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tion. Under commercial production conditions the  $\text{CuSO}_4$  treatment would have likely been judged unnecessary and not cost effective. Under the circumstances of the epizootic we took all action we felt appropriate to avoid the loss of the experiment in the ponds.

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### **Cyclopia, Congenital Limb Deformity, and Osteomyelitis in the Collared Peccary, *Tayassu tajacu* (L.)**

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The collared peccary is a social ungulate and the sole member of the family Tayassuidae in North America. Knowledge of this species' natural history has increased in recent years (for reviews, see Sows, 1978, *In Big Game of North America*, Schmidt and Gilbert (eds.), Stackpole Books, Harrisburg, Pennsylvania, pp. 191-205; Bissonette, 1982, *In Wild Mammals of North America*, Chapman and Feldhamer (eds.), John Hopkins University Press, Baltimore, Maryland, pp. 841-850). Pathology of the collared peccary remains one of the least studied aspects of its biology. Indeed, with the exception of the description of anomalous canine tooth development in a peccary in Arizona (Neal and Kirkpatrick, 1957, *J. Mammal.* 38: 420), skeletal anomalies have not been reported. This paper reports skeletal lesions in three wild and captive peccaries from southern Texas.

Cyclopia refers to a gross malformation of the central nervous system characterized by a single, median orbital fossa. Eyeballs may be absent or ranging from a single, almost perfect eyeball through all

degrees of doubling to two complete, closely adjacent globes of reduced size (Potter and Craig, 1975, *Pathology of the Foetus and the Infant*, Yearbook Medical Publishers, Chicago, 697 pp.; Morison, 1970, *Foetal and Neonatal Pathology*, Appleton-Century-Crofts, New York, 641 pp.). In cases where two eyes are present in varying degrees of fusion, the condition may also be termed synophthalmos (Yanoff and Fine, 1975, *Ocular Pathology*, Harper and Row, Hagerstown, Maryland, 748 pp.). This malformation is not uncommon among domestic animals, especially swine, which are the closest taxonomic relatives of peccaries. Cyclopia has been observed in three piglets of a litter of eight (Potter and Craig, 1975, *op. cit.*). To our knowledge, a report by Bubenik (1982, *Saugetierk. Mitt.* 30: 158-160) on cyclopia in a male white-tailed deer fawn (*Odocoileus virginianus* (Zimmermann)) is the only such report of this anomaly in a wild ungulate species.

Between September 1981 and July 1983, captive collared peccaries housed in a 30-m-square enclosure on the campus of Texas A&M University farrowed 57 young in 32 litters (Lochmiller et al., 1984, *Zoo Biol.* In press). In June 1983, a female peccary

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FIGURE 1. Photograph of 6-hr-old collared peccary neonate with cyclopa. Note malformed mandible, fleshy proboscis, and lack of external nares.

on a pelleted, low protein diet (8.5% crude protein) gave birth to twins, one a normal 605-g young and the other a grossly malformed 562-g young. Two other peccaries on the same diet gave birth to normal twins and a stillborn single young, respectively. The deformed young was born alive, but was removed from the pen and euthanized following maternal attacks and subsequent abandonment. Externally, the neonate had a fleshy, medial proboscis 3 cm in length descending over closely appositioned eyes. The eyeballs were reduced in size, but grossly normal. There were no external nares (Fig. 1). Necropsy revealed that gross appearance of visceral organs and glands were normal, although the adrenals were fused. This is the sole case of fused adrenals we have observed in over 50 necropsies of juvenile peccaries, although it has been seen in two adult animals (see below). Detailed examination of the central nervous system was not performed.

The cranial vault was approximately  $\frac{2}{3}$  normal size (Fig. 2). A single median orbit was evident. The frontal and nasal bones were small and arose dorsal and caudal to the orbit. The maxilla was shortened and deviated dorsally such that the upper canines were parallel to the occlusal surfaces



FIGURE 2. Radiograph of 6-hr-old collared peccary littermates, normal (top) and cyclopic (bottom). Note bony remnants in proboscis above orbit, rostral deviation of mandible, and upper jaw distortion in cyclopic individual.

of the upper molars. The distal half of the mandible was also displaced dorsally, placing the lower canines distal to and at the level of the upper canines. The condition was characterized as cyclopa (synophthalmos). The head and carcass of the cyclopic individual have been deposited in the Texas Cooperative Wildlife Collection, Accession No. 43463.

The cause of the anomaly in the peccary neonate is unclear. Binns et al. have related toxicosis due to skunk cabbage or corn lily (*Veratrum californicum* Durand) in pregnant ewes to cyclopa in lambs (1960, J. Am. Vet. Med. Assoc. 137:



FIGURE 3. Radiograph comparing congenitally malformed forelimb (left) with normal forelimb (right) in adult female collared peccary. Note scapulo-humeral joint remodeling, humero-radius fusion, and changes distal to the carpels in deformed limb.

515-521; 1963, *Am. J. Vet. Res.* 24: 1164-1175; 1964, *Ann. N.Y. Acad. Sci.* 111: 571-576). They postulated that the condition arose from a teratogenic agent active during early pregnancy. The pelleted diet supplied to the mother of the neonate consisted of corn cobs, ground corn, and vitamin and mineral supplements. Natural vegetation was not available. Genetic factors, such as a hereditary genetic defect or a genetic mutation, may also be involved in causing cyclopia (Morison, 1970, *op. cit.*).

Limb abnormalities have not been reported previously in the family *Tayassuidae*. Neal et al. (1970, *In Diseases of Swine*, 3rd Ed., Dunne (ed.), Iowa State University Press, Ames, Iowa, pp. 942-955) reviewed congenital defects in domestic swine, including limb deformities. Scanlon (1973, *Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm.* 27: 301-302) reported on the prevalence of limb and mandible abnormalities in a population of white-tailed deer, while Verme (1968, *J. Mammal.* 49: 148) described a female white-tailed deer which apparently transmitted leg defects to two of its sev-



FIGURE 4. Radiograph of collared peccary hindlimbs, one normal (right) and one showing evidence of chronic osteomyelitis (left).

en offspring. Such conditions are not often seen in wild species as they are not compatible with survival in a free-ranging situation.

A young adult female collared peccary trapped in October 1982 from the Chaparosa Ranch, Zavala County, Texas and maintained in captivity for observations, had a deformed right forelimb (Fig. 3). The carpals, metacarpals, and digits were hypoplastic and appeared fused. Radioulnar length of the bowed right limb was 92 mm, compared to 260 mm for the normal limb. The humerus was displaced caudally. The ulna was absent and the radius was fused to the distal humerus. The ulnar carpal bone was the lone proximal carpal present and the fourth carpal bone was present distally. The single "digit" present was comprised of the fourth metacarpal, fused proximal and middle phalanges, and a rudimentary distal phalanx.

This peccary locomoted with an unusual hopping gait by medial placement of her normal left forelimb, which through compensatory hypertrophy had become extremely muscular. Her survival to adulthood indicated that she could probably maintain the pace of a free-ranging herd. She was reproductively active and recently farrowed a single, stillborn young with normal limbs. This is the sole congenitally afflicted peccary which we have seen in over 125 trappings. However, ranch personnel have reported seeing a

juvenile peccary with a similar condition in the same herd as the above-described individual. In addition, we captured an aged, adult female peccary from this herd with what appeared to be an amputated left hindfoot. Although the missing hindfoot may have been due to attempted predation, Fredeen and Jarmoluk's (1963, *Can. J. Anim. Sci.* 43: 143-149) observation of a domestic piglet born without hindfeet (but otherwise normal) raises the possibility that this peccary was also congenitally afflicted. It should be noted that, like the cyclopic neonate, the two peccaries described above were observed to have fused adrenal glands, unlike any of the other 40 adult peccaries which we have examined at necropsy.

An apparently healthy, adult male colored peccary, trapped on the Chaparral Wildlife Management Area in Dimmit and LaSalle Counties, Texas by Texas Parks and Wildlife personnel, was presented to us in March 1983. The left hindlimb of this individual had an enlarged, clublike appearance. No hoof was visible and the dewclaw was twisted laterally. On a radiograph of the foot, several osteolytic areas were present at the level of metatarsus 3-4 and the proximal phalanges (Fig. 4). The fusion of the joint and smoothness of the periosteal reaction indicated a chronic process, probably resulting from past trauma.