy pattern No. 11; i. e. 1. no copulatory lock; 2. thrusting; 3. no multiple intromissions required to ejaculate; 4. multiple ejaculations probable.

As can be expected of a tropical weasel that lives in an environment without extreme climatic changes and seasonal food shortages, the tayra does not have a delayed implantation. The gestation period is rather short, for the first litter at the Louisville Zoo 63 days and for the second, third and fourth litter 64 days from the

last copulation to parturition. VAUGHN (in litt. 1972) reports: "the mating lasted for some 5 days until May 18, 1972 . . . Birth occurred during the night of July 22, 1972"; this results in a gestation period of 65 days. VAUGHN (in litt. 1973) further writes: "the male became interested in breeding on December 22, 1972. Actual breeding took place from December 25 to December 31 . . .". With March 4, 1973, as the birth date this would suggest a gestation period of 64 days¹. SAWYER, R. C. J. (in litt. 1973) mentions a gestation period of "approximately 8 to 9 weeks" for a tayra at a facility of the Greater London Council's Parks Department in 1966.

Acknowledgements

Thanks are due to several employees of the Children's Zoo at the Louisville Zoological Garden, namely Dr. INGEBORG POGLAYEN-NEUWALL, MARIAN JONES and ALICE HINTON, who made and reported many observations from 1969 till 1972.

Summary

1. The first estrus a ♀ tayra can experience does not occur before age two years. The periods of heat with vulval enlargement, attempted and successful, copulations may last from 3 to 20 days (3, 4, 8, 9, 20, 4, 7, 12 pers. observations; 5, 10 VAUGHN, in litt., 1972 and 1973). Up to three periods of heat per year have been noticed.
2. The ♂ may attempt to copulate with the ♀ before she has reached full estrus and under certain conditions (reunion after separation) even when the ♀ is in diestrus. The coy ♀ will struggle and the ♂ may drag her around (or be dragged in the process) with a firm grip on the ♀'s neck. Mounting may or may not be successful, but no penetration occurs. There is considerable vocalising, especially by the ♀.
3. When the ♀ is at the peak of heat she will demonstrate a "soliciting" behavior, consisting of clicking vocalizations, anal sniffing, mounting of the ♂ (up to 70 seconds and usually without nape bite), stimulatory movements and grooming of the ♂, which the ♂ often reciprocates. This ambivalent behavior of the ♀ is also seen less frequently, outside the heat period and then always without nape bite; the ♂ then shows no overt responses.
4. The ♂ eventually mounts with nape bite (the grip on the nape is often attained before mounting), clasping the ♀ in the lumbar region, makes stimulatory pushing movements against the flanks of the ♀ with a specially adapted radial sesamoid bone of the wrist, establishes intravaginal contact and performs brief bouts of pelvic thrusts. Successful copulations may last from 3 to 86 minutes (mean of 7 copulations: 35.3 minutes). Such copulations are essentially silent, though mainly the ♀ may occasionally utter segmented rasping sounds.
5. Simultaneous or alternating scratching with the hind feet, with or without prior voiding of small amounts of urine (or squirting in the ♂) has been observed, much more often in the ♀ and almost always during her heat; the ♂ has shown this behavior once outside the estrus of the ♀ and the ♀ once two hours before parturition. The significance and social function of this behavior is not clear.
6. In the ♂ the testicles descend by the age of 37 days, when they can be palpated, and measure then less than 5 mm. Intrascrotally they continue to grow slowly and steadily and reach their full size probably around 1½ years.
7. The gestation period of *Eira barbara* as determined from six observations is from 63 to 65 days.
8. Two births of sets of twins were described. They lasted from the first labor pains to completed expulsion 6 and 4 minutes for one litter and were both cranial presentations; and 32 and 5 minutes for the other litter, with one breech and one cranial presentation. The fetuses were expelled with intervals of 28 and 17 minutes respectively.

¹ After submission of this manuscript I read the paper by R. VAUGHN on "Breeding the tayra, *Eira barbara*, at Antelope Zoo, Lincoln (Int. Zoo Yb. vol. 14: 120—122, 1974), in which the writer established the two gestation periods of his tayra with 70 and 67 days; these periods were calculated counting from the first day of mating for one and "from the peak of sexual activity" for the other, rather than from the last observed mating.

Zusammenfassung

Paarungsverhalten, Tragzeit und Geburt der Tayra (*Eira barbara* L., 1758)

1. Frühestens mit 2 Jahren erreicht die ♀ Tayra die Geschlechtsreife (1. Östruszyklus). Hitzeperioden, gekennzeichnet durch Ödematisierung der Vulva und Kopulationen können von 3 bis 20 Tagen dauern (3, 4, 8, 9, 20, 4, 7, 13 Tage, eigene Beobachtungen; 5, 10 Tage, VAUGHN in litt. 1972 und 1973). Es wurden bis zu 3 Hitzeperioden pro Jahr beobachtet.
2. Das ♂ versucht nicht selten sich mit dem ♀ zu paaren noch bevor dieses den Östrusgipfel erreicht hat und unter bestimmten Bedingungen (nach Wiederzusammenführung), selbst wenn sich dieses nicht im Östrus befindet. Das spröde ♀ sträubt sich heftig, während das ♂ es mit Nackenbiß am Boden entlangzerrt bzw. vom ♀ nachgezogen wird. Dem ♂ gelingt es oft für kürzere Zeit aufzureiten, doch kommt es zu keiner Intromissio. Während solcher Paarungsversuche vokalisieren die Tiere, besonders das ♀, meist intensiv.
3. Wenn das ♀ sich auf dem Gipfel des Östrus befindet, zeigt es auffälliges Werbeverhalten, das aus Muckern, Analkontrolle am ♂ und Aufreiten (bis zu 70 Sekunden Dauer und gewöhnlich ohne Nackenbiß) mit Stimulationsbewegungen besteht; dabei beknaabert und beleckt es das ♂, was dieses häufig erwidert. Solch ambivalentes Verhalten des ♀ (doch niemals mit Nackenbiß) kann man auch, in weit geringerer Intensität, außerhalb der Hitze beobachten; jedoch reagiert das ♂ dann nicht darauf.
4. Schließlich reitet das ♂ mit Nackenbiß (dieser wird oft noch vor dem Aufreiten angebracht) auf das ♀ auf, umfaßt es mit den Vordergliedmaßen hinten an den Flanken und führt arttypische, stoßende Stimulationsbewegungen mit dem spezialisierten, radialen Sesambein des Carpus gegen die Seiten des ♀ aus. Nachdem die Intromissio gelungen ist, führt es kurze Serien von Friktionsbewegungen durch. Erfolgreiche Kopulationen können von 3 bis 86 Minuten dauern (Durchschnitt aus 7 Kopulationen: 35,3 Minuten). Diese Paarungen gehen im wesentlichen lautlos vor sich, doch mag das ♀ gelegentlich tiefe, gedehnte Kreischlaute ausstoßen.
5. Gleichzeitiges oder abwechselndes Kratzen mit den Hinterbeinen, mit oder ohne vorherige Abgabe einiger Tröpfchen Urin (oder Urinspritzen des ♂) wurde beobachtet, und zwar sehr viel öfter beim ♀ als beim ♂ und fast stets zur Zeit der Hitze des ♀. Das ♂ hat dieses Verhalten nur einmal außerhalb der Hitze des ♀ gezeigt, das ♀ einmal 2 Stunden vor dem Gebären. Die soziale Funktion dieses Verhaltens ist unklar.
6. Die Hoden des ♂ wandern schon im Alter von 37 Tagen ab in das Scrotum, wo sie palpiert werden können; sie messen dann weniger als 5 mm. Im Scrotum wachsen sie langsam weiter und dürften ihre volle Ausbildung nach etwa 1½ Jahren erreichen.
7. Die Tragzeit der Tayra wurde in 6 Fällen ermittelt und beträgt von 63 bis 65 Tagen.
8. Zwei Zwillingsgeburten wurden beschrieben. Eine Geburt dauerte vom Beginn der Wehen bis zur vollständigen Austreibung des Fötus 6 und 4 Minuten (beides Kopfendgeburten), die andere Geburt dauerte 32 und 5 Minuten (mit einer Steiß- und einer Kopfendlage). Die Föten wurden in Abständen von 28 und 17 Minuten ausgestoßen.

Literature

- ALTMANN, P. L.; DITTMER, D. S. (1964): Biological Data Book. Federation Amer. Societies of Biology, Wash. D. C.
- BRODMANN, K. (1952): Mauswiesel frei im Hause. Köln: Baldwin Pick Verlag.
- BROSSET, A. (1968): Observations sur l'Ethologie du Tayra, *Eira barbara* (Carnivore). *Tierre et la Vie* 1, 29—50.
- CLIEFT, C. E. (1967): Notes on Breeding and Rearing of a Kinkajou, *Potos flavus* at Syracuse Zoo. *Inter. Zoo Yb.*, London, VII, 126—127.
- CRANDALL, L. S. (1964): Management of Wild Mammals in Captivity. Univ. Chicago Press.
- DEWSBURY, D. A. (1972): Patterns of Copulatory Behavior in Male Mammals. *Quarterly Rev. Biology* 47, 1—33.
- ENCKE, W. (1968): A Note on the Breeding and Rearing of Tayras, *Eira barbara* at Krefeld Zoo. *Inter. Zoo Yb.* VIII, 132.
- EIBL-ELBESFELDT, I. (1956): Zur Biologie des Iltis (*Putorius putorius* L.). *Zool. Anz. Suppl.* 19, 304—314.
- GOETHE, F. (1964): Das Verhalten der Musteliden. *Handb. Zool.* 10, 1—80, Berlin: W. de Gruyter & Co.
- HEIDT, G. A.; PETERSEN, M. K.; KIRKLAND, G. L. (1968): Mating behavior and development of least weasels (*Mustela nivalis*) in captivity. *J. Mamm.* 49, 413—449.
- HERTER, K. (1953): Über das Verhalten von Iltissen. *Z. Tierpsych.* 10, 56—61.

- HERTER, K.; OHM-KETTNER, I. D. (1954): Über die Aufzucht und das Verhalten zweier Baummarder (*Martes martes* L.). Z. Tierpsych. 11, 113—137.
- KAUFMANN, J. H.; KAUFMANN, A. (1965): Observations on the Behavior of Tayras and Grisons. Z. Säugetierkunde 30, 146—155.
- LANDOWSKI, J. (1970): Breeding the Pine Marten (*Martes martes* L.) in Captivity. Inter. Zoo Yb. III, 21—23.
- MÜLLER, H. (1970): Beiträge zur Biologie des Hermelins. Säugetierkundl. Mitt. 18, 293—380.
- NAAKTGEBOREN, C.; SLIJPER, E. J.: Biologie der Geburt. Eine Einführung in die vergleichende Geburtskunde. Hamburg u. Berlin: Parey.
- POGLAYEN-NEUWALL, I. (1962): Beiträge zu einem Ethogramm des Wickelbären (*Potos flavus* Schreber). Z. Säugetierkunde 27, 1—44.
- (1970): Winter 1969—1970 at Louisville Zoo. Int. Zoo. News, Woudenberg, Netherlands, 7, 118—119.
- (1974): Zur Fortpflanzungsbiologie und Jugendentwicklung von *Potos flavus* (Schreber, 1774). Der Zool. Garten (N. F.), Leipzig (inpress.).
- REMPE, U. (1957): Beobachtungen über Brunst, Paarung, Tragezeit, Geburt und Kreuzungen bei Mitgliedern der Untergattung *Putorius*. Säugetierkundl. Mitt. 5, 111—113.
- SCHMIDT, F. (1951): Die Marder und ihre Zucht. Beitr. Tierkunde u. Tierzucht 4. Leipzig: Akad. Verl. Ges. Geest & Portig, K.-G.
- WALKER, E. P. (1968): Mammals of the World. II., Baltimore: Johns Hopkins Press.
- WRIGHT, P. L. (1948): Breeding habits of captive long-tailed weasels (*Mustela frenata*), Amer. Midl. Nat. 39, 338—344.

Author's address: Dr. IVO POGLAYEN-NEUWALL Department of Biology, University of Louisville, Louisville, Kentucky, USA

ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Mammalian Biology \(früher Zeitschrift für Säugetierkunde\)](#)

Jahr/Year: 1974

Band/Volume: [40](#)

Autor(en)/Author(s): Poglayen-Neuwall Ivo

Artikel/Article: [Copulatory behavior, gestation and parturition of the tayra \(*Eira barbara* L., 1758\) 176-189](#)