



True Hermaphroditism in a St. Lawrence Beluga Whale (*Delphinapterus leucas*)

Authors: De Guise, Sylvain, Lagacé, André, and Béland, Pierre

Source: Journal of Wildlife Diseases, 30(2) : 287-290

Published By: Wildlife Disease Association

URL: <https://doi.org/10.7589/0090-3558-30.2.287>

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

True Hermaphroditism in a St. Lawrence Beluga Whale (*Delphinapterus leucas*)

Sylvain De Guise,^{1,2} André Lagacé,¹ and Pierre Béland,² ¹ Faculté de Médecine Vétérinaire, Université de Montréal, C.P. 5000, St-Hyacinthe, Québec, Canada J2S 7C6; ² St. Lawrence National Institute of Ecotoxicology, 3872 Parc-Lafontaine, Montréal, Québec, Canada H2L 3M6

ABSTRACT: A hermaphrodite beluga whale (*Delphinapterus leucas*) was found in the St. Lawrence Estuary, Québec, Canada. This animal had two testicles, two separate ovaries, and the complete ducts of each sex; cervix, vagina and vulva were absent. Mature spermatozoa were found in the lumen of seminiferous tubules in the testicles, and numerous involuted corpora lutea were recognized in the ovaries. This represents the first case of true hermaphroditism in a cetacean, and is the fourth hermaphrodite mammal with two testicles and two separate ovaries.

Key words: True hermaphrodite, beluga whale, *Delphinapterus leucas*.

In the course of a study on the pathology and toxicology of stranded beluga whales (*Delphinapterus leucas*) in the St. Lawrence Estuary, Québec, Canada, a 4.16-m-long animal weighing 1,045 kg was found drifting at Ste-Flavie (48°39'N, 68°17'W). It appeared externally to be a male, and was transported to the University of Montreal and necropsied. Sections of skin, lungs, mediastinal lymph nodes, heart, aorta, kidneys, spleen, adrenals, the four gastric compartments, intestine, testes, ovaries, uterus, and urinary bladder were fixed in 10% neutral buffered formalin, embedded in paraffin, cut into 5 µm sections and stained with hematoxylin, phloxin and saffron (Luna, 1968). Age was determined by tooth section (Sergeant, 1973). A spondylosis ankylosans, an ulcerative enteritis, gastric papillomas and a periodontitis also were found in this animal aged >26-year-old.

The penis was normally located in the genital slit, halfway between the anus and the umbilicus. Internally, two small testicles, 350 g and 400 g respectively, were found, along with normally located epididymis and vas deferens. A complete female genital tract also was present. An ova-

ry was located dorsally to the caudal pole of each testicle (Fig. 1). Ovaries measured 4 × 3 × 2 cm, had an irregular surface, with reddish nodules resembling corpora hemorrhagica, and were hidden in an ovarian bursa (Fig. 2). Uterine horns, 1 cm in diameter and prolonged by a short uterine tube, followed their normal course, fusing into a 4-cm-long uterine body (Fig. 3). The abdominal urethra formed a urinary meatus where it joined the uterine body, and the urethra and the uterus both opened into the beginning of the penile urethra. Thus, this animal had two testicles, two ovaries, and the complete ducts of each sex; cervix, vagina and vulva were absent. Examination of mammary glands was omitted.

Histologically, mature spermatozoa were found in the lumina of seminiferous tubules in the testicles (Fig. 4). Despite moderate to severe autolysis, numerous involuted corpora lutea were recognized in the ovaries. These appeared as irregular nodules ≤5 mm in diameter showing various



FIGURE 1. The left ovary (long arrow) of the beluga whale was located dorsally to the caudal pole of the testicle (T). The uterine horns (short arrow) and the penis (P) also are seen.

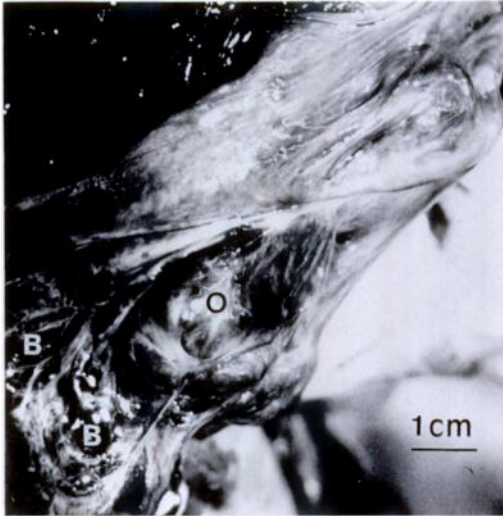


FIGURE 2. The right ovary (O) of the beluga whale was located in the ovarian bursa (B) and had an irregular surface.

degrees of fibrosis in the ovarian parenchyma (Fig. 5). Remnants of large cells (luteal cells) were recognized in these nodules. Also, some small cysts probably corresponded to follicles. Autolysis of the uterus was severe and the mucosa was totally desquamated. Unfortunately, a karyotype was not done on this animal because of autolysis and lack of unfixed frozen tissues.

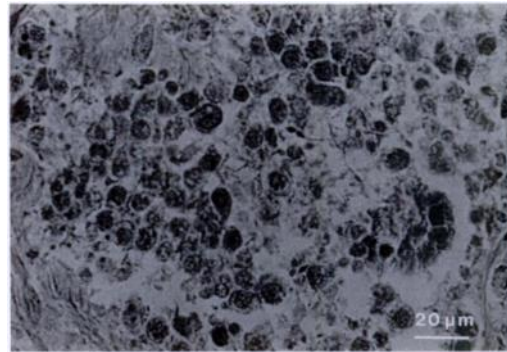


FIGURE 4. Mature spermatozoa in the lumen of an autolyzed seminiferous tubule of the beluga whale. Hematoxylin, phloxin, saffron stain.

Hermaphroditism is a rare condition in animals. Pseudohermaphroditism already has been reported in a bowhead whale (*Balaena mysticetus*) (Tarpley et al., 1990), a fin whale (*Balaenoptera physalus*) (Bannister, 1962) and a dolphin (*Prodelphinus caeruleoalbus*) (Nishiwaki, 1953), but true hermaphroditism has never been reported in a cetacean.

True hermaphroditism can be bilateral (two ovotestes), unilateral (one ovotestis), or lateral (an ovary and a testicle) (Tangner et al., 1982). The present case, two rabbits (Sheppard, 1943; Frankenhuis et al., 1990) and a pig (Walentowicz, 1888),



FIGURE 3. The opened uterine horns (arrows) of the beluga whale were fused into a short uterine body (B). The scissors were inserted in the abdominal urethra to show the urinary meatus (point of insertion of the scissors), just proximal to the entry into the penis (under the visible part of the scissors).

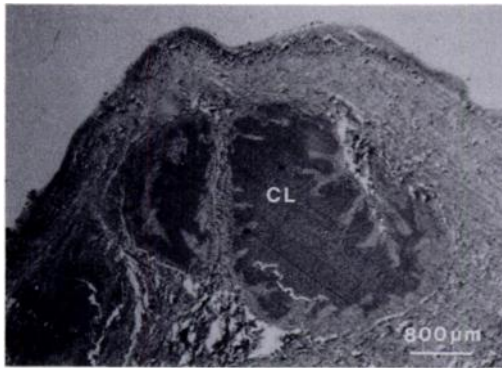


FIGURE 5. Three involuted corpora lutea (CL) of the beluga whale appeared as irregular nodules up to 5 mm in diameter in the ovarian parenchyma. Hematoxylin, phloxin, saffron stain.

with separate gonads of both sexes on each side, probably should be classified as atypical bilateral hermaphrodites.

Speroff et al. (1989) summarized the normal development of the genital tract. Normally the genetic sex is fixed at the time of fertilization, and then imposed on the undifferentiated bipotential gonad. The conversion of this gonad to a testis would require a single gene determinant on the Y chromosome, the testis determining factor (TDF). This gene produces a protein that would be the "master switch" for male differentiation because of its capacity to activate the expression of other genes elsewhere on X, Y, and autosomes, including the H-Y locus (or loci). These H-Y genes code for the H-Y antigen invariably expressed in individuals with testes. In the absence of a Y chromosome, the undifferentiated gonad develops into an ovary. The formation of the testicle precedes and controls any subsequent sexual development (Speroff et al., 1989).

Duct primordia of both sexes coexist temporarily. In males, mesonephrotic ducts develop under the influence of androgens, while the Müllerian inhibiting factor (MIF) induces the regression of the paramesonephrotic ducts. In females, the lack of MIF allows development of the paramesonephrotic ducts, while the mesonephrotic ducts regress without testosterone. Bi-

potential external genital primordia develop as male under the influence of dihydrotestosterone, or as female in its absence.

In the present case, male development would have been complete. The simultaneous development of separate ovaries must have required the duplication of the undifferentiated bipotential gonads, with a lack of response of the future ovaries to TDF. The development of the paramesonephrotic ducts into a uterus must reflect a lack of MIF, a deficient timing in MIF production, or a lack of response to it (Sommer and Meyers-Wallen, 1991). The absence of vulva and outer vagina is expected since they originate from the single external genital primordia that developed as male, but the absence of cervix and inner vagina remains unexplained.

Questions arise about the hormonal balance that would allow simultaneous testicular and ovarian activity in this animal, but pregnancy has already been noted in true hermaphrodite individuals: a sow (Hulland, 1964), a dog (Selden et al., 1978), a few humans (Williamson et al., 1981) and two rabbits (Sheppard, 1943; Frankenhuis et al., 1990), in one of which autototalization occurred (Frankenhuis et al., 1990).

To our knowledge, this case of true hermaphroditism in a beluga whale represents the first report of this condition in a cetacean, and is the fourth report in animals or humans of coexistence of distinct pairs of testes and ovaries in the same individual; no clear explanation could be provided for this phenomenon.

We thank Dr. Daniel Martineau for useful discussions and comments. The study was supported by the Wildlife Toxicology Fund, a joint initiative of World Wildlife Fund Canada and Environment Canada, with major contributions from the Department of Fisheries and Oceans Canada, under the St. Lawrence Action Plan, from Alcan, and the World Wildlife Fund, significant contribution from the Fondation de la Faune de Québec and Environne-

ment Quebec, and an additional contribution from Greenpeace (Canada). S. De Guise was supported by a grant from FCAR.

LITERATURE CITED

- BANNISTER, J. L. 1962. An intersexual fin whale *Balaenoptera physalus* (L.) from South Georgia. *Proceedings of the Zoological Society of London* 141: 811-822.
- FRANKENHUIS, M. T., C. M. C. SMITH-BUJIS, L. E. M. DE BOER, AND J. W. KLOOSTERBOER. 1990. A case of combined hermaphroditism and autofertilisation in a domestic rabbit. *The Veterinary Record* 126: 598-599.
- HULLAND, T. J. 1964. Pregnancy in a hermaphrodite sow. *Canadian Veterinary Journal* 5: 39-41.
- LUNA, L. G. (editor). 1968. *Manual of histologic staining methods of the Armed Forces Institute of Pathology*, 3rd ed. McGraw-Hill Book Company, New York, New York, pp. 39-40.
- NISHIWAKI, M. 1953. Hermaphroditism in a dolphin (*Prodelphinus caeruleoalbus*). *Scientific Reports of the Whales Research Institut, Tokyo* 8: 215-218.
- SELDEN, J. R., S. S. WACHTEL, G. C. KOO, M. E. HASKINS, AND D. F. PATTERSON. 1978. Genetic basis of XX male syndrome and XX true hermaphroditism: Evidence in the dog. *Science* 201: 644-646.
- SERGEANT, D. E. 1973. Biology of white whales (*Delphinapterus leucas*) in western Hudson Bay. *Journal of the Fisheries Research Board of Canada* 30: 1065-1090.
- SHEPPARD, E. M. 1943. The reproductive system of a pregnant hermaphrodite rabbit (*Oryctolagus cuniculus*). *Journal of Anatomy* 77: 288-293.
- SOMMER, M. M., AND V. N. MEYERS-WALLEN. 1991. XX true hermaphroditism in a dog. *Journal of the American Veterinary Medical Association* 198: 435-438.
- SPEROFF, L., R. H. GLASS, AND N. G. KASE (editors). 1989. Normal and abnormal sexual development. *In Clinical gynecologic endocrinology and infertility*, 4th ed. Williams & Wilkins, Baltimore, Maryland, pp. 379-408.
- TANGNER, C. H., M. A. BREIDER, AND M. S. AMOSS. 1982. Lateral hermaphroditism in a dog. *Journal of the American Veterinary Medical Association* 181: 70-71.
- TARPLEY, R. J., M. S. JARRELL, J. C. GEORGE, AND T. ALBERT. 1990. Male pseudohermaphroditism in the bowhead whale (*Balaena mysticetus*). *Proceedings of the 21st International Association of Aquatic Animal Medicine Conference, Vancouver, British Columbia*, p. 179.
- WALENTOWICZ, A. 1888. Oprzypadku devuplcio-wosci obustronnej u swini (hermaphroditismus bilateralis). *Proceedings of the Academy of Sciences, Krakow* 14: 69.
- WILLIAMSON, H. O., S. A. PHANSEY, AND R. S. MATHUR. 1981. True hermaphroditism with term vaginal delivery and a review. *American Journal of Obstetrics and Gynecology* 141: 262-265.

Received for publication 8 March 1993.