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OVARIAN CHARACTERISTICS, CORPORA LUTEA AND CORPORA ALBICANTIA IN *DELPHINUS DELPHIS* STRANDED ON THE ATLANTIC COAST OF FRANCE

Anne Collet, Centre d'Etude des Mammifères Marins, 28 Rue Albert 1er, 17000 La Rochelle, France.
R.J. Harrison, Anatomy School, Downing Street, Cambridge, England.

Reports of strandings of the Common Dolphin *Delphinus delphis* on the north east Atlantic coast of France during the past decade have been those of DUGUY and BUDKER (1972) and DUGUY (1973 to 1979). A few dolphins were also recovered dead from the sea. FRASER (1934 to 1974) has listed strandings on British coasts of Common Dolphins from 1913 to 1966. SLEPTZOV (1940) and TOMILIN (1967) have described *Delphinus* from the Black Sea and have made observations on reproductive events and on gonads. HARRISON, BROWNELL and BOICE (1972) have given details of gonadal characteristics in odontocetes, including *Delphinus*, and have suggested that corpora albicantia of pregnancy persist for life in the species described. More evidence has been provided by HARRISON (1977) for persistent corpora albicantia in *Tursiops truncatus*. HARRISON *et al.* (1981) are not convinced, however, that in the platanistid *Pontoporia blainvillei* corpora albicantia persist beyond four years. Efforts have been made by several investigators (see HARRISON, BROWNELL and BOICE, 1972) to differentiate between corpora albicantia derived from corpora lutea of pregnancy and those from corpora lutea of a cycle, of pseudopregnancy, of abortion, of a secondary or accessory type (HARRISON, 1977). More recently HARRISON and McBREARTY (1977) have reported on the ovaries of *Tursiops* and *Lagenorhynchus* which had been held in captivity for varying periods and about which some details of reproductive events had been recorded. In these circumstances it appeared that successive ovulations not followed by pregnancy could occur in *Lagenorhynchus*.

Immature females

Number	*Date*	*Stranded*	*Length cm.*	*Ovary weight g.*
1226	19 Jan 1981	Mimizan	163	L 0.57 R 0.44
1235	3 Feb 1981	St Nazaire	171	L 0.51 R 0.42
1143	18 April 1979	Telgruc	177	L 0.54 R 0.50
1230	26 Jan 1981	Messanges	183	L 0.87 R 1.17
1225	17 Jan 1981	Mimizan	186	L 1.55 R 1.09
1114	12 Feb 1979	St Trojan	187	L 0.72 R 0.88
1145	26 April 1979	Guethary	187	1.21
1065	17 Dec 1977	Taken off Ile d'Yeu	189	L 1.36 R 1.29

The ovaries of these animals were flattened and elongated with smooth surfaces. No large follicles were observed and even in the larger dolphins active enlargement of follicles had not commenced.

Mature females

The ovaries of females possessing corpora lutea and/or corpora albicantia have been examined and are described below in detail. The ovaries were removed, measured, weighed and fixed in 10% formalin. After fixation each pair of ovaries was photographed and the scars of corpora albicantia were identified and numbered on the print. The ovaries were then sliced by hand into segments a few millimetres thick and after all corpora had been identified and diameters measured in millimetres, histological sections were cut where the appearance indicated this would be instructive. *None of the females was pregnant and none was lactating.*

D. delphis No. 1169 195 cm. Stranded Sainte Marie en Re 23 March 1980. *Left ovary* 3.32 g. exhibited six external scars of corpora albicantia 5 x 5 x 5, 5 x 6 x 4, 5 x 5 x 4, 5 x 4 x 3, 4 x 3 x 3, 4 x 2 x 2 mm. A seventh small corpus albicans 4 x 3 x 2 mm was found in the histological sections. This indicates the importance of always sectioning ovaries carefully to ascertain the correct number of corpora albicantia. No large or growing follicles present but numerous primordial follicles with oocytes are distributed in the cortex and suggest potential reproductive activity. *Right ovary* 2.53 g. showed seven external scars of corpora albicantia 5 x 5 x 4 (2), 4 x 4 x 3, 4 x 3 x 3, 3 x 3 x 3, 4 x 1 x 1, 3 x 2 x 2 mm. No large follicles but numbers of primordial follicles.

No. 1196 195 cm. Stranded St. Clement des Baleines 29 August 1980. *Left ovary* 4.16 g. possessed a retrogressing corpus luteum or young corpus albicans 20 x 18 x 13 and an old corpus albicans 3 x 3 x 3 mm. There was also two other corpora about 1.0 mm in diameter which exhibited a similar structure but were discovered only in histological sections. The ovarian cortex contained numerous oocytes and a few developing follicles up to 1.0 mm in diameter, suggesting that this was a young mature female. The retrogressing corpus luteum exhibited luteal cell degeneration with loss of cell boundaries, pyknotic nuclei and deposition of extensive amorphous palely eosinophilic material. Many well developed blood vessels and sinusoids contained red cells but the general appearance was not that of a recent well-developed corpus luteum of pregnancy: indeed this female showed no evidence of mammary gland activity.
The *right ovary* weighed only 0.71 g. and lacked corpora.

No. 1168 195+ cm. Stranded Dolus an Oleron 2 March 1980.
Left ovary 1.63 g. had two external scars of corpora albicantia about 6 x 5 x 5 mm (one was not measured) and a third smaller one only found on sectioning. No healthy follicles were present. The largest corpus albicans resembled a degenerating corpus luteum which had not fully developed and over wich a proper scar had not yet formed. The next largest was a more condensed form of the previous corpus.
Right ovary 1.61 g. exhibited several surface scars of atretic follicles which contained yellow pigment. No corpora albicantia were present.

No. 1134 196 cm. Stranded Porspoder 30 March 1979. *Left ovary* 4.27 g. possessed a large, pedunculated, well-organized corpus luteum 15 x 14 x 9, a recently ruptured (or lutealized) follicle 10 x 9 x 6, and exhibited five external scars of corpora albicantia 9 x 6 x 4, 6 x 6 x 6, 6 x 6 x 4, 6 x 5 x 4, 4 x 3 x 3. The corpus luteum showed advanced retrogression, vacuolation of luteal cells and the appearance of acellular material in its lobules. Two of the corpora albicantia displayed a well-organized structure with much acellular hyaline material in lobules and large obliterated blood vessels at their periphery. *Right ovary* 2.35 g. had five external scars of corpora albicantia 9 x 7 x 7, 8 x 7 x 5, 8 x 6 x 6, 6 x 5 x 4, 4 x 3 x 3. The two largest exhibited quantities of acellular material and resembled the two present in the left ovary.

No. 1126 198 cm. Stranded Le Bois en Re 22 March 1979. *Left ovary* 4.87 g. had nine surface scars of corpora albicantia 8 x 7 x 7, 7 x 5 x 2, 5 x 4 x 3 (2), 5 x 3 x 3, 4 x 4 x 4, 4 x 2 x 2, 3 x 3 x 3, 3 x 3 x 2.
Right ovary 4.29 g. contained one large, young corpus albicans (or old retrogressing corpus luteum) 10 x 8 x 3 and three scars of smaller corpora albicantia 8 x 6 x 3, 6 x 3 x 3, 5 x 5 x 3.

No. 1237 199 cm. Stranded Paimboeuf 16 February 1981. *Left ovary* 3.06 g. had three corpora albicantia 6 x 6 x 5, 5 x 5 x 5, 5 x 5 x 3. *Right ovary* 2.59 g. had two relatively large corpora albicantia 10 x 9 x 7 and 8 x 8 x 7 mm.

No. 1186 200 cm. Stranded Chatelaillon 1 July 1980. *Left ovary* 3.25 g. had a small pigmented structure 2 x 2 x 4 which on section contained degenarating vacuolated granulosa cells, aggregations of densely stained cells resembling theca interna cells and was surrounded by thick-walled, occluded blood vessels: it was considered to be a corpus atreticum.
Right ovary 3.3 g. had one small corpus albicans 5 x 4 x 4.

No. 1178 202 cm. Stranded Loctudy 29 March 1980. *Left ovary* 1.95 g. had six corpora albicantia 6 x 6 x 5, 5 x 5 x 5, 5 x 5 x 4, 5 x 4 x 4, 3 x 3 x 3 (2). *Right ovary* 1.55 g. had five corpora albicantia 7 x 6 x 5 (2), 5 x 5 x 3, 4 x 3 x 3, 3 x 3 x 3. The ovaries were small for a female of this length.

No, 1203 202 cm. Stranded Penmarch 29 September 1980. *Left ovary* 3.98 g. had one follicle 9 x 8 x 7 mm and six corpora albicantia of which four were pedunculated and arranged in a row along one margin of the ovary. They measured 8 x 8 x 7, 7 x 6 x 6, 6 x 6 x 5, 5 x 4 x 3 and the other two placed at one pole were 9 x 8 x 6 and 5 x 4 x 3. *Right ovary* 3.37 g. had a single corpus albicans 11 x 11 x 10 mm. It also possessed several small pedunculated protuberances along one edge but these were not corpora, only exfoliations of the ovarian margin.

No. 1167 208 cm. Stranded Le Croisic 28 February 1980. *Left ovary* 6.02 g. exhibited seven external scars of corpora albicantia 10 x 10 x 8, 8 x 8 x 8, 7 x 7 x 5, 6 x 5 x 3, 5 x 4 x 3, 4 x 4 x 3, 4 x 4 x 2. Three of the larger corpora had a more organized appearance with remnants of central and radiating septa, a thick surface scar, large blood vessels embedded in acellular material of which several had a lumen containing red cells. The four smaller corpora were formed mainly of aggregations of obliterated blood vessels with scanty acellular material and resembled the type of corpus albicans found so consistently in mature ovaries of *Delphinus*. *Right ovary* 2.63 g. lacked corpora albicantia but did have many small follicles.

No 1162 208 cm. Stranded Saint Denis d'Oleron on 8 February 1980. *Left ovary* 3.45 g. exhibited fourteen external scars of corpora albicantia 7 x 6 x 5, 7 x 6 x 6, 6 x 6 x 4, 6 x 5 x 3, 5 x 5 x 4, 5 x 4 x 4, 5 x 4 x 3, 6 x 3 x 3, 5 x 3 x 3, 4 x 4 x 4, 4 x 4 x 3, 4 x 4 x 3, 4 x 3 x 2, 3 x 3 x 3. *Right ovary* 2.37 g. had four external scars 9 x 5 x 4, 8 x 7 x 4, 7 x 5 x 5 (2). Two of these corpora were larger and appeared more recent formations in that they had a more organized structure and projected more from the ovarian surface in a more or less pedunculated fashion. The variations in size and characteristics of the eighteen corpora in the two ovaries emphasized the difficulties in analysing their possible significance.

Discussion

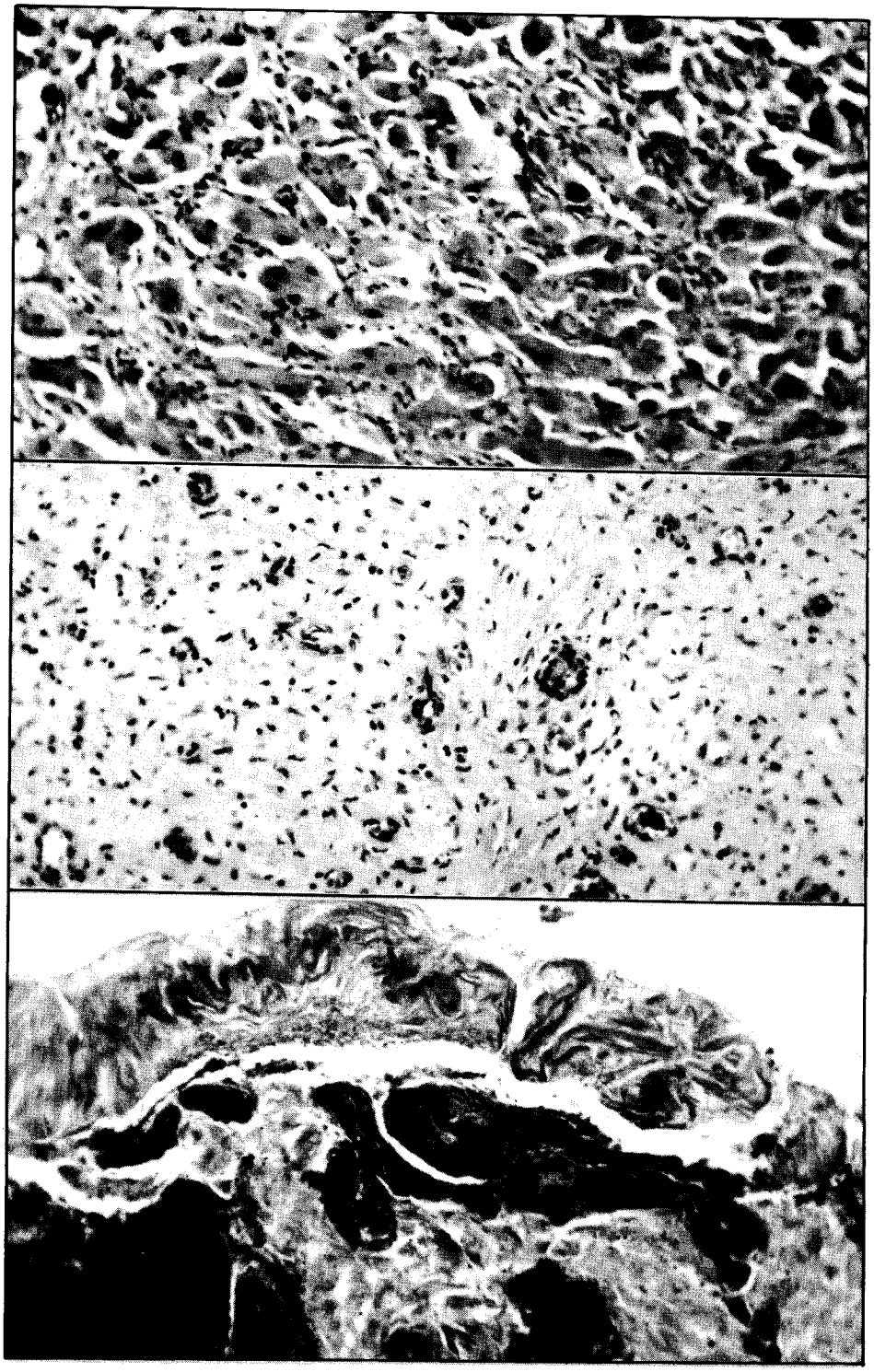
Female *Delphinus delphis* in this series up to a length of 189 cm were immature. One female of 195 cm had a recent corpus luteum and one corpus albicans but another of similar length had fourteen scars of corpora albicantia. A female of 200 cm, on the other hand, had only a single corpus albicans.

The ovaries of fifteen *Delphinus*, 170—192.5 cm in length, stranded on Californian coasts, have been collected by William A. Walker and examined by us. All females had corpora albicantia (1-9) in one ovary, five had them in both ovaries. Four of the shorter females (172—180.5 cm) also had a corpus luteum but were not pregnant: two females (182, 188 cm) were pregnant and had a corpus luteum as well as nine and three corpora albicantia respectively. The greatest number of corpora albicantia was at least ten (9+1), in a female 182.5 cm long.

HARRISON, BROWNELL and BOICE (1972) found *Delphinus* of 145—193 cm from Californian waters that showed no evidence of ovulation, yet one female of 172.5 cm had six small corpora albicantia and one of 182 cm was pregnant, had a large corpus luteum (25 x 20 mm) and two small corpora albicantia. Another female of 195 cm (Dd 502) was stated by GUREVICH *et al.* (1980) to have eleven complete and one incomplete growth layer groups in the dentine. This animal had been in captivity for over two years. The ovaries were examined by us and weighed only 1.1 and 1.5 g. No corpora were present but there were numerous small (1-2 mm) healthy and atretic follicles.

Fig. 1 (Top). The right and left ovaries of *Delphinus delphis* No. 1126, 198 cm in length, showing a retrogressing corpus luteum in the right ovary and many scars of corpora albicantia. X 2.

(Bottom). The left and right ovaries of *D. delphis* NO. 1203, 202 cm in length, with a follicle (top) and four pedunculated corpora albicantia arranged in a row along the margin of the left ovary: the similar masses on the right ovary were not corpora. X 2.



HUI (1977) found that in *Delphinus* there was "a wide range of recorded ovarian corpora" at any given age. He also found that some females show no evidence of having ovulated although various indicators of maturity suggest that they could have. If there were always to be non-ovulating adult females in a school, he believes that they may have some special role in the social structure.

Any analysis of corpora albicantia in delphinids has to be based on certain assumptions. One is that females increase in length, albeit unequally, as they age, at least during early life, and a second is that the corpora albicantia persist, albeit shrinking more or less gradually (HARRISON, BROWNELL and BOICE, 1972). Recently, however, HARRISON *et al.* (1981) have presented evidence which suggests that in *Pontoporia blainvillei* corpora albicantia are reabsorbed completely after four years.

There is also the difficulty of determining whether a particular corpus albicans was derived from a corpus luteum of pregnancy, or of pseudopregnancy, or from one of a series of ovulations occurring during successive oestrous cycles. There are also other possible sources of corpora albicantia in delphinids, such as accessory corpora lutea (HARRISON, 1977). It is also difficult, without serial sectioning, to be sure a small corpus albicans has not been missed. There are in this series of *D. delphis* four females of length 195—196 cm. Their ovaries contained respectively, one, fourteen, two and ten corpora albicantia. Unless *D. delphis* does not increase in length much after reaching sexual maturing it would seem unlikely that an animal of 195 cm would have had fourteen young. Indeed, one female of 208 cm had eighteen corpora albicantia, and if all female *D. delphis* were potentially capable of begetting ten, fourteen and eighteen young over as many years there would soon be an enormous number of that species unless there were a high mortality of young females. There is to date no evidence of a rapidly increasing population of *Delphinus* in these waters nor of an excessive postnatal mortality.

Dolphin No. 1134, 196 cm, had a large well organized but retrogressing corpus luteum, a recently ruptured follicle, and ten corpora albicantia decreasing in mean diameter from about 8 to 3 mm. The animal was not pregnant and the uterine horns were equal in size (it is possible of course that it had been pregnant but had aborted). The corpora albicantia could be divided into two types, the first (2) with considerable acellular hyaline material arranged in lobules, the second (8) with little more than coils of obliterated blood vessels and sparse hyaline material. It is therefore argued that the appearances could provide one explanation of the pattern of ovarian activity in *D. delphis*. Sexual maturity might be marked by the onset of a variable number of successive oestrous cycles not resulting in pregnancy until that particular individual attains the status of a breeding cow within the social structure of its school. Whether ovulation is spontaneous, or induced by sexual activity, would not be strategically important: position in the social hierarchy would be the key to recruitment for breeding. Mature females that have not ovulated might be playing a protective or supporting role, those that ovulate but do not become pregnant are potential breeding recruits and exhibit only small, poorly organized corpora albicantia, whereas breeding cows exhibit some of this type but also more organized corpora albicantia related to pregnancies.

Fig. 2 Photomicrographs of (top) the well-developed corpus luteum of *D. delphis* No. 1134, 196 cm in length, showing signs of retrogression, (centre) the young corpus albicans of *D. delphis* No. 1196, 195 cm in length and (bottom) the scar of a small corpus albicans of *D. delphis* No. 1168, 196 cm in length. All X 10.

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