

Endoparasites Collected from the Gray Whale *Eschrichtius robustus* Entangled in a Set Net off Minamiboso-shi, Chiba, on the Pacific Coast of Japan

Toshiaki Kuramochi¹, Kazumi Arai-Leon², Ayako Umetani³,
Tadasu K. Yamada¹ and Yuko Tajima¹

¹ Department of Zoology, National Museum of Nature and Science,
4–1–1 Amakubo, Tsukuba, Ibaraki 305–0005, Japan

E-mail (TK): kuramoti@kahaku.go.jp

² Caminito Montanoso, San Diego, CA USA

³ Chiba Prefectural Office,
1–1 Ichiba-cho, Chuo-ku, Chiba-shi, Chiba 260–8667, Japan

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Abstract During a necropsy of the gray whale, *Eschrichtius robustus* Lilljeborg, entangled and found dead in a set net along the Pacific coast of Japan, several endoparasites were collected. They were identified to be *Ogmogaster antarctica* Johnston, 1931 (Trematoda: Notocotylidae), *Diphyllbothrium macroovatum* Jurachno, 1973 (Cestoda: Diphyllbothriidae) and *Priapocephalus eschrichtii* Murav'eva and Treshchev, 1970 (Cestoda: Tetrabothriidae). These are the first records on endoparasites of the gray whale from the western North Pacific.

Key words: *Ogmogaster antarctica*, *Diphyllbothrium macroovatum*, *Priapocephalus eschrichtii*, gray whale, Japan.

Introduction

Surveys on stranded and incidentally caught animals are essential for marine mammal studies. It is also the case with parasitology to reveal faunal diversity and to evaluate potential utilities of several biological indicators; these have been carried out by many authors (e.g. Abollo *et al.*, 1998; Dailey and Stroud, 1978; Dailey *et al.*, 2000; Gibson *et al.*, 1998; Gulland *et al.*, 2005; Mignucci-Giannoni *et al.*, 1998).

Among those and other papers, reports on parasites of stranded gray whales, *Eschrichtius robustus* Lilljeborg, are limited. Dailey and Stroud (1978) recorded a cyamid ectoparasite by the examinations on two gray whales stranded along the coast of Oregon. Dailey *et al.* (2000) examined a juvenile gray whale stranded along the California coast and recorded one cyamid, one acanthocephalan, two trematodes and one

nematode species. Gulland *et al.* (2005) reported several species of trematodes, one acanthocephalan and cyamid from three gray whales during a survey of an “unusual mortality event” in 1999–2000 along the west coast of North America.

Sixteen species representing 9 genera from 7 families of gray whale parasites have been recorded to date, however most of all of those records have been made on the gray whales inhabiting the eastern North Pacific, Bering Sea and Chukchi Sea (e.g. Dailey *et al.*, 2000; Hurley and Mohr, 1957; Rice and Wolman, 1971; Jurachno, 1967, 1973; Treshchev, 1966; Zimushko and Ivashin, 1980). Moreover, nothing is known on endoparasites of the gray whale in the western North Pacific including the waters around Japan (see Kuramochi, 2003). There are only two references on parasites of the gray whale in Japanese waters. Takeda and Ogino (2005) and Murase *et al.* (2014) reported a cyamid ectoparasite col-

lected from the same individual examined in the present study, entangled and found dead in a set net off Minamiboso-shi (it was addressed in Tomiyama-machi, Awa-gun at the time of the event), Chiba, off the Pacific coast of central Japan, on 11 May 2005, and stranded off the Pacific coast of Nishiki-oka, Tomakomai-shi, Hokkaido, Japan, on 2 August 2007, respectively. The present paper reports three endoparasite species of the gray whale for the first time from the western North Pacific.

Materials and Methods

Worms were fixed in 10% formaldehyde solution in the field and later preserved in 70% ethanol in the laboratory. Some were flattened under slight pressure by two pieces of slide glass, stained in alum carmin, dehydrated in a graded ethanol series and mounted in Canada balsam. In the case of the diphyllbothriid cestode, sagittal and transverse sections were also made. Measurements were made by using a microscope equipped with an ocular micrometer or a profile projector. Specimens were deposited in the National Museum of Nature and Science (NSMT-PI), Tokyo, Japan.

Results

The following three species of endoparasites were obtained from the single gray whale exam-

ined. Remarks on taxonomy, distribution and prevalence are given for each parasite species.

Class Trematoda Rudolphi, 1808

Order Echinostomida LaRue, 1957

Superfamily Pronocephaloidea Looss, 1899

Family Notocotylidae Lühe, 1909

Genus *Ogmogaster* Jägerskiöld, 1891

Ogmogaster antarctica Johnston, 1931

(Fig. 1)

Materials. Many specimens from the large intestine (NSMT-PI 5701) and caecum (NSMT-PI 5702).

Remarks. Present specimens with body 6.10–7.45 long $\times$ 3.24–4.51 mm wide, 15–17 ventral ridges, 28–31 crenulations on body margin; vitellaria scattered in rather limited pre-testicular zone; filamentous eggs ca. 190–280 μ m in length (eggs proper 18.2–19.2 $\times$ 10.0–11.5 μ m) correspond well with the taxonomic criteria of *O. antarctica* by Rausch and Fay (1966).

This species has been recorded from several marine mammalian hosts inhabiting both hemispheres (see Malatesta *et al.*, 1998) including the gray whale (Dailey *et al.*, 2000; Rice and Wolman, 1971). In contrast, *O. pentalineata* Rausch and Fay, 1966, a smaller species with a body 1.5–3.5 $\times$ 0.8–2.0 mm and only five or six ventral ridges, seems to be known only from the gray

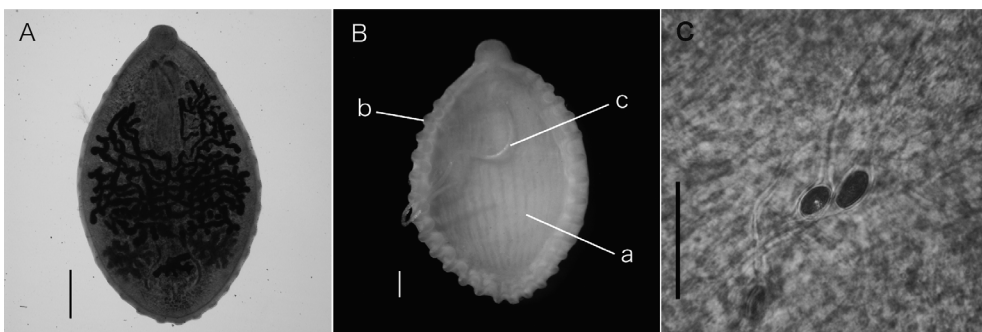


Fig. 1. *Ogmogaster antarctica* Johnston, 1931. A, a whole mount (scale bar, 1 mm); B, a contracted specimen showing a-ventral ridges, b-marginal crenulations and c-everted cirrus (scale bar, 0.5 mm); C, eggs with polar filaments (scale bar, 50 μ m).

whale (Dailey *et al.*, 2000; Rausch and Fay, 1966; Rice and Wolman, 1971; Zimushko and Ivashin, 1980). Zimushko and Ivashin (1980) reported the prevalence of *O. pentalineata* to be 58.7% in the gray whales mainly caught off Chukotka (= Chukchi) Peninsula but no *O. antarctica* was found, while Rice and Wolman (1971) recorded prevalences of *O. pentalineata* to be 22% and of *O. antarctica* to be 33% in the grey whales off California. In addition, Rice and Wolman (1971) and Dailey *et al.* (2000) stated that a large majority of the intestinal trematodes in the gray whale were *O. antarctica*. In the present study, *O. pentalineata* was not found in our examinations of two sub-samples.

Species of the genus *Ogmogaster* have not been recorded from marine mammals in the waters around Japan even though a series of intensive parasitological surveys on the common minke whale, *Balaenoptera acutorostrata* Lacépède, in the western North Pacific have been performed (Araki *et al.*, 1997; Kuramochi *et al.*, 1996; Uchida *et al.*, 1998; see also Kuramochi, 2003). We are aware of one case where *O. cf. plicata* (Creplin, 1829) Jägerskiöld, 1891 was recorded from a common minke whale stranded in the Japan Sea off the coast of Gotsu City, Shimanu, Japan (Kuramochi, unpublished).

Class Cestoda Van Beneden, 1849

Order Pseudophyllidea Carus, 1863

Family Diphyllbothriidae Lühe, 1910

Genus *Diphyllbothrium* Cobbold, 1858

Diphyllbothrium macroovatum Jurachno, 1973

(Fig. 2)

Materials. A total of three lots of specimens from the small intestine, a strobila over 5 m long with scolex and gravid ploglottids (NSMT-PI 5703), a young strobila ca. 1.8 m long with scolex (NSMT-PI 5704) and several fragments containing scoleces and gravid ploglottids (NSMT-PI 5705).

Remarks. Present specimens with scolex 1.05–1.32 mm long by 1.16–1.39 mm wide in lat-

eral view, ploglottids 2.82–3.47 mm long by 18.5–20.4 mm wide in the approximate portion of maximum width; seminal vesicle 0.62 mm long by 0.49 mm wide in sagittal section, cirrus pouch 0.74 mm long by 0.32 mm wide in sagittal section; uterine loop count 6–9; eggs 90.0–95.0 × 60.0–64.5 µm are identified to be *D. macroovatum* mainly based on Kamo (1999).

Records of this species are limited to the original description by Jurachno (1973), which was based on material from the gray whale caught off the Chukotka (= Chukchi) Peninsula, and several records from the common minke whale in the northwestern North Pacific (Araki *et al.*, 1997; Kamo *et al.*, 1980; Maeda, 1986; Uchida *et al.*, 1998). Uchida *et al.* (1998) reported the prevalence of *D. macroovatum* to be 10% in the common minke whale, while in the previous surveys of the gray whale by Rice and Wolman (1971), Zimushko and Ivashin (1980) and others, this species was not recorded. The worms from the common minke whale are dwarfed in size, 9.5–12.0 mm wide (Kamo *et al.* 1980) or 4.0–4.4 mm wide in the specimen collected by Araki *et al.* (1997) (NSMT-PI 4928), and also contain several morphological differences, i.e. smaller scolex, smaller cirrus pouch, larger seminal vesicle and slightly larger number of uterine loop from those of the gray whale (Kamo, 1999; Kamo *et al.* 1980; Maeda, 1986).

Order Tetrabothriidea Baer, 1954

Family Tetrabothriidae Linton, 1891

Genus *Priapocephalus* Nybelin, 1922

Priapocephalus eschrichtii Murav'eva and Treshchev, 1970

(Fig. 3)

Material. A scolex with strobila about 6 cm long removed from the wall of small intestine (NSMT-PI 5706).

Remarks. Present material has scolex 1.39 mm long by 1.70 mm wide and ploglottids 0.316–0.356 mm long by 2.91–2.96 mm wide.

This species was originally described and is

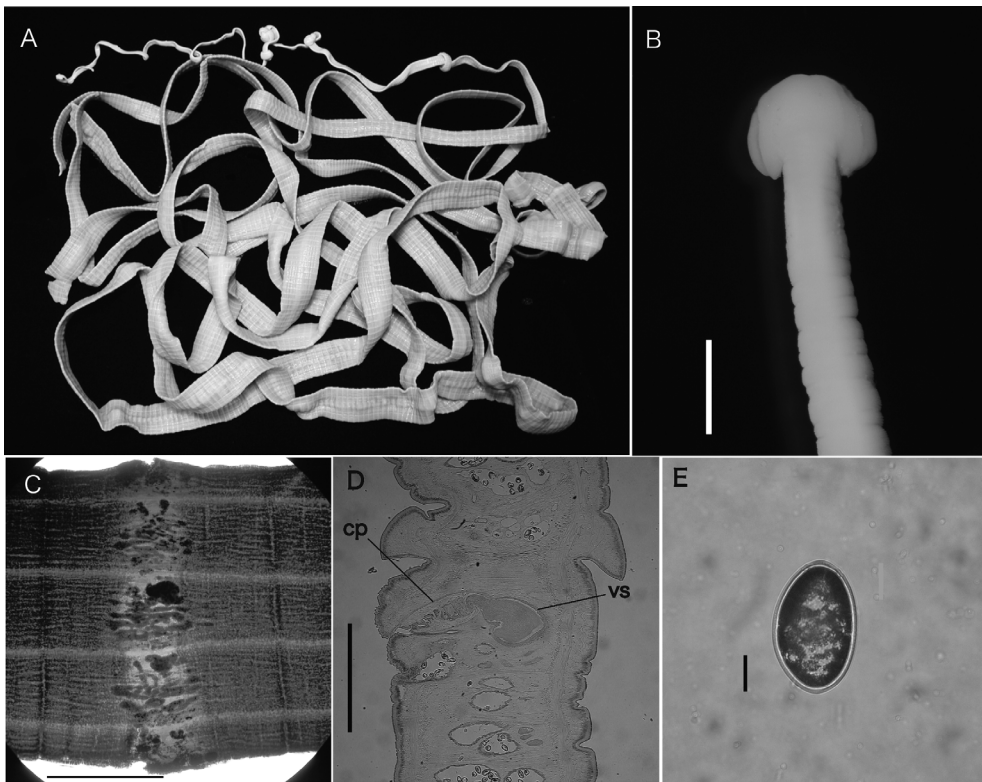


Fig. 2. *Diphylobothrium macroovatum* Jurachno, 1973. A, a strobila with scolex; B, a scolex in lateral view (scale bar, 1 mm); C, adult ploglottids (scale bar, 5 mm); D, a sagittal section of ploglottids showing vs-seminal vesicle and cp-cirrus pouch (scale bar, 1 mm); E, an egg (scale bar, 25 μ m).

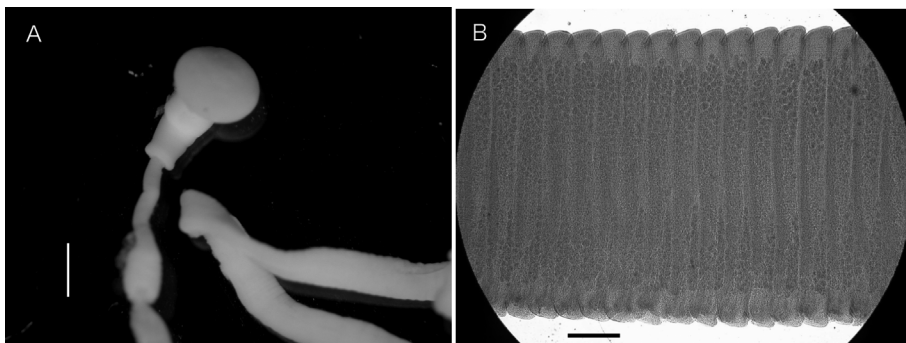


Fig. 3. *Priapocephalus eschrichtii* Murav'eva and Treshchev, 1970. A, a scolex with collar-like basal region (scale bar, 1 mm); B, adult ploglottids (scale bar, 0.5 mm).

known only from the gray whale in the Chukchi Sea (Murav'eva and Treshchev, 1970; Zimushko and Ivashin, 1980), and it seems to be rather abundant having been reported in 68.3% of the gray whales mainly caught off the Chukotka (=

Chukchi) Peninsula (Zimushko and Ivashin, 1980). In contrast, other congeners such as *P. grandis* Nybelin, 1922, known from several species of baleen whale and the sperm whale, *Physeter macrocephalus* Linnaeus, and *P. minor*

Table 1. Parasite fauna of gray whale, *Eschrichtius robustus* Lilljeborg, accumulated from previous and present works by catch locality and data source

Localities	British Columbia, Oregon and California coasts	Off Point Barrow, Alaska	Off Chukotka (= Chukchi) Peninsula and St. Lawrence Is., Alaska	Off Korea and Kamchatka Peninsula, Russia	The Pacific coasts of Japan
Areas	The eastern North Pacific	The Chukchi, Beaufort and Bering Seas		The Japan and Okhotsk Seas	The western North Pacific
Trematoda					
<i>Brachycladium goliath</i> (Van Beneden, 1858)	12				
<i>Orthosplanchnus pygmaeus</i> Yurakhno, 1967			16, 19		
<i>Ogmogaster antarctica</i> Johnston, 1931	4, 12				20
<i>Ogmogaster pentalineata</i> Rausch & Fay, 1966	4, 12		11, 19		
<i>Ogmogaster plicata</i> (Creplin, 1829) Jägerskiöld, 1891			19		
<i>Ogmogaster</i> spp.	5				
Cestoda					
<i>Diphyllbothrium macroovatum</i> Jurachno, 1973			17		20
<i>Pseudophyllidea</i> sp.			14		
<i>Priapocephalus eschrichtii</i> Murav'eva & Treshchev, 1970			10, 19		20
<i>Priapocephalus</i> spp.	12				
Nematoda					
<i>Anisakis simplex</i> (Rudolphi, 1809)	4, 12				
Acanthocephala					
<i>Bolbosoma balaenae</i> (Gmelin, 1790)	4, 5				
<i>Bolbosoma</i> sp.	12				
<i>Corynosoma semerme</i> (Forssell, 1904)			19		
<i>Corynosoma septentrionalis</i> Treshchev, 1966			15, 19		
<i>Corynosoma strumosum</i> (Rudolphi, 1802)			19		
<i>Corynosoma validum</i> Van Cleave, 1953			19		
<i>Corynosoma</i> sp.	12				
Amphipoda					
<i>Cyamus ceti</i> (Linnaeus, 1758)	3, 7, 12	6, 7	2, 19		
<i>Cyamus kessleri</i> Brandt, 1873	7, 12	6, 7	2, 19		
<i>Cyamus scammoni</i> Dall, 1872	4, 7, 8, 12	6, 7	2, 19	1, 18	9, 13

Data sources. 1, Andrews (1914); 2, Berzin and Vlasova (1982); 3, Dailey and Stroud (1978); 4, Dailey *et al.* (2000); 5, Gulland *et al.* (2005); 6, Hurley and Mohr (1957); 7, Leung (1965); 8, Margolis (1954; 1955); 9, Murase *et al.* (2014); 10, Murav'eva and Treshchev (1970); 11, Rausch and Fay (1966); 12, Rice and Wolman (1971); 13, Takeda and Ogino (2005); 14, Tomilin (1937); 15, Treshchev (1966); 16, Yurakhno (1967); 17, Yurakhno (1973); 18, Zenkovich (1934; 1937); 19, Zimushko and Ivashin (1980); 20, Present study.

Nybelin, 1928, recorded from the sei whale, *Balaenoptera borealis* Lesson, and the fin whale, *B. physalus* (Linnaeus) (cited from Schmidt, 1986), are lacking in recent record except for the only reference by Dailey and Vogelbein (1991) from Antarctic whales.

Discussion

Compared with the abundant work on the gray whale of the eastern North Pacific, fundamental knowledge on the gray whales of the western North Pacific is extremely limited (Jones *et al.*,

1984; Jones and Swartz, 2002; Rice and Wolman, 1971). Parasitology is not an exception, and most of the 16 parasite species representing 9 genera from 7 families reported from the gray whale are known from those hosts examined mainly in the eastern North Pacific, Bering Sea and Chukchi Sea (Table 1). Especially in the waters around Japan, no primary description of a parasite from the gray whale was published until Takeda and Ogino (2005) and Murase *et al.* (2014), who examined cyamid ectoparasitic whale lice.

Of the three species of endoparasites recorded

in this study, the finding of *D. macroovatum* is the second record of this species from the gray whale since its original description in the waters around the Chukotka (=Chukchi) Peninsula (Jurachno, 1973). Tomilin (1937) reported a pseudophyllidean cestode (Ord. Pseudophaliidae [sic.]) from the gray whale caught in the Chukchi Sea, which is speculated to be *Diplogonoporus balaenopterae* (Lönngberg, 1891) by Rice and Wolman (1971), but it is also possibly *D. macroovatum*. This evidence suggests that *D. macroovatum* is one of the major components of the endoparasite fauna of the gray whale. However, *D. macroovatum* has neither been recorded from whales off California nor from off the Chukotka (= Chukchi) Peninsula, except for the original description of this species by Jurachno (1973) (see Table 1). The present finding of *D. macroovatum* in the gray whale is rather feasible when we consider the occurrence of this cestode in the common minke whale from the western North Pacific (Araki *et al.*, 1997; Kamo *et al.*, 1980; Maeda, 1986; Uchida *et al.*, 1998).

The gray whales from the eastern North Pacific, Bering Sea and Chukchi Sea are infested by three species of amphipod whale louse, *Cyamus ceti* (Linnaeus, 1758), *C. kessleri* Brandt, 1873 and *C. scammoni* Dall, 1872 (Cyamidae), while only *C. scammoni* has been recorded from gray whales in the western North Pacific, Japan Sea and Okhotsk Sea (see Table 1). This may be due to the possibility that *C. ceti* and *C. kessleri* were overlooked by previous authors, as pointed by Hurley and Mohr (1957) and Rice and Wolman (1971). However, it is also possible that the gray whales from the western North Pacific, Japan Sea and Okhotsk Sea really lack these two whale lice in their parasite fauna.

This study represents the first report of these three species of endoparasites collected from gray whales from the western North Pacific. These parasites should be added to the list of helminth parasites recorded from marine mammals in the waters around Japan and adjoining seas (Kuramochi, 2003). Needless to say, the parasite fauna of the gray whale from the western North

Pacific is inadequately studied because only a few individuals of this host species have been examined. However, it will be suggested that gray whales from different localities consume similar prey items and have similar food habits, by the fact that the endoparasite species collected in this study were mostly shared among their habitats.

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