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Source: Journal of Wildlife Diseases, 23(3) : 510-514

Published By: Wildlife Disease Association

URL: <https://doi.org/10.7589/0090-3558-23.3.510>

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## Unusual Multisystemic Pathology in a Sperm Whale Bull

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**ABSTRACT:** This report describes an unusual combination of lesions and apparent behavioral abnormalities in a sexually mature sperm whale bull taken in whaling operations off Iceland. Lesions included heavy combative scarring of the head, grossly roughened and thickened skin on the lower left flank, cutaneous maculae, genital papillomatosis, partial duodenal obstruction by plastic debris, colo-rectal obstruction by ambergris, cystic degeneration of the right kidney, and a deeply ulcerative gastric nematodiasis. Sealskin was found in the stomach. Gross and histopathologic observations suggested that the disease complex in this animal may have been related both to habitat degradation and health risks naturally associated with its ecology and age.

**Key words:** Sperm whale, comparative pathology, *Physeter catodon*, Cetacea, pollution, plastic debris, genital papillomatosis, nematodes, *Anisakis physeteris*.

The sperm whale, *Physeter catodon*, inhabits global oceans from equatorial to subpolar latitudes. It is a pelagic species found primarily in open water of greater than 600 m depth, rarely in coastal regions. Cephalopods and deepwater fish constitute its principal diet (Tomilin, 1957; Nishiwaki, 1972).

This report describes an unusual combination of pathologic lesions and apparent behavioral abnormalities in a 15.2 m sexually mature sperm whale bull (No. 278-82) taken in commercial whaling operations off the western coast of Iceland on 4 September 1982. Postmortem studies were conducted at the Icelandic Whales Research Laboratory, Hvalfjordur, Iceland. The combination of abnormalities found in this animal was judged to be unusual in relation to the results of systematic necropsies of 30 other sperm whale bulls conducted by one of us (RHL) in 1981 and

1982. From conventional age-length keys (Cooke and de la Mare, 1983) whale 278-82 was probably >40 yr old.

The majority of sperm whales examined in 1981 and 1982 were affected with superficial lesions of the skin, variable degrees of combative scarring, cestode cysts in their blubber, and a noninvasive gastric nematodiasis. Fistulous lesions of the skin were common, and evidence of genital papillomatosis occurred in 3 of the 31 bulls examined (Lambertsen et al., 1987).

Sperm whale 278-82 was unusual in having very heavy combative scarring of the head, grossly roughened and thickened skin on its lower left flank, an uncommon type of punctate skin lesion (dark gray maculae), extensive genital papillomatosis, partial duodenal obstruction by a man-made foreign body, colo-rectal obstruction by ambergris, cystic degeneration of the right kidney, and a deeply ulcerative gastric nematodiasis. Also, the site of capture was unusual. Whale 278-82 was found in shallow, nearshore waters just west of Snaefellsness, an area where sperm whales rarely if ever were sighted during 35 years of whale ship traffic through the region (K. Loftsson, pers. comm.). Other unusual behavior was suggested by the unique finding of pieces of freshly dead sealskin in this whale's stomach. Seals have not previously been reported as a food item of sperm whales.

A necropsy was conducted by the method previously described for fin whales (Lambertsen, 1986). Extensive scarring of the head (Fig. 1A) secondary to intraspecific combat was confirmed by the spacing of the observed scars, which fit the natural tooth spacing of sperm whales. Three of

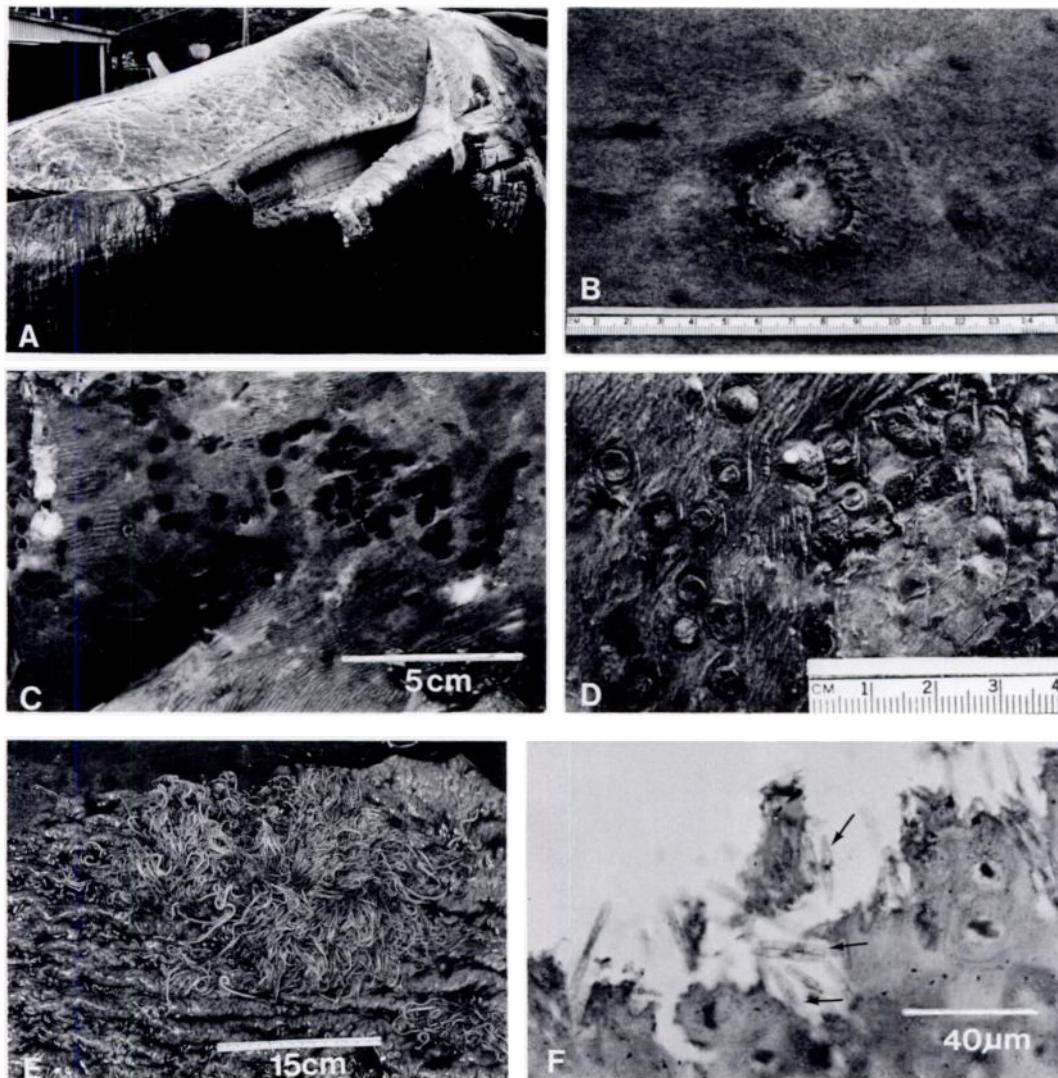


FIGURE 1. Sperm whale bull no. 278-82. A. Scarring of the head and jaws. B. Typical gross appearance of cutaneous fistula extending into dermis. C. Dark gray maculae in gular region. D. Elevated, roughened skin anteriolateral to genital slit. E. Verminous plaque invading wall of second stomach compartment. F. Pennate diatoms associated with macular lesions of skin shown in C; periodic acid-Schiff stain.

the first 10 teeth on the right lower jaw were broken. At the angle of the mouth there were numerous sucker marks and scars from teuthid squid.

Twenty to 30 cutaneous fistulae (Fig. 1B), each typically 1–1.5 cm in diameter and 2–4 cm in depth, occurred on the dorsal body surface. These ended blindly in the dermis. Histologic evaluation revealed extensive ballooning degeneration of epi-

dermal cells at the margins of the fistulae. The fistulae terminated in dermal granulation tissue which was sparsely infiltrated with inflammatory cells.

A second type of skin lesion occurred in arrays of dark gray, 3–15 mm maculae (Fig. 1C). Several hundred such maculae were present on the lateral and ventral body surfaces and in the gular region. Histologic sections showed mild hyperplasia

of the outer portion of the epidermis with moderate cytoplasmic vacuolation. PAS and H&E staining revealed  $21.4 \times 3.5 \mu\text{m}$  unicellular organisms embedded in the epidermis at the margins of the maculae (Fig. 1F). These were identified as pennate diatoms on the basis of their characteristic median raphe, dimensions, and fusiform shape.

There was a large,  $1 \times 2 \text{ m}$  elevated patch of roughened skin (Fig. 1D) immediately anterior and lateral to the genital slit. This appeared to be an extensive papillomatous plaque. Similarly, the unsheathed penis was affected extensively with papillomatous lesions which ranged in size from 1 cm hemispherical nodules to a  $4 \times 6 \text{ cm}$  elevated plaque. The tissue surrounding these papillomatous nodules and plaques was depigmented and scarred. Intranuclear virus particles were found in the affected epithelial tissue using transmission electron microscopy (Lambertsen et al., 1987).

Organs were opened or sectioned in 20–25 cm thick slices to facilitate internal examination. The cardiovascular, musculoskeletal and respiratory systems, and the left kidney, ureters and bladder were grossly normal. A small mesothelioma of no apparent functional consequence occurred on the dorsal surface of one lung.

Sectioning of the right kidney revealed a  $30 \times 15 \times 15 \text{ cm}$  area of cystic degeneration and localized hydronephrosis lateral to the renal hilus. Twenty individual cysts, each 3–5 cm in diameter, were connected to several atretic branches of a common intrarenal ureter. These cysts were degenerate reniculi, or lobules, of the kidney and contained a clear, watery fluid. Histologic evaluation of the walls of excised renal cysts revealed a marked interstitial fibrosis around isolated and degenerating renal corpuscles and tubules, the latter of which were dilated with hyaline casts. The cavities of the cysts were lined with 1–2 layers of low cuboidal or squamous epithelium. Inflammatory infiltra-

tion was sparse and consisted of scattered patches of lymphocytes, mononuclear cells and plasmacytes in adjacent areas of fibrosis.

The stomach was heavily infected with anisakid nematodes, probably *Anisakis physeteris*, which occur commonly in the stomach of sperm whales (Delymure, 1955). Typically, large numbers of worms were free in the ingesta of the first three stomach compartments. However, others occurred in dense verminous concentrations that invaded the wall of the second stomach compartment. The largest of three such lesions, with smaller patches of invading nematodes, was  $21 \times 27 \text{ cm}$  (Fig. 1E). Removal of the parasites revealed deep ulcers that obliterated the submucosa and penetrated the tunica muscularis. On section these were gritty and apparently mineralized. Histologic examination confirmed full thickness mucosal ulceration with sparse infiltration of lymphocytes, plasmacytes, and occasional eosinophils.

Five meters of the small intestines were opened and appeared free of natural disease. However, a broken 3-gallon plastic bucket was lodged tightly in duodenal ampulla. This foreign body dilated and partially obstructed the gut.

A large, tightly bound internal mass was found at the colo-rectal junction. This consisted of one 45 cm round and one 35 cm faceted stercolith. Both were determined to be ambergris using the test described by Scammon (1874). Together these dilated the colo-rectal junction and acted to plug the proportionately smaller lumen of the anal canal. The intestinal wall surrounding this obstruction was stretched and appeared inflamed.

Due to the great size of the sperm whale, and the operational difficulties associated with its study, the diseases of this species are poorly understood. Early pathological investigations conducted in conjunction with commercial whaling in the Antarctic revealed no evidence of "specific" lesions (Cockrill, 1960). However, the accuracy of

such observations is suspect because logistical difficulties encountered during work on the high seas precluded detailed examination of the viscera (Cockrill, 1960). Clark (1956) similarly reported that 37 sperm whales captured in the Azores in 1949 were "virtually free of disease," but noted that the intestines of only one or two whales were opened and examined. The most extensive information on potential causes of disease in large cetaceans comes from a number of excellent parasitologic records and reviews (Baylis, 1932; Delymure, 1955; Margolis and Pike, 1955; Dailley and Brownell, 1972), which unfortunately give little or no information on associated pathology. From these sources it is clear that simple, noninvasive gastric nematodiasis, usually with *Anisakis physeteris*, is ubiquitous in sperm whales. The present study provides the first evidence, however, that such infections can be pathogenic.

It has been suggested that the bottom feeding habits of sperm whales account for the tendency of this species to ingest a variety of non-food items, including sand, rocks, coconuts and other debris (Nishiwaki, 1972). Presumably, such habits also account for the plastic bucket found in this animal's duodenal ampulla, which lies immediately distal to the fourth stomach compartment. The implication is that ingestion of dense plastic debris may pose a greater health hazard for the bottom feeding sperm whale than for those cetacean species which feed in the midwater column.

The probability that ambergris in the sperm whale forms as a pathological concretion of fecal material is generally accepted. This belief appears to have originated from information reported in 1791 by Captain Coffin, a whaling privateer. Coffin testified in the English House of Commons that he had found ambergris in the anus of a "very bony and sickly" sperm whale cow killed off the coast of Guinea (Scammon, 1874). In the present case we

note also that the presence of ambergris was associated, although perhaps not causally, with an unusual diet and invasive parasitic disease of the upper gastrointestinal tract.

Our observations in this case are of particular interest because they document a disease complex of multiple etiologies associated with apparently abnormal behavior in a mature sperm whale bull. The presence of this whale in near-coastal waters might have been antecedent to a natural stranding, if the whale first had not been killed by man. Furthermore, it appears that ingestion of artificial debris contributed to the observed disease complex and was potentially lethal. The plastic bucket removed from this whale was lodged tightly in the small, sac-like duodenal ampulla, and it seemed unable to pass in either a proximal or distal direction. Hence, there was a potential for fatal intestinal obstruction, although small foreign bodies at a higher level in the gastrointestinal tract (especially the first two compartments of the stomach) probably could be eliminated naturally by vomition.

Decreased immune competence associated with aging may have contributed also to the diseased condition of this whale. Clearly, heavy scarring of the head is consistent with old age, since this indicates a long history of intraspecific combat. The coexistence of multiple pathologic conditions in the same individual suggests an impaired immune response. Additionally, our histopathologic studies revealed only sparse inflammatory cell infiltration around invading organisms and there was an extensive, virus-associated genital papillomatosis (Lambertsen et al., 1987). Thus, the complex of pathologic problems in this animal appears to be related both to artificial degradation of its habitat and to health risks naturally associated with its ecology and senescence.

The authors express their gratitude to J. Sigurjonsson, K. Loftsson, G. Petursson, P. Palsen, and the government of Iceland for

the opportunity to work at the Icelandic Whales Research Laboratory, J. S. Davis for consultation in identification of the diatom, and R. Demuth for her assistance in conducting the necropsy. The Subcommittee on Sperm Whales of the International Whaling Commission Scientific Committee kindly reviewed and commented on the manuscript prior to publication. Research support was provided by the Harbor Branch Foundation, the Institute of Experimental Pathology, University of Iceland, and the Florida Sea Grant College, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

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*Received for publication 18 July 1986.*