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THE GONADS OF THE SOUTH AMERICAN DOLPHINS, *INIA GEOFFRENSIS*, *PONTOPORIA BLAINVILLEI*, AND *SOTALIA FLUVIATILIS*

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ABSTRACT.—The appearances of the gonads are described in males and females of 18 *Inia geoffrensis*, 11 *Pontoporia blainvillei*, and eight *Sotalia fluviatilis* from South America. Males of *I. geoffrensis* become sexually active at a length of about 228 centimeters, females at 175 to 180 centimeters. Length at birth is 76 to 80 centimeters; parturition occurs from about July to September in the upper Amazon. Males of *P. blainvillei* are still sexually immature at a length of 128.5 centimeters, females become sexually active at a length of 137 centimeters. Off Uruguay, pregnant females have fetuses 6 centimeters in length in February and 61 centimeters in October. Males of *S. fluviatilis* are sexually active at a length of 148 centimeters, females at 140 centimeters. Gonad weights and details of corpora lutea and albicantia are given. Corpora albicantia appear to persist as in other cetaceans. The ovaries of *I. geoffrensis* are relatively bulky with the corpora enclosed in the ovarian substance and not pedunculated as in *P. blainvillei* and *S. fluviatilis* in which the right ovary is poorly developed.

Little is known about reproductive and gonadal characteristics of the South American platanistid dolphins called the "bouto" (*Inia geoffrensis*) and the "franciscana" (*Pontoporia blainvillei*), and the delphinid "tucuxi" (*Sotalia fluviatilis*). One offspring is born at a time (Cabrera and Yepes, 1940) and a lactating, 240-centimeter female *I. geoffrensis* has been recovered from the upper Amazon in December (Layne, 1958). Sexual activity has been reported in captive male *I. geoffrensis* during late summer in Florida (Layne and Caldwell, 1964). Huffman (1970) has reported a birth of an 81-centimeter young at Fort Worth Zoological Park on 17 April 1969 in a female *I. geoffrensis* that had been 7 years in captivity. Burmeister (1869) described the testes of a *P. blainvillei* 137 centimeters in length: they would seem to have been inactive. Lahille (1899) gave lengths of male and female specimens of *P. blainvillei* but did not record observations on their gonads.

MATERIALS AND METHODS

During the period 1960 to 1969, specimens of *I. geoffrensis* were obtained from rivers near Iquitos, Peru, from Leticia, Colombia, and from Guanare, Venezuela. Specimens of *P. blainvillei* were obtained from offshore between Punta del Diablo and Playa La Coronilla, Uruguay, and individuals of *S. fluviatilis* from Iquitos, Peru, and from the Amazon near Manaus, Brazil. The specimens of *I. geoffrensis* and *S. fluviatilis* were caught for display at Marineland of the Pacific and Sea World, California and Marineland, Florida. Some specimens of *I. geoffrensis* died on capture or during transport, others survived in captivity for periods of a few days to 18 months. The specimens of *Pontoporia* were collected dead in shark gill nets.

Nine male *I. geoffrensis* (length 123 to 228 centimeters) and nine females (length 130 to 210 centimeters) were examined and their gonads removed. Observations were also made on three males (93, 119, 128.5 centimeters) and eight females (102 to 138 centi-

TABLE 1.—*Specimens examined, weights and measurements, and comments.*

Animal No.	Date of death	Length (cm)	Weight (kg)	Gonadal weight (g)		Diameter of tubules (μ)	Comments
				Left	Right		
				Inia geoffrensis, males			
63-3199	26 Oct 63	123	18	20.7 (both)		80	Immature.
4-67	11 Feb 67	159	42	7.3	7.0	80	Immature; in captivity from September 1966.
26-66	17 July 66	183	65	8.5	—	85	Immature; in captivity from April 1965.
3-67	11 Feb 67	185	62	13.8	13.8	85	Immature; in captivity from September 1966.
76-66	Sep 66	190	59	319	294	100	Testes inactive; no sperm in epididymides.
25-66	20 July 66	198	—	—	—	—	No sperm in epididymides.
3-68	12 Feb 68	219	—	173.5	183.0	150	No sperm in epididymides; in captivity from September 1966.
3-65	Aug 64	221	—	—	—	110	In captivity from July 1964; emaciated; testes inactive.
77-66	Sep 66	228	122	724	723	200	Testes active; sperm in epididymides.
				Inia geoffrensis, females			
2-65	3 Aug 64	130	—	1.6	1.3		Immature.
78-66	Sept 66	135	22.6	1.0	1.2		Immature; in captivity for a few days.
24-66	18 July 66	148	—	1.5	1.5		Immature; in captivity for a few days.
336	—	163	—	2.1	1.9		Ovaries immature.
79-66	Sept 66	183	71	10.1	7.4		In captivity for a few days; one corpus albicans in left ovary.
5-65	—	197	—	10.9	3.9		Pregnant, 3-centimeter fetus; corpus luteum in left ovary, one corpus albicans in the right.
7-68	March 68	201	—	6.3	5.5		One corpus albicans in left ovary, one in the right; in captivity from September 1966.
441	11 Apr 67	202	—	16.0	6.3		Pregnant, 15.5-centimeter fetus; lactating; one corpus luteum and one corpus albicans in left ovary, one corpus albicans in the right.
8-68	March 68	210	—	10.0	10.0		Four corpora albicantia in right ovary; in captivity from September 1966.
				Pontoporia blainvillei, males			
459	7 Feb 69	93	12	—	—		Immature.
458	7 Feb 69	119	20	4.85	4.85	110	Immature.
467	7 Feb 69	128.5	24.5	—	—		Immature.
				Pontoporia blainvillei, females			
468	7 Feb 69	102.5	15	—	—		Immature.
464	7 Feb 69	110	15.5	—	—		Immature.
462	7 Feb 69	113	18	—	—		Immature.
469	9 Feb 69	132.5	23.5	1.0	0.8		Immature.
450	3 Feb 69	134	28	—	—		Immature.
463	7 Feb 69	137	19.5	1.95	0.35		Recently ruptured follicle and two corpora albicantia in left ovary; lactating.
465	7 Feb 69	137.5	29.5	4.75	0.9		Pregnant, 6-centimeter fetus; corpus luteum in left ovary.
466	7 Feb 69	138	28	1.6	0.55		Large follicle (12 millimeters) and one corpus albicans in left ovary.

TABLE 1.—*Continued.*

Animal No.	Date of death	Length (cm)	Weight (kg)	Gonadal weight (g)		Diameter of tubules (μ)	Comments
				Left	Right		
				Sotalia fluviatilis, males			
13-67	—	120	18	10.05	9.5	45	Immature.
11-67	—	130	23.6	26	24.5	70	Immature.
10-68	March 67	133	—	16.5	16.5	—	Immature.
12-67	Nov 66	148	32.7	257	220	150	Testes active.
				Sotalia fluviatilis, females			
23-66	Oct 65	85	13.6	0.66	0.68		Immature; recently born.
14-67	—	114	18	0.5	0.6		Immature.
27-66	Oct 65	132	20.5	1.7	1.4		Immature.
9-68	March 67	146	—	2.3	1.0		Nine corpora albicantia in left ovary.

meters) of *P. blainvillei*. Four male *S. fluviatilis* varied in length from 120 to 148 centimeters and four females were 85 to 146 centimeters long. After noting the reproductive state of each animal, the gonads were removed, weighed and measured (Table 1). The gonads were fixed in 10 per cent formalin, photographed and subsequently sectioned by hand to count corpora lutea and corpora albicantia. Portions of ovaries and testes were embedded in paraffin wax, sectioned and stained with hematoxylin and eosin. The degree of activity of the testes was assessed by measuring the diameter of seminiferous tubules, by the presence of a lumen, by the activity of the spermatocytes and by the presence of spermatozoa in the epididymis. Sections of ovaries were examined for developing and atretic follicles, for the degree of development of corpora lutea and for the histological appearances of corpora albicantia.

Inia geoffrensis

Two males taken in February measured 159 centimeters and 189 centimeters and had inactive testes with combined weights of 14.3 and 27.6 grams, respectively. A male (190 centimeters) taken in September had testes weighing together 613 grams but with inactive seminiferous tubules (average diameter 100 microns) surrounded by abundant fibrous tissue. Another specimen (219 centimeters) died in February after 17 months in captivity at Marineland of the Pacific, California: its two testes had a combined weight of 357 grams, the tubules averaged 150 microns in diameter and were inactive. Males measuring 198 centimeters (taken in July) and 221 centimeters (died in September after 1 month of captivity) also had histologically inactive testes. Another male (228 centimeters), taken in September, had testes with a combined weight of 1.447 kilograms. The tubules averaged 200 microns in diameter and were active, spermatozoa were in the epididymis.

Females reach sexual maturity at a length of 175 to 180 centimeters. Females from 130 to 163 centimeters in length had ovaries (combined weights 2.2 to 4.0 grams) lacking follicles over 1.0 millimeter in diameter and corpora lutea or albicantia. A female of 183 centimeters obtained in early September had a large corpus albicans, 20 × 18 millimeters, with appearances suggesting

that it was an involuting corpus luteum of a recent pregnancy. A pregnant female (197 centimeters) with a fetus of 3.0 centimeters in total length was taken in February; a corpus luteum of 25 × 20 millimeters in the left ovary was enclosed within the structure of the ovary (Fig. 1A) and not pedunculated as in most odontocetes (Harrison *et al.*, 1969). One corpus albicans (8 × 6 millimeters) was in the right ovary (Fig. 1A). A lactating and pregnant female (202 centimeters) with a 15.5-centimeter fetus was caught on 11 April. The corpus luteum in the left ovary was 35 × 30 millimeters. There was a corpus albicans, 8 × 5 millimeters, in the right ovary and a smaller one, 3 × 3 millimeters, in the left ovary.

The length of three newborn specimens was 76 to 80 centimeters; details are not known except that one 80-centimeter specimen was taken at Iquitos, Peru, in July (see Huffman, 1970, for specimen born in captivity at Fort Worth Zoological Park). A lactating female of 196 centimeters and its female calf of 115 centimeters were captured early in April (measured in May). Another lactating female (190.5 centimeters) with a calf (114.0 centimeters) was caught in April.

These findings suggest that implantation can occur during the period October to November, and also probably earlier, and that parturition takes place from July to September in the upper Amazon. Pregnancy can occur while a female is lactating, but it is not certain whether conception immediately follows parturition or occurs a year later. As shown above, the testes are active in September. Two adult females (201 and 210 centimeters in length) died in March, 18 months after capture. They were neither pregnant nor lactating. The ovaries were relatively bulky (combined weights, 12 and 20 grams, respectively) and had two and four small surface scars (2 to 3 millimeters across) marking the sites of persistent corpora albicantia. These appear histologically to be of two types. One is a mass of relatively acellular connective tissue, 8 × 4 millimeters, giving a small raised scar, and is arranged in lobules divided by fibrous septa with obliterated and degenerated blood vessels distributed about the periphery and in the septa. The second type is smaller, 3 × 2 millimeters, exhibiting a yellow pigmentation when cut, and the surface scar is depressed and darkly colored. It consists of coiled obliterated blood vessels embedded in dense fibrous tissue. The general organization suggests that the second type could have been derived from a corpus luteum less well established than one of pregnancy and thus possibly from an infertile ovulation. Although the total number accumulated in the ovaries of these females is few, the corpora albicantia appear to persist as in other cetaceans and to be formed in both ovaries (see type I of Ohsumi, 1964) rather than in one ovary, usually the left (Ohsumi, 1964; Harrison *et al.*, 1969).

Pontoporia blainvillei

Males (93, 119 and 128.5 centimeters in length) taken in February had testes 30 × 9, 40 × 15 (total weight 9.7 grams) and 40 × 13 millimeters in

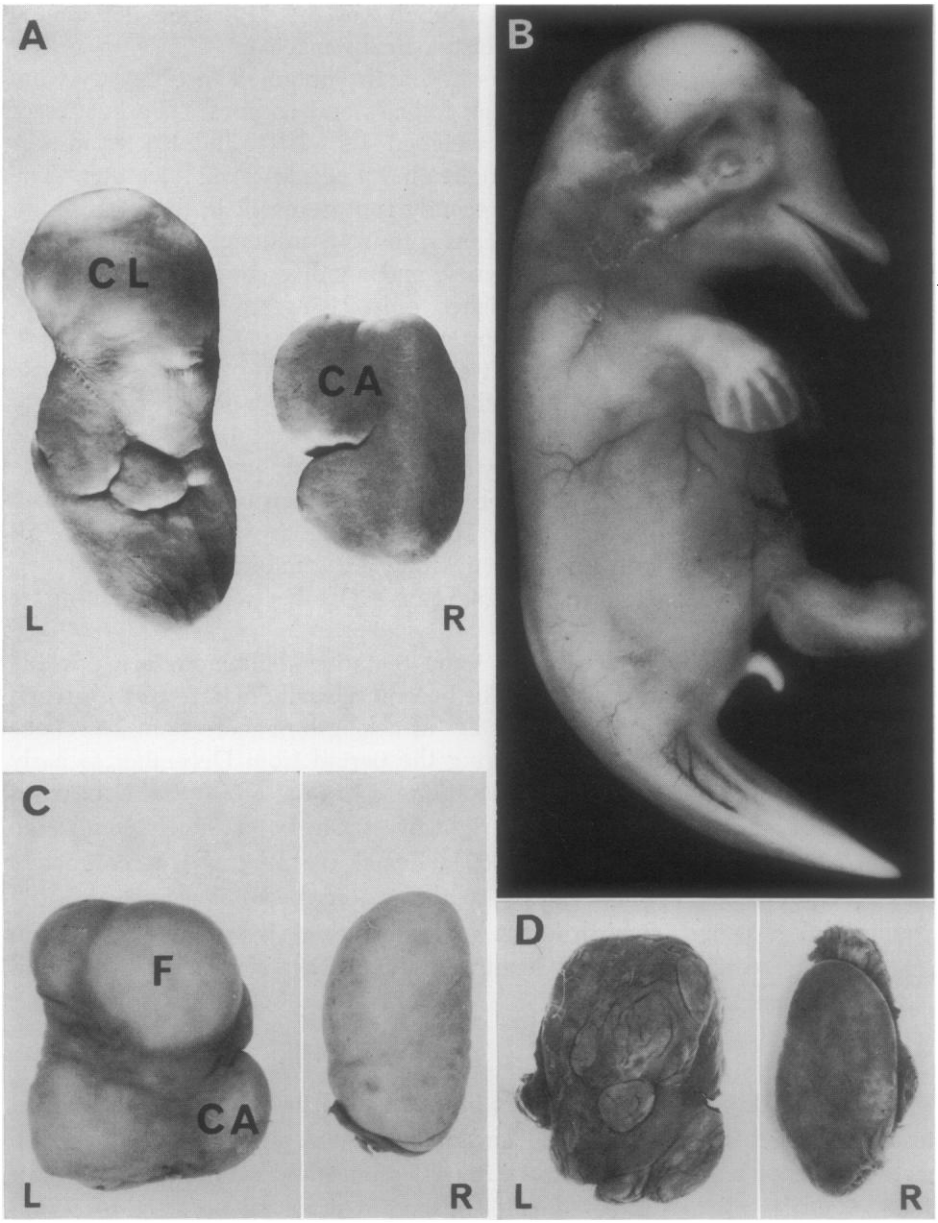

FIG. 1.—A, Ovaries of a 197-centimeter specimen of *Inia geoffrensis*, pregnant with a 3.0-centimeter fetus, showing corpus luteum (CL) in left and corpus albicans (CA) in the right ovary, × 1.0; B, fetus of *Pontoporia blainvillei*, 6.0 centimeters in total length, obtained 7 February 1969, × 2.3; C, follicle (F) and corpus albicans (CA) in the left ovary of a specimen of *P. blainvillei*, length 138 centimeters taken 7 February 1969, × 1.2; D, nine corpora albicantia in the left ovary of a specimen of *Sotalia fluviatilis*, length 146 centimeters, taken March 1967, × 1.1.

length and breadth. The seminiferous tubules of the 119-centimeter animal averaged 100μ in diameter and were histologically inactive.

Females (102.5 to 134.0 centimeters in length) obtained in February were immature; their ovaries lacked growing follicles and corpora. The ovaries of a female, length 132.5 centimeters, weighed 1.0 (left) and 0.8 grams. A female 137 centimeters in length, caught on 7 February, was lactating. The left ovary (1.95 grams) contained a recently ruptured follicle (15 × 10 millimeters), one projecting corpus albicans (10 × 8 millimeters), which was presumably that of the recent pregnancy, and another corpus albicans (3 × 3 millimeters). The right ovary weighed only 0.35 gram. A female (137.5 centimeters) was obtained on 7 February with a 6-centimeter fetus (Fig. 1B) in the left uterine horn. The left ovary (4.75 grams) contained a single spherical corpus luteum, 25 × 11 millimeters. Neither it nor the small right ovary (0.9 gram) exhibited any corpora albicantia or large follicles. A female (138.0 centimeters) taken in February and not lactating had a healthy follicle 12.0 millimeters in diameter and one protuberant corpus albicans (6 × 6 millimeters) in the left ovary (Fig. 1C). The right ovary was devoid of corpora and had only one small atretic follicle (1 millimeter in diameter). A female of 142 centimeters was pregnant on 4 October with a 61-centimeter fetus.

Despite the paucity of specimens some tentative deductions are possible from the gonadal appearances. Females become sexually mature as they reach a length of 134 to 137 centimeters; males at a length of more than 140 centimeters. Ovulation occurs at least during the period from December to early February and can occur during lactation. Corpora albicantia appear to persist as in other cetaceans and the right ovary can be extremely small (see Ohsumi, 1964, and Harrison *et al.*, 1969). Females as long as 174 centimeters have been reported (Lahille, 1899) so those described above are probably young adults. Length at birth is not known but there is an alleged newborn female of 59 centimeters total length in the Museo Nacional de Historia Natural, Montevideo, Uruguay.

Sotalia fluviatilis

Males from 120 to 133 centimeters in length had inactive testes; combined testicular weights varied from 20 and 50 grams. A 148-centimeter, captive male had active testes, together weighing 477 grams, when it died in November 1966. Females up to 132 centimeters in length displayed no signs of sexual activity. A 140-centimeter female captured in October was lactating. A female of 146 centimeters that died in March had nine corpora albicantia (Fig. 1D) in the left ovary (2.3 grams) but none in the small right ovary (1.0 grams). The corpora albicantia projected as more or less pedunculated excrescences of which the largest was 8 × 5 millimeters and the rest about 3 × 3 millimeters. Only the largest seemed likely from its histology to be a

corpus albicans of pregnancy, the others resembled a type seen in *Lagenorhynchus* and considered that of an infertile ovulation (Harrison *et al.*, 1969).

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