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## Common Diseases of Small Cetaceans

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SMALL CETACEANS (Order: Cetacea), including dolphins, porpoises, and small odontocete whales, have become popular and almost commonplace in many aquariums, oceanariums, and marine research institutions. The accumulation of medical experience with small cetaceans over the past decade enables us to define the prevalence of certain diseases and to direct research toward their prevention and treatment. Most of the available information and experience is with the Atlantic bottlenosed dolphin (*Tursiops truncatus*) but may be applied to the other small cetaceans as well.

Relative mortality among captive cetaceans compared with that in the wild populations has not been assessed. Among certain species, natural mortality is approximately 10% of the population per year.<sup>19</sup> Mortality in the captive population of bottlenosed dolphins with which we have worked varies between 2.5 and 15%/year, with a 10-year average of less than 10%/year. By careful selection of animals, good nutrition, safe environment, and a good preventive medicine program, disease and mortality of captive cetaceans can be minimized. *Tursiops* spp and perhaps a few other cetaceans are more adaptive and heartier than certain other cetaceans, e.g., the Pacific whitesided porpoise (*Lagenorhynchus obliquidens*) and the pilot whale (*Globicephala* spp), and have been shown to have greater longevity.<sup>33</sup> Cetaceans less than 2 years old and those more than 14 years old tend to become ill and die at a greater frequency than those within the middle age group. There have been more than 50 live births of bottlenosed dolphins in captivity. Only about one-third of these have reached the age of 3 years. Learning to breed dolphins

in captivity and to deal with the husbandry and medical problems associated with rearing the young are among our most challenging endeavors.

This report attempts to deal with the more commonly found diseases of small cetaceans. Information on their diagnosis, treatment, and prevalence is presented by organ or tissue primarily affected.

### Respiratory Tract Diseases

**Nasal Cavity**—Nonspecific inflammation of the nares often occurs secondary to other diseases. The Pacific pilot whale (*Globicephala scammoni*) frequently has exudative lesions within the nares associated with the production of tenacious, foul-smelling sputum. Such lesions should be considered as they relate to problems within the cranial sinuses or respiratory tract. Infection of the nares by *Candida* spp is relatively common and also tends to occur secondarily. This infection must be treated topically with an appropriate antifungal agent (using either a spray or oil-based cream) while treating the primary disease. In the debilitated patient, topical infection with *Candida* spp can progress to a systemic infection through the respiratory tract.

**Sinuses**—Parasitic infections of the cranial sinuses are common among most small cetacean species.<sup>8</sup> In *Tursiops* spp, a fluke (*Nasitrema* spp) causes low-grade inflammation, with production of a foul-smelling blow-hole exudate. Eggs of this trematode within the exudate can be demonstrated under the microscope with a direct smear. We believe that bacterial infections that usually accompany fluke infections predispose the affected cetaceans to recurrent respiratory tract disease. A treatment for this parasitism is still under investigation.<sup>31</sup> In several dolphins, e.g., *Delphinus delphis* and *L. obliquidens*, flukes cause encephalopathy as they migrate into the brain and deposit eggs.<sup>25</sup> The resultant in-

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farctive and necrotic lesions within the cerebrum and cerebellum lead to loss of equilibrium and eventual death.

The nematode *Stenurus* spp is found within the cranial sinuses of many dolphins, including *Tursiops* spp. It also is found within the external ear canal and middle ear. At least one mass stranding of *Lagenorhynchus acutus* was attributed to massive infection by this organism.<sup>13</sup>

**Larynx and Trachea**—Diseases of upper airways are infrequent and when they occur, are secondary to more generalized respiratory tract disease.

**Lungs**—Bacterial infection of the lungs is the most frequent systemic disease of small cetaceans and is the most common cause of death. Infection frequently occurs as a sequel to diseases that result in immunosuppression. All forms of the disease are seen, from peracute hemorrhagic bronchopneumonia to chronic abscessation.

Bacterial isolations from a series of pneumonia cases have been reported.<sup>21</sup> In that series, *Staphylococcus* spp (coagulase positive), *Streptococcus* spp (beta hemolytic), *Escherichia coli*, and *Pseudomonas* spp predominated. Similar isolations have been identified in our laboratory. In most acute cases, severe depression, foul breath odor, and pulmonary rales develop. Some chronic cases may require radiography for a confirmed diagnosis. Systemic antibiotic therapy is indicated. Therapy should be based on antibiotic sensitivity testing on a culture obtained from a blowhole swab or, preferably, directly from the bronchus. Intratracheal administration of antibiotics offers a good method for achieving high concentrations of an antimicrobial agent in the infected pulmonary tissue.<sup>30</sup>

Although suspected from time to time, viral pneumonia has not been diagnosed in small cetaceans. Several *T truncatus* were exposed to virulent influenza virus without development of clinical signs. An antibody response was induced against the challenge virus.<sup>28</sup>

Numerous systemic mycoses have been reported in the small cetaceans, nearly all characterized by pulmonary infections. These will be discussed later in the infectious diseases section.

Parasitic infections of the lungs are common but rarely of clinical significance in captive cetaceans. The nematode *Halocercus lagenorhynchus* is found within calcified nodules in the lungs of *T truncatus*. Occasionally we have seen allergic reactions to this organism. In *D delphis*, *H lagenorhynchus* was responsible for verminous pneumonia.<sup>32</sup> With active infection, this organism produces a larval form that may be seen in sputum samples. In the Beluga whale (*Delphinapterus leucas*), we have found a large nematode, *Stenurus arctomarinus*,<sup>3</sup> within the bronchi.

Pleuritis with pleural adhesions is a frequent incidental finding at necropsy and is often associated with pneumonia. Organisms isolated from such lesions are usually the same as are found within the affected lungs.

Sneezing or snorting is frequently done by dolphins, as a form of aggression, play, or annoyance. Coughing, which appears and sounds the same, also occurs with respiratory tract disease. Such coughing was noticed in a dolphin that was later found to have tracheitis, bronchitis, and bacterial pneumonia.<sup>3</sup>

## Cardiovascular Diseases

**Heart and Major Vessels**—Primary cardiac lesions are difficult to diagnose in the living cetacean because the heart sounds are not easily auscultated and because we lack sufficient radiographic capabilities and expertise. Normal electrocardiographic tracings have been reported for *T truncatus*.<sup>17</sup> Incidental myocarditis was reported in a study of 55 pilot whales (*Globicephala melaena*).<sup>7</sup> In the same series, atherosclerosis of the coronary arteries and aorta was found. In another study, atheromas were found in arteries of Pacific pilot whales (*G scammoni*), a pigmy sperm whale (*Kogia breviceps*), and a killer whale (*Orcinus orca*).<sup>26</sup> In the latter 2 whales, severe vascular disease, including thrombus formation, was found. We have observed small myocardial infarctions in the hearts of several *T truncatus*. These lesions apparently were not causing any functional disturbance. Mitral valve endocardiosis was found in 2 aged *T truncatus* examined by one of the authors and a holosystolic murmur of mitral insufficiency was noticed in another *T truncatus*.

**Peripheral Vessels**—Thrombosis of peripheral arteries and local tissue infarction occur typically after infection with *Erysipelothrix rhusiopathiae*. Rhomboid cutaneous lesions result. Local thrombosis with infarction is seen in the brain of those cetacean species in which migration of flukes occurs. Similar vessel damage may occur after various traumatic events (see section on Dermatologic Diseases).

Pericarditis is usually seen in conjunction with adjacent pulmonary infections and systemic bacteremias.

## Dermatologic Diseases

**Bacterial**—Bacteria of all sorts may be found within cutaneous lesions. There are, however, only a few conditions that are known to be of primary bacterial origin. The rhomboid lesions of erysipelas (*E rhusiopathiae*) stand out as the infarcted tissue undergoes depigmentation (Fig 1A). These lesions occur all over the body but with some predominance on the dorsal trunk. An atypical lesion of erysipelas, which is not rhomboid, occurs over the melon and snout (Fig 1B).

*Streptococcus* sp was isolated as the causative agent in an infarctive lesion of the head that appears similar to the atypical lesion of erysipelas (Fig 1C).

**Fungal**—*Candida* sp is a common opportunist found on existing necrotic skin lesions, particularly around the blowhole. It does, however, act as an agent of disease, especially in cetaceans that are debilitated. In one killer whale, a candida infection that began as a blowhole lesion but became systemic was thought to be due to the sterile water in which the whale was kept continuously.<sup>6</sup>

The lesions in *T truncatus* associated with infection by *Loboa lobo* were first reported in 1971.<sup>23</sup> Since that time, several additional cases have occurred, each with cauliflower-like lesions. An effective treatment has not been found.

A case of mycotic dermatitis in *T truncatus* was due to *Trichophyton* sp.<sup>18</sup>

**Traumatic**—Bite wounds from companion cetaceans ("rake marks") occur commonly and, within limits, may

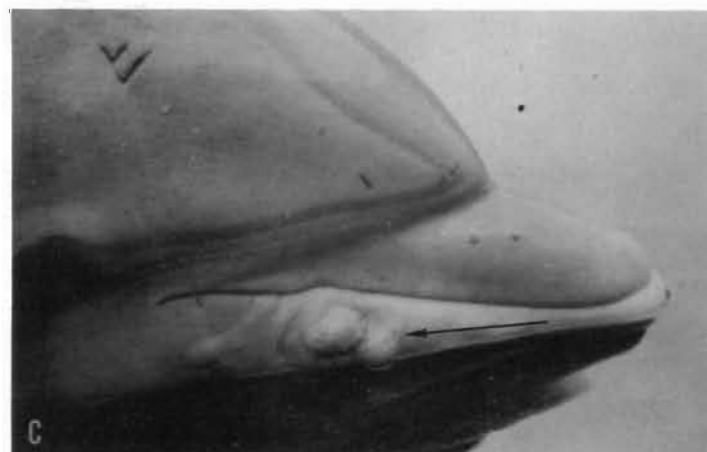
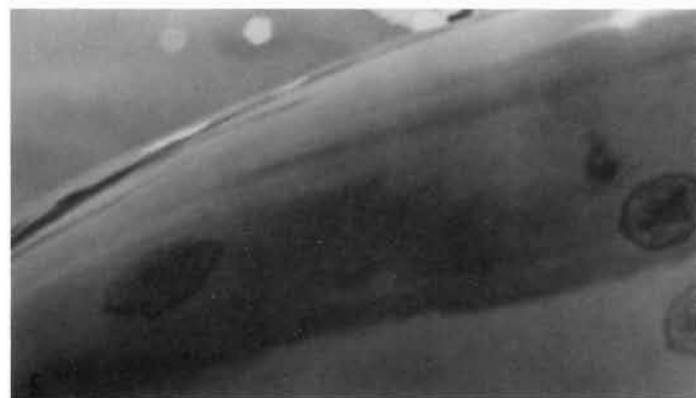
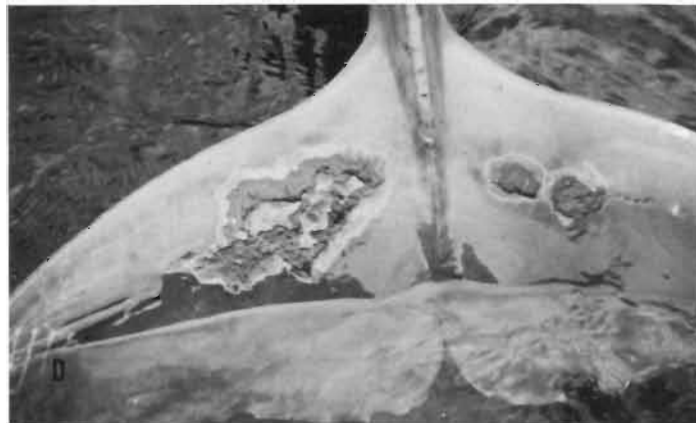
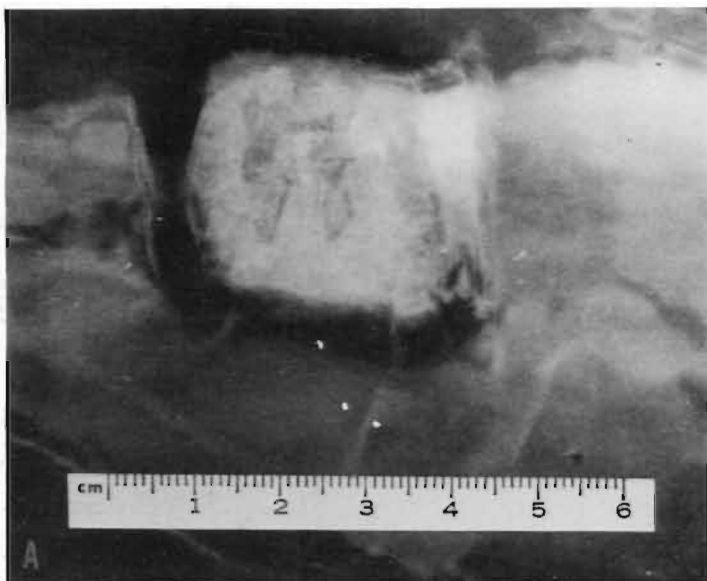


Fig 1—Common cutaneous lesions of small cetaceans.  
 A—Erysipelas.  
 B—Erysipelas.  
 C—Streptococcus infection (arrow).  
 D—Traumatic infarction.  
 E—Tattoo.  
 F—Paisley.

be regarded without concern. These appear as numerous epidermal lacerations, always in a parallel orientation. If found in large numbers, they may indicate a social dominance problem. Cetaceans suddenly taken ill are sometimes molested by their companions. Rake marks normally heal within several weeks. If healing is retarded, the cetacean may be seriously ill.

**Windburn**—When the skin of cetaceans is allowed to become dry (due to sun, wind, or absence of water), it soon becomes dark and cracked and eventually blisters. Body fluids may escape through such wounds and allow penetration by microorganisms. Windburn lesions may be prevented by maintaining the skin wet while the cetacean is out of the water or by the application of moisturizing salves such as lanolin. Some cetaceans (normal or sick) may rest motionless at the water surface, allowing their back and dorsal fin to dry. This is most likely to happen when a cetacean is brought into a strange environment. A water spray should be provided to maintain continual moisture.

**Infarctions**—Attempts at intravenous injection of medications have frequently resulted in infarction at the distal extremities (Fig 1D), due to the small size of peripheral veins and the fact that they envelope arteries. Drugs that are irritating should not be given intravenously as one can expect a small amount of the injected drug to be intraarterial or extravascular. It is a good rule to follow intravenous injections with a physiologic saline solution flush.

Various forms of blunt trauma may result in arterial thrombosis, with tissue infarction. Pressure trauma, as during prolonged transport, occurs by the same process.

In all cases of infarction, the necrotic tissue should be allowed to slough off as healing occurs; however, premature closure of wounds by granulation tissue may be avoided so as to prevent abscess formation.

**Lacerations**—Cuts and sores tend to occur through self-induced trauma, e.g., repeated knocking of the tip of the snout on the enclosure edge. Improper handling during restraint procedures results in struggling and trauma. Such wounds often progress to chronic infections, with progressive debilitation.

**Fresh Water**—At salinity less than approximately 2% NaCl, the skin of *Tursiops* spp begins to balloon and degenerate, with increased epithelial sloughing. Most *Tursiops* spp can be kept in fresh water for up to 10 days before serious skin abnormalities are observed. Fresh water exposure has been used as therapy for skin disease and suspected renal failure.<sup>6</sup> Plasma electrolyte concentrations must be monitored and fresh water exposure must be terminated if plasma sodium content decreases to less than about 137 mEq/L.

**External Parasites**—Several types of organisms may be found in necrotic skin. Ciliated protozoans are commonly found in dolphins with skin disease. We regard them as secondary invaders. Copepods have been found on dolphins, resulting in epithelial damage. Barnacles (*Cirripedia*) have been found attached to the trailing edges of the flukes or dorsal fin. They are usually removed when the cetacean is captured. Fresh water ex-

posure and copper sulfate baths have proved useful in the treatment of external parasites.

**Lesions of Unknown Cause**—There are several cutaneous lesions of cetaceans that are well recognized, but for which causative factors remain unknown. "Tattoo" lesions (Fig 1E) occur on any portion of the body but most frequently on the head. It may remain for many months or years without apparent ill effects although one cetacean that developed many of these tattoos over the body died. It is strictly an epidermal lesion. "Paisley" lesions (Fig 1F) are similar to tattoo lesions but are far more extensive and have a characteristic pattern. "Pinhole" lesions first appear as black dots but may progress to cellulitis around a necrotic core. Such lesions may be debrided but usually heal spontaneously, providing the animal is not ill from other disease. Some clinicians believe the lesion results from migration of a parasite. It commonly appears around the head and extremities.

## Digestive Tract Diseases

**Internal Parasitism**—Newly acquired cetaceans are frequently parasitized. By monitoring fecal specimens routinely, the parasites may be identified and treatment may be initiated. Examples of internal parasitisms follow.

1) Nematodes—Nematodes of the genus *Anisakis*<sup>8</sup> are found within the stomach of nearly all of the small cetaceans. In our experience, infections are rarely severe. Diagnosis is made by fecal examination (by direct smear or flotation) and treatment with one of several effective anthelmintics is routine.<sup>31</sup> Almost all newly captured cetaceans need to be treated, inasmuch as parasitism is almost universal among free-living cetaceans. Captive cetaceans are fed frozen fish and thus rarely develop new gastrointestinal parasitisms.

2) Cestodes—Tapeworms of the genus *Diphyllobothrium*<sup>8</sup> are occasionally seen in *Tursiops* spp as well as other cetaceans. Rarely have infections been severe and all are easily treated.<sup>31</sup>

3) Trematodes—The Stomach fluke (*Braunina cordiformis*)<sup>8</sup> is commonly found attached to the mucosa of the glandular stomachs. It rarely causes significant lesions, but if left untreated may persist for 3 years or more.

In *T truncatus*, the liver fluke (*Campyla rochebruni*)<sup>8</sup> may be found within the hepatic and pancreatic ducts. It has been implicated in cases of colicystitis<sup>1</sup> and pancreatitis,<sup>1</sup> presumably by causing obstruction of the ducts, with reflux of secretions. A diagnosis may be confirmed by finding eggs in fecal specimens.

**Ulcers**—Mucosal ulcers, usually of the forestomach but occasionally of the duodenal stomach, are frequently seen in all cetacean species. Their cause remains unknown although many workers believe them to be due to various stresses. We have also seen ulcers of both recent and long-standing occurrence in free-living cetaceans. A relationship to high concentrations of dietary histamine (in food fish) has been postulated.<sup>11</sup> The occurrence of stomach ulcers in relation to gastric nematode

infection is common in pinnipeds but not nearly as frequent in cetaceans. Mucosal erosions have been noticed in association with a particularly heavy infection with *B cordiformis*.<sup>10</sup> We have seen ulcers caused directly by a gastric foreign body. Whatever their cause, gastric ulcers are painful, causing depression, anorexia, and a typical "tucked up" body conformation. Sometimes the affected cetacean will appear alert and active in the morning but after taking 1 or 2 fish will refuse more fish and become inactive and depressed. If hemorrhage develops, chronic blood loss can be serious. Perforation has not been reported. A diagnosis is made either by gastroscopy, radiography, or examination of gastric contents (the finding of red and white mammalian blood cells is diagnostic). To date, treatment has been with antacid products such as magnesium hydroxide. A gruel consisting of homogenized fish, water, and the medication given by stomach tube, has been recommended.<sup>24</sup>

Mucosal ulcers are frequently seen in the mouth and esophagus but appear to be related to debilitation.

*Foreign Objects*—The consumption of foreign objects is a major problem for anyone dealing with cetaceans. Because of the small opening between the first and second stomachs, few foreign bodies pass into the intestines. Occasionally, foreign objects are vomited but most remain within the first stomach for long periods. Objects causing problems have included towels, balls, vegetation, beer cans, soft drink bottles, wire, and plastic. Sharp objects such as nails are extremely dangerous. In several *T truncatus*, stingray spines have been found associated with abdominal or thoracic abscessation.<sup>1</sup> The spines may have penetrated the wall of the alimentary tract after being ingested.

Diagnosis is by gastroscopy, radiography, or gastric palpation.<sup>31</sup> Foreign objects in the forestomach may be removed using a gastroscope appendage, a stomach tube and magnet, or by manual palpation and extraction.<sup>24</sup>

*Enteritis*—Transient enteritis, characterized by various degrees of anorexia, increased peristalsis, diarrhea (feces may float due to inclusion of gas and mucus), and flatulence, is relatively common and is often associated with the feeding of poor-quality fish. Diagnosis is based on clinical signs and fecal cultures. A fecal leukocyte determination<sup>31</sup> may be performed to detect mucosal erosion. Treatment is dictated by clinical signs and results of fecal cultures.

Enteritis due to infection by *Pasteurella multocida*, involving several cetacean species, has been reported.<sup>2</sup> The affected cetaceans (*Tursiops aduncas* and *D delphis*) became acutely ill and died, due to bacteremia and intestinal hemorrhage. The source of the organism was traced to a local bird rookery.

Volvulus, bowel torsion, and other intestinal obstructions have been seen, but are infrequent.

*Hepatitis*—Hepatic disease is one of the major organ diseases of cetaceans. In chronic fibrosis and fatty degeneration, the liver is swollen, irregular, friable, and brown yellow, with the parenchyma having an exaggerated lobular appearance. In older *Tursiops* spp these

lesions are extremely common. This type of hepatitis is suspected to be either nutritional or toxic, but the cause remains unknown. Progressive wasting is eventually followed by secondary disease. Diagnosis may be made by liver biopsy or an indocyanine green retention test.<sup>31</sup> Symptomatic therapy (replacement enzymes) is used.

We have observed acute or subacute hepatic intoxications that are suspected of resulting from exposure to exogenous toxins such as heavy metals and pesticides, or endogenous insult from bacterial toxins. The hepatic parenchyma appears yellow, with a "sawdust" appearance of marked lobulation. Histologically, the lesion is characterized by infiltration of lymphocytes into portal triads. Hepatocytes appear to be undergoing necrosis and stain deeply eosinophilic.<sup>5</sup> We have recently seen these signs in a free-living *T truncatus* population in the Gulf of Mexico. The toxic source remains unknown.

Several episodes of acute hepatitis have occurred in *T truncatus* within the United States. In one episode in which nearly every dolphin exposed became ill (with a near total death loss) a viral cause was suspected.<sup>5</sup> The dolphins became lethargic and anorectic and in most cases death ensued within 48 hours of onset of clinical signs.<sup>5</sup>

*Pancreatitis*—Chronic fibrosis of the pancreas is a lesion seen most commonly in older cetaceans. The affected organ is usually enlarged, white, and hard. Enzyme production by the pancreas is reduced, as normal acinar cells are replaced by fibrous stroma. In advanced cases, feces become progressively pale and greasy. Biliary obstruction and jaundice were reported in a case of chronic pancreatic fibrosis in *T truncatus*.<sup>22</sup> Because the pancreas lies immediately over the hepatopancreatic duct, fibrosis with contraction of the collagen fibers frequently involves the duct. Diagnosis is made on the basis of clinical signs. Pancreatic enzymes are used for treatment.

*Acute Pancreatitis*—Acute pancreatitis is characterized by anorexia and extreme depression. The condition has been seen infrequently by us in *L obliquidens* and *Tursiops* spp. The condition was seen in a killer whale that died from nocardiosis. Hematologic indices include leukocytosis (may rapidly become degenerative) and increased serum amylase activity. At necropsy, the pancreas is usually swollen and hyperemic.

## Musculoskeletal Diseases

*Trauma*—Like skin disorders, a large proportion of musculoskeletal diseases are traumatic. Occasionally cetaceans jump or are pushed out of the enclosure. If there is a long fall, or if there are obstructions such as exposed pipes, broken bones or muscle hematomas, as well as internal injuries, may result. We have seen flipper dislocations (resulting in the flipper being held fast along the horizontal axis of the body) associated with improper restraint. Fighting between cetaceans can cause bone and muscle injuries. When conflicts over social dominance appear, one of the problem individuals should be removed.

**Scoliosis**—We have observed spinal scoliosis in *Tursiops* spp and *Globicephala* spp. In some cases the conformation defect has occurred acutely, over minutes or several hours, whereas in others the scoliosis has developed gradually over several months. All cases of which we are aware have resulted in death or the need for euthanasia. The cause is not known although several interesting relationships have been observed: in several *Tursiops* spp, antibody titers to polio virus have been found;<sup>27</sup> the development of pale-colored musculature in 3 *T truncatus* suggested a vitamin E-selenium deficiency; another case in *T truncatus* was thought to be associated with a cutaneous fungal infection.<sup>18</sup> Bony defects have not been observed. Treatment with muscle relaxants may prove beneficial if begun during the acute episode.

**Gas-Producing Myositis**—We have seen a blackleg-like disease in the iliopsoas muscle group of one *T truncatus* from which a *Clostridium* sp was isolated.

**Osteomyelitis**—Infection around bone in any mammal can result in osteomyelitis. We have noticed the condition repeatedly in cetaceans with infected teeth. Pus is usually found within the alveolus. Removal of the tooth and systemic antibiotic therapy are recommended.

In aged free-living Dall porpoises (*Phocoenoides dalli*), we have seen osteomyelitis of the frontal bone occurring secondary to invasion by the nematode, *Stenurus* sp.

## Urogenital Diseases

**Prerenal azotemia**—The most common renal disease of captive cetaceans is caused by altered renal perfusion. Physiologically, cetaceans are capable of vascular shunting during diving, so that whole organ systems may be temporarily deprived of blood. With certain acute stresses, or with dehydration, renal failure may occur. Renal failure is characterized by anorexia, depression, and increased serum creatinine and blood urea nitrogen concentrations. Examination of urine specimens will usually reveal high specific gravity and proteinuria, with numerous renal epithelial cells and casts in the sediment. Therapy includes administration of fluids, either orally by force feeding fish and water or by intraperitoneal fluid infusion.<sup>31</sup>

**Pyelonephritis**—Renal infections are unusual in cetaceans and when they occur, are usually associated with infection elsewhere. Postfeeding diuresis of cetaceans tends to inhibit ascending infections. Renal abscesses have been reported.<sup>3</sup>

**Renal Calculi**—We have found calculi within the renal calices of several cetacean species. Most have been comprised of triple phosphates. Only minor pathologic changes have been associated with these, most of which have been found incidentally at necropsy.

**Dystocia**—Normal parturition for *T truncatus* has been described,<sup>20</sup> yet abnormal parturition is often missed, largely due to inexperience. We have observed several dystocias, each involving an intrauterine fetal death due to malpositioning. Maternal toxicosis progressed rapidly. With existing methods of detecting fetal vitality in the smaller cetaceans,<sup>31</sup> a diagnosis of

intrauterine fetal death prior to parturition should be possible.

**Gonadal Disease**—We have detected orchitis in a mature male *T truncatus*. Clinical signs were not seen prior to death. At necropsy, marked parenchymal inflammation, local peritonitis, and hemorrhage involving 1 testis were found.

Diseases of the female genital system that we have observed include endometritis<sup>24</sup> and ovarian cysts. Parasitic cysts of the tapeworm *Phyllobothrium delphini* are commonly found within the blubber and muscle around the genital openings and attached to the mesentery and ovarian ligaments of certain cetaceans. e.g., *D delphis* and *L obliquidens*.<sup>5</sup>

**Mastitis**—We have found mastitis in several *T truncatus*. One dolphin had massive purulence from an *Edwardsiella tarda* infection.

## Neurologic and Ophthalmic Diseases

Brain abscesses believed associated with previous infections elsewhere in the body have been found in *T truncatus*.<sup>4</sup> Neurologic signs such as uncoordinated body movements, loss of ability to remain upright, and stranding have been associated with brain lesions. Encephalopathy caused by the migration of nasal flukes in the cerebrum and cerebellum of certain species was discussed under Respiratory Tract Diseases. In *D delphis* nearly all stranded individuals that we have examined have been so affected.

Corneal trauma with keratitis and conjunctivitis is the only common ophthalmologic disease that we have seen. Blepharospasm is usually unilateral. Corneal abrasion is diagnosed, using fluorescein dye. Because cetaceans are able to retract their globe well in the orbital space, examination of the eye is difficult. A canine vaginal speculum may be used to retract the lid and conjunctival tissue. Most ophthalmic ointments and solutions wash from the eye once in water and so are not useful. Most keratitis cases will resolve on their own, providing water quality is good and adequate nutrition is maintained.

## Endocrine and Metabolic Diseases

**Thyroid Gland**—Lesions of the thyroid gland in the pilot whale include colloid goiter, follicular hyperplasia, and foreign body granulomas. We have observed a hyperthyroid-like syndrome in *T truncatus* that is characterized by high metabolic rate, increased food consumption, and weight loss. One affected dolphin died with a histologic diagnosis of thyroiditis. Treatment with propylthiouracil<sup>6</sup> at a dosage of 100 mg every 8 hours failed to result in clinical improvement.

**Adrenal Gland**—Little can be said about the clinical manifestation of adrenal gland disease. We have seen adrenal gland lesions at necropsy, but have been unable to associate the lesions with shifts in leukocyte or electrolyte values. Adrenal gland depletion seems to occur after intoxication and stress.

<sup>6</sup> Eli Lilly and Company, Indianapolis, In.

**Anemia**—Anemia due to bone marrow suppression appears to predominate in *Tursiops* spp related to bouts with infection or organ disease. The specific nature of the depression will remain unknown until cetacean bone marrow specimens have been analyzed and normal indices established. Bone marrow biopsies may now be performed routinely.<sup>31</sup> Circulating blood reticulocyte counts are useful in determining marrow response to the anemia (the base line reticulocyte count in *Tursiops* spp is 1%).

Iron deficiency anemia, characterized by small hypochromic red blood cells, has been found in dolphins. Reticulocyte counts are usually at or below normal values. A rapid marrow response usually follows appropriate hematinic therapy.

Anemias of cell loss and destruction are seen most frequently in association with gastrointestinal bleeding and are characterized by reticulocytosis. Bilirubinemia and bilirubinuria occur rarely with hemolytic anemias.

Because cetacean red blood cells have a short life-span (half-life of 16.5 days in *T. truncatus*<sup>15</sup>), any anemia not associated with corresponding marrow production is life threatening and warrants immediate therapeutic attention.

### Neoplastic Disease

Despite the frequent reports of tumors in large whales, few neoplasms have been found in the small cetaceans. A leiomyoma was found in the uterus of a pilot whale.<sup>7</sup> An adrenal teratoma was found in a Pacific white-sided porpoise.<sup>29</sup>

### Infectious Diseases

Although several infectious diseases have been observed or suspected in small cetaceans, proof of their infectious nature is lacking. Transmissibility studies with the various agents have not been performed.

**Erysipelas**—Disease caused by the bacterium *E. rhusiopathiae* appears in 2 distinct clinical forms—a dermatologic form and an acute septicemic form.<sup>12</sup> The cutaneous lesions were described under dermatologic diseases. Rhomboid plaques are seen with the onset of clinical illness. Marked leukocytosis with left shift is common throughout the disease. If not treated, the disease usually terminates with septicemia and death within several days to several weeks, depending on the host species and host resistance to the organism. The preferred treatment is penicillin or chloramphenicol.

The acute septicemic form of erysipelas progresses so rapidly that clinical signs are rarely seen. Affected cetaceans are found dead, sometimes within hours of a normal feeding period. At necropsy, petechial hemorrhages within the pancreas and over various mucosal surfaces are often the only gross findings. The causative organism may be cultured from all organs. Prevention is with vaccination semiannually, using a commercially prepared bacterin<sup>b</sup> (dosage: 3 ml intramuscularly). In *T. truncatus*, an attenuated culture vaccine<sup>c</sup> has been shown to induce a better immune response than that

induced by the bacterin<sup>16</sup>; however, disease has occurred with the attenuated vaccine in both *Tursiops* spp and *Lagenorhynchus* spp, especially when used in a particularly susceptible individual. The pelagic species, e.g., *Lagenorhynchus* spp, appear to be particularly susceptible to erysipelotheix infection.

**Mycoses**—Systemic mycoses are found relatively frequently in marine mammals (including pinnipeds), predominantly within the following geographic areas: Hawaii, the northeastern United States, the Mississippi and St Lawrence River valleys, and the United States Gulf coast. Genera involved include, in order of frequency of isolations: *Nocardia*, *Candida*, *Aspergillus*, *Mucor*, *Actinobacillus*, *Blastomyces*, and *Histoplasma*.

The disease, regardless of the organism, is characterized by lower respiratory tract involvement, with selected other organs affected. Diagnosis is based on clinical signs of illness and by demonstrating pulmonary nodules on radiography. Few hematologic changes occur prior to the onset of diseases that occur secondary to fungal invasion. Direct transmission between animals has not been demonstrated. To our knowledge, there have been no successful treatments or therapeutic tests.

**Pasteurellosis**—*Pasteurella multocida* infection was discussed under Digestive Tract Diseases. An episode of *Pasteurella hemolyticum* septicemia recently occurred in a group of *T. truncatus*, resulting in the death of 1 of 6 dolphins involved.<sup>14</sup> Hemorrhagic tracheitis was found at necropsy. The other dolphins responded to treatment with chloramphenicol.

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