Parasites of the bowhead whale, *Balaena mysticetus*

Richard A. Heckmann  
*Brigham Young University*

Lauritz A. Jensen  
*University of Health Sciences, Kansas City, Missouri*

Robert G. Warnock  
*Westminster College, Salt Lake City, Utah*

Bruce Coleman  
*Brigham Young University*

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PARASITES OF THE BOWHEAD WHALE, BALAENA MYSTICETUS

Richard A. Heckmann1, Lauritz A. Jensen2, Robert G. Warnock3, and Bruce Coleman4

ABSTRACT — Blood, tissue, and organ samples from five bowhead whales were examined for ecto- and endoparasites. Two species of protozoans, four genera of diatoms, one species of trematoda, two species of nematoda, and one species of amphipoda "louse" were found. No blood parasites were recovered. The larval anisakid nematode, found in the submucosa of the forestomach of one whale, generated a prominent inflammatory response. Protozoans found in contents of the colon included a flagellate and a sarcodinan. The sarcodinan, which was common in the colon contents of one whale, belongs to the genus Entamoeba and probably represents an undescribed species. Ogomogaster plicatus, a trematode, was also identified. The data from this study are compared with previous lists of parasites for the bowhead whale and two other species of baleen whales. From the results presented, the previous list of parasites for the bowhead whale has been expanded to include eight additional genera and species.

Cetaceans throughout the world are known to be infested and infected with parasites (Dailey and Brownell 1972). This does not necessarily mean that the hosts are seriously affected or damaged by the symbionts. If, in addition to the parasite load, stress and/or nutritional imbalances occur, the animal may become weak and possibly die. Stroud and Roffe 1979, Dailey and Walker 1978, Martin et al. 1970, Ridgway and Dailey 1972 have indicated that helminths were a possible factor for cetacean strandings. Stranded animals exhibited disoriented behavior with an obvious loss of equilibrium. Necropsy results of these animals showed that the central nervous system was infected with trematodes of the genus Nasitrena, thus providing at least a partial explanation for the whale strandings. The nematode Sternurus, located in the ears of cetaceans, is also a potential factor for cetacean strandings. The brains of these stranded animals showed lesions induced by trematode eggs.

Activities associated with offshore oil and gas development, such as those in the Beaufort Sea, may increase the stress to bowhead whales and thereby allow an increase in parasite burden. It would be advantageous to determine the types of parasites harbored by bowhead whales for such knowledge would help in understanding what effect contact with spilled oil may have on cetaceans.

The primary objective of this study was to estimate the parasite burden of the bowhead whale, Balaena mysticetus, through the examination of the selected specimen materials obtained from subsistence harvested whales.

METHODS

Specimen materials were obtained from five bowhead whales taken off Barrow, Alaska, in 1980 by Eskimo hunters. Tissue samples, including colon contents, were collected on-site (Albert 1981), fixed in 10% formalin, and shipped by air freight to the parasitology laboratory at Brigham Young University. Blood smears from whales were air dried and sent with the above samples. The samples were processed as follows:

TISSUES AND ORGANS.—After the code number for the whale was recorded, each specimen was weighed, measured, and then dissected to determine the presence of parasites. Intestinal segments were cut lengthwise, after which the lumen was examined for macroscopic parasites. Samples of lumen contents were placed on glass slides and examined with a light microscope. Slides of lumen contents from the intestine were also fixed and stained with iron haematoxylin, trichrome, or Giemsa-Wrights stains to enhance parasite presence. After the staining procedure was completed, each slide was examined for para-

1Department of Zoology, Brigham Young University, Provo, Utah 84602.
2Department of Microbiology, University of Health Sciences, Kansas City, Missouri 64124.
3Department of Biology, Westminster College, Salt Lake City, Utah 84101.

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Table 1. Bowhead whale, *Balaena mysticetus*, specimens examined for parasites.

<table>
<thead>
<tr>
<th>Whale number (Code)</th>
<th>Type of specimen</th>
<th>Specimen length (cm)</th>
<th>Specimen weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0B1</td>
<td>Blood smears (4 slides)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Intestine segments:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>83</td>
<td>7.3</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>107</td>
<td>8.6</td>
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<tr>
<td></td>
<td>C</td>
<td>99</td>
<td>3.15</td>
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<td></td>
<td>D</td>
<td>134</td>
<td>2.25</td>
</tr>
<tr>
<td>S0B2</td>
<td>Blood smears (2 slides)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Intestine segments:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>87</td>
<td>6.75</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>59</td>
<td>3.15</td>
</tr>
<tr>
<td></td>
<td>Liver sample</td>
<td>—</td>
<td>2.7</td>
</tr>
<tr>
<td>S0B7</td>
<td>Blood smears (2 slides)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Intestine segments:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>78</td>
<td>1.21</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>75</td>
<td>2.41</td>
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<td></td>
<td>C</td>
<td>44.5</td>
<td>4.70</td>
</tr>
<tr>
<td></td>
<td>Liver sample</td>
<td>—</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>Diaphragm sample</td>
<td>—</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>Colon contents (1.5 liters)</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>S0B8</td>
<td>Blood smears (2 slides)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Intestine segment</td>
<td>96</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td>Diaphragm sample</td>
<td>—</td>
<td>0.6</td>
</tr>
<tr>
<td>S0B9</td>
<td>Loose on baleen</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Liver sample</td>
<td>—</td>
<td>1.35</td>
</tr>
<tr>
<td></td>
<td>Colon segment</td>
<td>95</td>
<td>9.9</td>
</tr>
</tbody>
</table>

Sites. Pieces of liver and diaphragm were placed in separate jars containing a standard digestive enzyme solution (pepsin and hydrochloric acid in water) for 24–48 hours at 37°C. This procedure digests host tissue but not nematode larvae and adults. The material was then centrifuged and examined with a light microscope.

**Colon contents.**—Formalin-fixed colon contents were examined following the same procedure as outlined for lumen contents from the intestine. The same stains were used for the preparation of permanent slides.

**Blood smears.**—Standard methods were followed for the examination of blood smears for parasites. A combination Giemsa-Wrights stain was used for maximum staining of any intracellular and extracellular parasites that might be present. Each stained slide was examined for at least 10 minutes at 400X and 1,000X magnification.

**Parasite procedure.**—Two procedures were used for flukes. Fluke specimens were fixed in alcohol-formalin-acetic acid (AFA) and gluteraldehyde. Those fixed in AFA were stained with semichon’s carmine and mounted on glass slides. Glutaraldehyde fixative in an acrulien buffer was used for flukes to be examined with scanning electron microscopy (SEM). For SEM each fluke was critically point dried, mounted on a specimen holder, coated with gold for three minutes with a CS mini-coater sputter, and then viewed with an AMRAY 1000A scanning electron microscope operating at 20 Kv. A whale louse, *Cyamus ceti*, was also examined with SEM.

A paraffin block of tissue containing a larval nematode (Migaki 1981) was prepared for histological evaluation, and sections were stained with haemotoxylin and eosin, trichrome and periodic acid-Schiff. An intact nematode found free in the stomach of a bowhead whale was also examined.

Skin samples representing normal and eroded areas were provided for parasite examination (Haldiman et al. 1981). These samples were prepared for SEM and light microscopy as explained for flukes and nematodes.

Results of the parasite examination were summarized and compared with the existing list for the bowhead whale, *B. mysticetus*,

**RESULTS**

Table 1 lists the specimens obtained for this study, with data on whale code number, type of tissue, and amount. The results of examining the pieces of tissue are listed in Table 2. Parasites obtained from these bowhead whale samples are indicated in the table, after which each parasite is listed separately and discussed.

Comments on Parasites Observed

Two species of protozoa, one amoeboid and one flagellated, were found in the formalin-fixed colon contents of one whale (80B7; Table 2). The amoeboid form appears to be a species new to science, while insufficient numbers of the flagellate negated further taxonomic study. Both represent the first known protozoa observed and described from bowhead whale intestinal contents.

**Amoeboid Protozoan**

![Image](Fig. 1)

An unidentified amoeba from the colon contents of animal 80B7 had the following characteristics, based on the observation of 100 specimens in stained and fixed preparations: trophozoite and cyst stages, cysts containing one to four nuclei, cysts oval in shape ranging from 15 to 18 µm in diameter, nuclei
Fig. 1. Photomicrographs and line drawings of an amoeboid parasite (Entamoeba sp.) from the colon contents of a bowhead whale, Balaena mysticetus. Note the pseudopod (P) characteristic of this protozoan group, both single (n) and multinucleate (mn) cells, vacuoles (v), granular cytoplasm (g), and chromatoid body (c) (1,000X for photomicrographs).

spheroid to ovoid, nuclei randomly distributed for multinucleate forms and centrally located in uninucleate forms, nucleus occupies approximately 10% of the cell volume,
Figure 2. Photomicrographs and line drawing of a flagellated protozoan found in the colon contents of *Balaena mysticetus*. Flagella (f) and a single nucleus (n) are visible, both characteristic of flagellated protozoa (1,000X for photomicrographs).

Pseudopodia observed, vacuoles vary in number, both food and water vacuoles present chromatoidlike bodies in cytoplasm, peripheral nonchromatic granules, it was common in the intestinal contents of one bowhead whale. Based on these observations and the similarity of characteristics (Kudo 1966), we consider this amoeba a species of *Entamoeba* Casagrandi & Barbagallo, 1895. Thus, based on Levine et al. (1980), the classification for this amoeba would be:

- **Phylum:** Sarcomastigophora
- **Subphylum:** Sarcochina
- **Class:** Lobosea
- **Order:** Amoebida
- **Family:** Endamoebidae
- **Genus:** *Entamoeba* sp.

From further literature research and observations of this protozoan, the correct species will be determined. The genus *Entamoeba* is common in many vertebrate species (Olsen 1974), and several species are parasitic, damaging the intestinal lining of the host (Faust 1975).

**Flagellated Protozoan**

Fig. 2

From the same bowhead whale (80B7) formalin-fixed colon contents containing an amoeboid protozoan, three flagellates were observed in the material examined. Insufficient specimens were available for species determination. The single-celled organism appeared to be much like a species of *Chilomastix* (Faust et al. 1975) or the "pear"-formed *Hexamita* (Olsen 1974).

**Diatoms**

- **Phylum:** Chrysophyta (Plant Kingdom)
- **Genera:**
  - *Coccomis* sp.
  - *Stauroneis* sp.
  - *Natricula* sp.
  - *Gomphonema* sp.

Four genera of diatoms were observed on the epidermis (Figs. 3, 4, 5, 6). Diatoms are plants belonging to the phylum Chrysophyta, which is characterized by silicon cell walls (Fuller and Tippo 1960). They are found in both fresh and salt water and are composed of single cells. There are a large number of diatom species. We observed diatoms on the normal whale epidermis surface and in the eroded areas of the epidermis (Figs. 7, 8, 9). The forms observed on the epidermis surface are common to cetacean hosts (Nemoto 1956, Nemoto et al. 1977, Omura 1950).
Fig. 3. Scanning electron microscope (SEM) micrographs (3a, 3b) and light microscope micrograph (3c) of one of the most common diatoms, *Cocconeis* (arrowheads), observed during this study. Fig. 3b shows the extent to which *Cocconeis* extends into the epidermis of whale skin. The micron bar at the bottom of each micrograph (SEM) is used to measure object size. Filamentous bacteria (b) and whale red blood cells (r) are present on one micrograph (3a). The light microscope micrograph (3c) is magnified 400X.
Helminths

Three species of worms were observed during the examination of whale tissue. One was a digenetic trematode and the other two were roundworms.

Flukes

Phylum: Platyhelminthes
Class: Trematoda (Digenea)
Family: Notocotylidae
Genus, Species: Ogmogaster plicatus

Species of the genus Ogmogaster have been reported from both pinnipeds and cetaceans. In the present study 24 specimens were collected from intestinal segments of three bowhead whales (80B2, 80B7, 80B8). Reported in the Antarctic and northern Pacific oceans, these flukes apparently cause no damage to the host (Dailey and Brownell 1972). The anatomy of O. plicatus from the bowhead whale was studied and appears to be similar to the antarctic form (Rausch and Fay 1966). The fluke has been reported recently from the bowhead whale (Shults 1979) and has been compared with O. antarcticus, O. trilineatus, and O. pentalineatus (Rausch and Rice 1970). One of the many characteristics for the species of Ogmogaster is the number of parallel, lon-
Fig. 5. SEM micrograph of a diatom (n) Navicula sp. Note micron bar at bottom of micrograph.

Fig. 6. The diatom (g) Gomphonema sp. on the surface of bowhead whale skin(s). Note filamentous bacteria (b) and a biconcave erythrocyte (r) (220X).
Fig. 7. SEM micrograph of bowhead whale epidermis from an area without prominent erosions of the epidermis. Note filamentous bacteria (b) and diatoms (d) such as *Gomphonema* and *Cocconeis* on the surface of the skin (220X).

Fig. 8. Bowhead whale epidermis: 8a, the free surface of the skin with initial erosion (100X); 8b (100X) and 8c (400X), the erosion (e) process continuing and the presence of bacteria (b) and diatoms (d) in the eroded area.

Gigantinal ridges on the ventral surface. *Ogmogaster plicatus* is characterized by 19–28 ridges with an average of 23 (Rausch and Fay 1966). Figure 10 represents the dorsal and ventral surfaces of *O. plicatus* collected during this study. The life cycle is unknown for this species.

Anisakid-type Larvae
Phylum: Nematoda (The Aschelminthes, Barnes 1980)
Order: Ascaridata
Family: Anisakidae

The piece of bowhead forestomach mounted in paraffin contained larval nematodes that appeared to be an anisakid-type
larva (Schmidt and Roberts 1984, Migaki et al. 1982) (Fig. 11). No adult stages of this roundworm were observed in examined samples. A description of the life cycle of *Anisakis* is found in parasitology texts (Faust et al. 1975, Schmidt and Roberts 1984) and in recent publications (Smith 1971, Wootten and Waddell 1977, Smith and Wootten 1978, Wootten 1978, Heckmann and Otto 1985). Adult stages of this nematode are characteristically found in stomachs of carnivorous marine mammals (Smith and Wootten 1978). The examined nematode was in the migratory larval phase of its life cycle. Larval characteristics for species of *Anisakis* include: esophagus with a ventriculus that ends obliquely at its junction with the intestine (Hadidjaja et al. 1978), no ventricular appendage nor intestinal caecum, the tail is blunt and terminates in a distinct mucron (Smith and Wootten 1978, Shiraki 1974, Oshima 1972), a prominent boring tooth (mucron) present (Smith and Wootten 1978). For the life cycle of *Anisakis* sp., euphausiids (Crustacea) are probably the most important intermediate host (Smith 1971, Smith and Wootten 1978). Euphausiids are a source of food for the bowhead whale (Lowry and Burns 1979, Lowry and Burns 1980, Lowry and Frost 1984). After examining serial sections of the larval nematode, we noted the following characteristics: no bursa or prominent teeth, blunt tail with mucron remains present, trilobed lips, dentigerous ridge on anterior end, no terminal enlargement for the esophagus, no alae, and overlapping annulations on the surface. The nematode is apparently a species of *Anisakis*. Because we lacked adult worms, which are required for a definitive taxonomic assignment (Smith and Wootten 1978), and because of the taxonomic confusion of the family Anisakidae, the larval nematode will be referred to as “anisakid-type” (Schmidt and Roberts 1984). Yokogawa and Yoshimura (1967) reported larval anisakiasis in the gastrointestinal tract of Japanese people. Recently, cases of anisakiasis have been reported in the United States (Schmidt and Roberts 1984), and larval stages of this roundworm, obtained from salmon harvested at Barrow, Alaska (Heckmann and Otto 1984), were sent to this laboratory.

**Anisakid Roundworm**

*Phylum:* Nematoda  
*Order:* Ascaridida  

One worm found free in the stomach of animal (S0B1) was too poor to evaluate properly; therefore, it is impossible to obtain a complete taxonomic description. This roundworm appears to be *Anisakis* or *Contracaecum*. Members of these genera are among the most common parasites in the stomachs of pinnipeds (Dailey and Brownell 1972).
Whale Lice

Phylum: Arthropoda
Class: Crustacea
Order: Amphipoda
Genus, Species: Cyamus cetti, highly modified for a parasitic mode of life

Cyamids have a vestigial abdomen, but the body, an exception among amphipods, is broad, depressed, and bears large legs (Leung 1967). The cyamids of whales have a high degree of host specificity; however, the same species that occurs on the bowhead whale is
found on gray whales. The species *Cyamus ceti* is one of the most common parasites observed during this and a previous study (Heckmann et al. 1980, Heckmann 1981).

Figure 12 represents the ventral surface of a whale louse. Note the enlarged appendages with numerous hooks. The mouthparts, as well as the appendages, are highly modified for the ectoparasitic mode of life. The cyamids have a direct life history with the young whale lice being released from the broodpouch of the female. The amphipods have no free-swimming stage. Subsequent moltings produce sexually mature adults.

Other Reported *Balaena mysticetus* Parasites

**NEMATODE.**—*Crassicauda crassicauda* is a nematode parasitizing the urogenital system and sometimes other parts of the body. Although the life cycle of *C. crassicauda* has not been determined, members of the order in which this genus belongs reproduce viviparously or ovoviviparously and parasitize the body cavity, blood sinuses, air bladder, or other tissues of aquatic vertebrates. Copepods are considered intermediate hosts for *C. crassicauda*. For cetaceans, the nematode has been reported from *Tursiops truncatus* (bottlenosed dolphin), *Balaenoptera musculus* (blue whale), *Megaptera novaeangliae* (humpback whale), *Balaen mysticetus* (bowhead whale), *Ziphius cavirostris* (Cuvier’s beaked whale), *Balaenoptera acutorostrata* (minke whale), *Balaenoptera borealis* (sei whale), and *Balaenoptera physalus* (fin whale) (Dailey and Brownell 1972).

**TREMATODE.**—*Lecithodesmus goliath* is a fluke that parasitizes bile ducts of Cetacea. *Lecithodesmus goliath* produces large eggs that are triangular in cross-section. Molluscs are intermediate hosts, and metacercariae can be ingested with the molluscan intermediate host (Dailey and Brownell 1972). Small clams (bivalves), which are members of the phylum mollusca, have been reported from the colon of a bowhead whale (Lowry and Burns 1979).

**ACANTHOCEPHALA.**—*Bolbosoma balaenae* is an acanthocephalan that is found in the intestine of marine mammals including *B. mysticetus* (Dailey and Brownell 1972, Nieland 1962).

The parasites observed during this study and all those reported for the bowhead whale are listed in Table 3. The parasites reported for the bowhead whale are compared with those reported for two other cetaceans, the gray whale (*Eschrichtus robustus*) and the blue whale (*Balaenoptera musculus*) (Table 4).

**DISCUSSION**

Samples of bowhead whale tissue were sent to our laboratory during 1980 to be examined for parasites. From samples of five bowhead whales, two protozoans, four genera of diatoms, and a nematode have been added to the existing list of parasites (Table 3). With additional samples, the list would most likely be expanded, especially the protozoan forms. Data from this study confirmed the presence of *Cyamus ceti*, a whale louse, as well as the presence of an *Omgogaster*, which had been described in a bowhead whale in 1979 (Shults 1979). Samples of blood from four whales were negative for parasites.

Because of its currently known dietary habits, the bowhead whale is not subject to many of the internal parasites found in marine mammals that feed on fish, large crustaceans, and mollusks. Fish, large crustaceans, and mollusks are common intermediate hosts for helminths of marine mammals (Ridgway and Dailey 1972).

The bases for placing the protozoan, found in the colon contents of one whale, in the family Endamoebidae are its small size and location, the presence of one to four nuclei per
Fig. 12. SEM of the ventral surface of the whale "louse," Cynamus ceti (8X). Cynamus ceti is not a louse but a highly modified amphipod infesting the skin of whales. The anterior (a) and posterior (p) parts of C. ceti are labeled.

cyst, and numerous food vacuoles in the cytoplasm. Members of the Endamoebidae are typically parasites or commensals of the digestive systems of arthropods and vertebrates (Schmidt and Roberts 1984). Species of Entamoeba are common entocommensals and parasites of the digestive system of vertebrate and invertebrate hosts. The present study is the first record of a protozoan parasite for the bowhead whale. Additional material must be
collected from the colon of *Balaena mysticetus* to determine the characteristics of this flagellated protozoan and its correct taxonomic status. Only three examples of the flagellate were observed from material taken during 1980.

The ideal situation for examining tissue for parasites is to be “on site” when an animal is killed. The necessity for examining tissue from the brain and ear, which was not available for this study, is due to the implication of two helminths in whale strandings (Stroud and Dailey 1978, Ridgway and Dailey 1972, Stroud and Roffe 1979). The trematode *Nasitrema* infects the central nervous system, and a species of *Stenurus*, a nematode, has been found in the ears of cetaceans. The brains of stranded animals have shown parasitically induced lesions caused by trematode (*Nasitrema*) eggs. Parasites may be a partial explanation for cetacean strandings (Beverly-Burton 1978).

Presumably due to feeding habits of the host (Lowry and Burns 1980, Lowry and Frost 1984, Lowry et al. 1978), no adult tapeworms have been reported for the bowhead whale.

*Phyllobothrium delphini* is a cestode larval stage (plerocercoid) found in the blubber of whales, usually around the anal orifice (Dailey and Brownell 1972). We did not find cestode plerocercoids in the samples of bowhead whale tissue sent to us for this study.

Diatoms are common organisms attached to the skin of whales (Nemoto 1956). Numerous diatoms, single-celled plants containing silicon walls, were observed infesting the skin of bowhead whales from 1980 skin samples. Four genera were identified in the present study. Diatoms were 5 to 10 times more numerous in the eroded areas of the host’s skin than in noneroded areas; bacteria and protozoa were also found in the same erosions. The skin of cetacea is an important area for thermoregulation (Ridgway 1972). Japanese workers consider diatoms to be parasitic on whale skin (Nemoto 1977, Omuro 1950). Once an opening is established in the outer surface of the skin, diatoms, bacteria, and protozoa (Figs. 13, 14) may become opportunists and use this area as a microhabitat. Excessive numbers of such opportunists appear to damage the skin.

The nematode *Anisakis* is common in marine mammals (Dailey and Brownell 1972). Larval anisakids have been reported in the digestive tract of humans (anisakiasis), and in Europe and Japan there are records of this helminth as a possible cause of host death (Faust 1975, Schmidt and Roberts 1984). A limited number of cases of anisakiasis have been reported in North America (Myers 1979, Dailey et al. 1981). Fish samples sent to our laboratory from Alaska contained a larval anisakid (Heckmann and Otto 1985).

Including the results of the present study, two protozoans, four diatoms, two trematodes, one cestode, one acanthocephalan, two nematodes, and one amphipod (louse) represent the current list of parasites for the bowhead whale.

**Acknowledgments**

We thank the on-site tissue-collection team at Barrow, Alaska, under the direction of Dr. Thomas F. Albert, for assistance in collection of specimen material. We also thank James Allen and Connie Swenson, Brigham Young University Electron Optics Laboratory, who assisted with the SEM preparations. Dr. Jer-

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**Table 3. A consolidated list of parasites for *Balaena mysticetus*, bowhead whale.**

<table>
<thead>
<tr>
<th>Parasite</th>
<th>Location in host</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protozoa</td>
<td>Colon, small intestine</td>
</tr>
<tr>
<td>&quot;Amoeba form Entamoeba sp.&quot;</td>
<td>Colon, small intestine</td>
</tr>
<tr>
<td>&quot;Flagellate form&quot;</td>
<td>Colon, small intestine</td>
</tr>
<tr>
<td>Diatoms (Plant)</td>
<td>Colon, small intestine</td>
</tr>
<tr>
<td>&quot;Cocconeis&quot;</td>
<td>Skin, normal and eroded areas</td>
</tr>
<tr>
<td>&quot;Stauroneis&quot;</td>
<td>Skin, normal and eroded areas</td>
</tr>
<tr>
<td>&quot;Navicula&quot;</td>
<td>Skin, normal and eroded areas</td>
</tr>
<tr>
<td>&quot;Gonophonema&quot;</td>
<td>Skin, normal and eroded areas</td>
</tr>
<tr>
<td>Acanthocephala</td>
<td>Intestine</td>
</tr>
<tr>
<td>&quot;Bolbosoma balaenae&quot;</td>
<td>Intestine</td>
</tr>
<tr>
<td>Cestoda (Platyhelminthes)</td>
<td>Tissue (blubber)</td>
</tr>
<tr>
<td>&quot;Phyllobothrium delphini&quot;</td>
<td>Tissue (blubber)</td>
</tr>
<tr>
<td>Trematoda (Platyhelminthes)</td>
<td>Intestine</td>
</tr>
<tr>
<td>&quot;Ognogaster pictatus&quot;</td>
<td>Intestine</td>
</tr>
<tr>
<td>&quot;Lecithodesmus goliath&quot;</td>
<td>Bile ducts</td>
</tr>
<tr>
<td>Nematoda</td>
<td>Forestomach submucosa, encysted</td>
</tr>
<tr>
<td>&quot;Anisakis-type larvae&quot;</td>
<td>Forestomach submucosa, encysted</td>
</tr>
<tr>
<td>&quot;Anisakid: Contracaecum or Anisakis&quot;</td>
<td>Stomach</td>
</tr>
<tr>
<td>&quot;Crassicauda crassicauda&quot;</td>
<td>Stomach</td>
</tr>
<tr>
<td>Amphipoda</td>
<td>Intestine</td>
</tr>
<tr>
<td>&quot;Cyamus ceti&quot;</td>
<td>Attached to baleen</td>
</tr>
</tbody>
</table>

*Parasites observed during this study.*

*Parasites not observed during this study, but reported for the bowhead whale (Dailey and Brownell 1972).*
<table>
<thead>
<tr>
<th>Baleen whale (host)</th>
<th>Protozoa</th>
<th>Acanthocephala</th>
<th>Cestoda*</th>
<th>Trematoda*</th>
<th>Nematoda</th>
<th>Amphipoda**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eschrichtius robustus</td>
<td>O O O</td>
<td>O O O O P</td>
<td>O P O O P</td>
<td>O P O O O</td>
<td>O O O O O</td>
<td>O</td>
</tr>
<tr>
<td>Balaenoptera musculus</td>
<td>O O O</td>
<td>P P P O O</td>
<td>O P O O P</td>
<td>P P O O P</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>Balaena mysticetus</td>
<td>P P P</td>
<td>P O O O O</td>
<td>P O O P O</td>
<td>P P O O P</td>
<td>P</td>
<td></td>
</tr>
</tbody>
</table>

O - Not observed  
F - Observed in food  
*Phylum: Plathelminthes  
**Phylum: Arthropoda  
1) Dailey and Brownell 1972  
2) This study and Dailey and Brownell 1972

** Codes for parasites.

** Protozoa:**
- E - Amoeboïd forms (Ectosypheus)
- F - Flagellate
- D - Diatoms: 4 species

** Acanthocephala:**
- B1 - Bolbosoma balosae
- B2 - Bolbosoma brevicelk
- B3 - Bolbosoma hamiltoni
- B4 - Bolbosoma turbinella
- C - Corynosoma sp.

** Cestoda:**
- P1 - Phyloleucotria delphina
- P2 - Pseudophyllodes sp.
- P3 - Pseudophyllodes sp.
- T - Tetraphistis affinis

** Trematoda:**
- O1 - Ommegaster phalera
- O2 - Ommegaster antarcticus
- O3 - Ommegaster peltalaeus
- L - Lechtoldus orlandi

** Nematoda:**
- A - Anisakidae
- A1 - Anisakid larvae
- C1 - Crassicauda crassicauda
- C2 - Contrahecom sp.
- P - Porocercom sp.

** Amphipoda:**
- C - Cymnes etr

Table 4. Comparison of parasites observed in three species of baleen whales.

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**LITERATURE CITED**


Fig. 13. Micrographs representing the presence of: 13a, protozoa (P); 13b, bacteria (b); and 13c, diatoms (d) in the eroded areas of bowhead whale epidermis (1,000X).

behavior patterns of whales in the vicinity of the Beaufort Sea lease area. Final Report to the Bureau of Land Management from the Naval Arctic Research Laboratory, Barrow, Alaska.


