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Checklist of marine mammal parasites in New Zealand and Australian waters

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Review Article

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Abstract

Marine mammals are long-lived top predators with vagile lifestyles, which often inhabit remote environments. This is especially relevant in the oceanic waters around New Zealand and Australia where cetaceans and pinnipeds are considered as vulnerable and often endangered due to anthropogenic impacts on their habitat. Parasitism is ubiquitous in wildlife, and prevalence of parasitic infections as well as emerging diseases can be valuable bioindicators of the ecology and health of marine mammals. Collecting information about parasite diversity in marine mammals will provide a crucial baseline for assessing their impact on host and ecosystem ecology. New studies on marine mammals in New Zealand and Australian waters have recently added to our knowledge of parasite prevalence, life cycles and taxonomic relationships in the Australasian region, and justify a first host–parasite checklist encompassing all available data. The present checklist comprises 36 species of marine mammals, and 114 species of parasites (helminths, arthropods and protozoans). Mammal species occurring in New Zealand and Australian waters but not included in the checklist represent gaps in our knowledge. The checklist thus serves both as a guide for what information is lacking, as well as a practical resource for scientists working on the ecology and conservation of marine mammals.

Introduction

In the oceanic waters around New Zealand (NZ) and Australia, marine mammals are considered as vulnerable wildlife and often endangered due to anthropogenic impacts on their habitat. Strandings of these long-lived top predators and often pelagic species are rare and individuals are seldom available for data collection. A recent assessment has shown that the conservation status of NZ marine mammals has not improved (Baker *et al*., 2010). Furthermore, three endemic NZ marine mammals, i.e. NZ sea lion (*Phocarctos hookeri*), Hector's dolphin (*Cephalorhynchus hectori hectori*) (both endangered) and Maui's dolphin (*Cephalorhynchus hectori maui*) (nationally critical) are regarded as threatened. Thirteen taxa are considered data deficient (Baker *et al*., 2010). Around Australia, at least seven species are classified threatened, among them the iconic blue whale (*Balaenoptera musculus*), and the conservation status of 25 cetacean species is unknown due to insufficient data (Schumann *et al*., 2013). Australian and NZ waters include critical feeding and breeding grounds for permanent cetacean residents and visitors that migrate from summer feeding grounds in the Antarctic to the warmer waters of the Australian coast during the winter (Bannister *et al*., 1996; Salgado Kent *et al*., 2012). Recent dangers to pinnipeds in Australasian waters include exposure to marine debris and bycatch in fishing gear, which is an acute threat for the endangered Australian sea lion (*Neophoca cinerea*) (Kovacs *et al*., 2012) and NZ sea lion (Robertson & Chilvers, 2011). Continuous pressure of anthropogenic impacts such as fisheries, entanglement, vessel strike and chemical and noise pollution has prompted researchers to evaluate the effects of cumulative stress on marine mammals in Oceania and to implement conservation strategies to protect their survival (Kingsford *et al*., 2009).

Parasitism is ubiquitous in wildlife, and parasites in marine mammals are common. While a certain parasite load may not hamper host physiology, heavy infections can have serious pathogenic effects on host fitness (Measures, 2001; Siebert *et al*., 2001). Although Australian and NZ waters are a hotspot for marine mammal species richness (Pompa *et al*., 2011), little is known of their parasite diversity.

Parasitic infections, their prevalence and intensity as well as emerging species have proven to be valuable bioindicators of the ecology and health of marine mammals (Siebert *et al*., 2006; Lehnert *et al*., 2014), reflecting habitat use (Aznar *et al*., 1995), diet (Marcogliese, 2002), social behaviour and population dynamics (Balbuena and Raga, 1994), but also as markers for exposure and detrimental effects of xenobiotics (Sures, 2004; Pascual & Abollo, 2005; Marcogliese & Pietrock, 2011). They reveal evolutionary host–parasite relationships and highlight their biogeography and phylogeny over historical timescales (Anderson, 1982; Leidenberger *et al*.,

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2007). In the future, metazoan parasites, emerging infectious diseases and microparasites like viruses may be used as markers for the effects of anthropogenic stress on the health of marine mammals, as their role also as indicators for global change has become evident (Gulland & Hall, 2007; van Bressem *et al*., 2009). Additionally, some parasites of marine mammals have zoonotic potential, causing public health concerns and economic harm. Both the tapeworm *Diphyllobothrium latum* and anisakid nematodes (e.g. *Anisakis* spp., *Pseudoterranova* spp.) increasingly cause zoonotic infections in humans (Dorny *et al*., 2009; Shamsi, 2014), and can induce severe gastro-intestinal disease when ingested via undercooked fish (Mattiucci *et al*., 2013; Bao *et al*., 2017). These parasites are transmitted to their definitive cetacean and pinniped hosts via infective larvae within prey intermediate hosts, while infected fillets cause economic losses for the fishery industries (Llarena-Reino *et al*., 2015). Zoonotic protozoans like *Giardia* and *Cryptosporidium* are significant enteropathogens in NZ, causing higher infection rates than in other developed countries (Britton *et al*., 2010). Faeces from humans, pets and farm animals are discharged in runoff, bringing encysted parasites to coastal waters. They are filtered and concentrated by invertebrates and consumed by marine mammals, infecting a wide range of hosts, resulting in morbidity and mortality to some species (Fayer *et al*., 2004).

Collecting information about parasite diversity in marine mammals will provide a crucial baseline for assessing their impact on host and ecosystem ecology (Poulin *et al*., 2016). Study design in live marine mammals is restricted by legal as well as ethical constraints so that, since the cessation of whaling, data are collected mostly opportunistically from stranded or bycaught individuals. In the oceanic waters of the southern hemisphere, many species are seldom found stranded; therefore, few parasitological records (Berón-Vera *et al*., 2008; Nikolov *et al*., 2010) exist. Parasitology increasingly complements marine ecology to further our understanding of ecosystem dynamics (Poulin *et al*., 2016), but, so far, little is known about the biodiversity of Australasian marine parasites (Poulin, 2004; Stockin *et al*., 2009). New studies on marine mammals in NZ and Australian waters have recently added to our knowledge about parasite prevalence, life cycles (Tomo *et al*., 2010; Lehnert *et al*., 2017) and taxonomic relationships (Shamsi *et al*., 2012, Hernández-Orts *et al*., 2017), and justify a first host–parasite checklist encompassing all available data. Previous marine mammal parasite checklists include Baylis (1932), Delyamure (1955), Dailey & Brownell (1972), Raga (1994), Felix (2013) and Fraija-Fernández *et al*. (2016). Most include host data, but geographical data are scanty. Australian lists include that of the internal parasites of mammals by MacKerras (1958), the references of which are unfortunately disconnected from the text and, therefore, not useable, and Arundel (1978), which records parasites found in all marine mammals that are found in Australian waters. This list, however, does not differentiate between parasites found in the host species within Australian waters and those found in the same species in other parts of the world. There are no equivalent lists for the marine mammals of NZ.

A couple of useful lists are available for particular host taxa (e.g. Blair, 1981: dugong monostome digeneans; Bowie, 1984: bottle-nosed dolphin parasites), and parasite taxa (e.g. Price, 1932: trematodes in marine mammals; Leung, 1967: whale lice of cetaceans). There have also been compilations with a veterinary perspective (e.g. Duignan, 2000; Dailey, 2001; Ladds, 2009; McFarlane *et al*., 2009) and those looking at certain pathologies (e.g. Baylis & Daubney, 1925: lungworms of cetacean; Spratt, 2002: respiratory parasites in Australian mammals; Measures, 2001: lungworms of marine mammals).

Here, we present a host–parasite checklist collating all information about the metazoan and protozoan parasites of marine mammals in NZ and Australian waters. Although viruses (e.g. morbillivirus) and bacteria (e.g. *Brucella*) are relevant pathogens with zoonotic potential that can cause mortality in marine mammals (Castinel *et al*., 2007), we limit our list to the better-known eukaryotic parasites. Where possible, we also identify knowledge gaps and research needs, especially with regard to human interactions and zoonoses, as well as marine mammal conservation.

Material and methods

We present a list of the parasites found in pinnipeds, cetaceans and sirenians of NZ and Australia, as far as possible up to date at the time of publication. The list was assembled from primary publications found through searches on Google Scholar using all combinations of relevant keywords, plus searches of the reference lists in those publications. The parasites are presented in alphabetical order of Families under their relevant Phylum, Class and Order. Within Families, species are listed in alphabetical order. Classifications followed for helminths are: Anderson *et al*. (2009) (Nematoda); Caira & Jensen (2017) (Cestoda); Olson *et al*. (2003), Gibson *et al*. (2002), Jones *et al*. (2005) and Bray *et al*. (2008) (Trematoda); and Amin (2013) (Acanthocephala). For arthropods and protozoa higher taxonomy was taken from the records cited, or from searches for more up-to-date phylogenetic studies. Synonyms are taken from the references in square brackets following the entries, with corrections and updates from primary sources in some cases.

Localities of records are given as indicated in the original source. Standard abbreviations are used for Australian states: New South Wales, NSW; Queensland, QLD; South Australia, SA; Victoria, VIC; Tasmania, TAS; Western Australia, WA; and New Zealand, NZ. We have included only those records that fall within the geographical boundaries of Australia and NZ, and their subantarctic islands. Records for mainland Antarctica have not been included, because there is no geographical distinction between Australian or NZ-held territory, and those territories belonging to other countries. Although there are many records for mainland Antarctica, these are best dealt with as a separate entity.

Where there is more than one reference source, hosts and localities bear a superscript number that refers to the numbered reference. In a few cases, where references cite differing infection sites, these are also numbered with the relevant superscript number. Multiple references are listed in chronological order.

For host taxonomy we have adhered to WoRMS (2018) (Pinnipeda and Cetacea), Berta and Churchill (2012) (Pinnipeda) and Perrin (2018) (Cetacea). Host names listed are considered to be up to date as of publication. Where hosts were named differently in the original source, we have noted this in the relevant Remarks section. Hosts' common names can be found in the host–parasite list.

The developmental stage of the parasite has been noted, where given in the original source. If such information was not given, worms are assumed to be adult if egg presence is noted or egg measurements are given.

Remarks sections contain information on intermediate hosts when available, notes on prevalence and intensity, and on pathology when available; short summaries of the latest research on disputed or complicated species; and mention of molecular data

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if available (i.e. from papers listed in the references and placed on GenBank) with the genetic markers used.

A list of host–parasite associations follows the parasite–host checklist.

Results

Parasite–host list

Phylum: Acanthocephala
Class: Palaeoacanthocephala Meyer, 1931
Order: Polymorphida Petrochenko, 1956
Family: Polymorphidae Meyer, 1931

Parasite name: *Bolbosoma balaenae* (Gmelin, 1790) Porta, 1908

Synonyms. *Bolborhynchus porrigens* Porta, 1906; *Bolbosoma porrigens* (Rudolphi, 1814) Porta, 1908; *Echinorhynchus balaenae* Gmelin, 1790; *E. lendix* Phipps, 1774; *E. mysticeti* Beneden, 1870; *E. porrigens* Rudolphi, 1819; *Sipunculus lendix* Phipps, 1774 [Amin, 2013; Yamaguti, 1963].
Hosts. *Megaptera novaeangliae*.
Localities. Bondi Beach, NSW.
Infection site.
Stage.
References. Johnston & Deland (1929).
Remarks. Called *B. porrigens* in this paper. Host reported as probably *M. nodosa* (= *longimana*); both now synonymized with *M. novaeangliae*.

Parasite name: *Bolbosoma capitatum* (von Linstow, 1880) Porta, 1908

Synonyms. *Bolborhynchus capitatus* (von Linstow, 1880) Porta, 1908; *B. physeteris* Gubanov, 1952 (*fide* Amin & Margolis, 1998); *Echinorhynchus capitatus* von Linstow, 1880 [Amin, 2013; Felix, 2013].
Hosts. *Pseudorca crassidens* (1, 3), *Globicephala melas* (2).
Localities. (1) Prime's Beach, St. Vincent Gulf, SA; (2) Macquarie Harbour, TAS; (3) Augusta WA.
Infection site. Intestine.
Stage.
References. (1) Edmonds (1957b); (2) McManus *et al.* (1984); (3) Edmonds (1987).
Remarks. Host reported in Edmonds (1957b) as Melon-headed whale (*G. melaenas* = *G. melas*); later corrected to false killer whale in Edmonds (1987).

Parasite name: *Bolbosoma* sp.

Synonyms.
Hosts. *Tursiops truncatus*.
Localities. Otago Harbour, NZ.
Infection site. Intestine.
Stage. Immature.
References. Bowie (1984).
Remarks. Single specimen.

Parasite name: *Corynosoma australe* Johnston, 1937

Synonyms. *Corynosoma otariae* Morino & Boero, 1960 [Amin, 2013].
Hosts. *Arctocephalus pusillus doriferus* (3), *Arctophoca australis forsteri* (4), *Hydrurga leptonyx* (2), *Neophocus cinerea* (1, 5), *Phocarctos hookeri* (2, 6).
Locality. (1) Pearson Island, SA; (2) Auckland/Campbell Island, NZ; (3) Phillip Island, VIC; (4) in captivity, NZ; (5) Port Adelaide and Dangerous Reef, SA; (6) NZ.
Infection site. Small and large intestine.
Stage. Adult.
References. (1) Johnston (1937); (2) Johnston & Edmonds (1953); (3) Obendorf & Presidente (1978); (4) Cordes & O'Hara (1979); (5) Smales (1986); (6) García-Varela *et al.* (2013).
Remarks. Johnston (1937) described host as *A. forsteri*, but corrected this to *N. cinerea* in Johnston & Mawson (1941). Although Johnston & Edmonds (1953) listed a number of ways in which their specimens differed from those of Johnston (1937), they nonetheless record them as *C. australe*. Smales (1986) agrees in her list of comparative specimens of the species. In her paper, the host is called *A. pusillus*. Johnston & Edmonds (1953) found immature specimens in *Phalacrocorax colensoi*. Molecular data available (18S, 28S, *cox1*) (6).

Parasite name: *Corynosoma bullosum* (von Linstow, 1892) Railliet & Henry, 1907

Synonyms. *Corynosoma arctocephali* Zdzitowiecki, 1984; *C. mirabilis* Skrjabin, 1966 (*fide* Zdzitowiecki, 1986); *C. singularis* Skrjabin & Nikolski, 1971, in part; *Echinorhynchus bullosus* von Linstow, 1892 [The World Register of Marine Species (WoRMS); Amin, 2013].
Hosts. *Hydrurga leptonyx* (2), *Mirounga leonine* (1–3).
Locality. (1) Auckland/Campbell Island, NZ; (2, 3) Heard Island, Australia; (2) Macquarie Island, Australia.
Infection site. Intestine.
Stage. Adult.
References. (1) Johnston & Edmonds (1953); (2) Edmonds (1955); (3) Edmonds (1957a).
Remarks. Edmonds reported 200 (1957a), and over 100 (1955) specimens from single hosts. He states that the larval stages are found encysted in the mesenteries of *Notothenia coriiceps*.

Parasite name: *Corynosoma cetaceum* Johnston & Best, 1942

Synonyms. *Corynosoma semerme sensu* Cordero, 1933; *Polymorphus arctocephali* Smales, 1986 (nec *arctocephalus*); *Polymorphus (Polymorphus) cetaceum* (Johnston & Best, 1942) Schmidt & Dailey, 1971 [Amin, 2013].
Hosts. *Arctocephalus pusillus doriferus* (2), *Delphinus delphis* (1), *Tursiops truncatus* (1).
Locality. (1) Port Lincoln, SA; (1) St. Vincent Gulf, SA; (2) Phillip Island, VIC.
Infection site. Stomach and small intestine.
Stage. Adult.
References. (1) Johnston & Best (1942); (2) Smales (1986).
Remarks. Described as new species in Johnston & Best (1942). Described as *P. arctocephali* n. sp., and host as *A. pusillus* in Smales (1986), synonymized by Aznar *et al.* (1999).

Parasite name: *Coryosoma semerme* (Forssell, 1904) Lühe, 1905

Synonyms. *Corynosoma gibber* (Olsson, 1894) Lühe, 1911; *Echinorhynchus semermis* Forssell, 1904 (Amin, 2013).

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Hosts. *Phocarctos hookeri*.
Locality. Auckland/Campbell Island, NZ.
Infection site.
Stage.
References. Johnston & Edmonds (1953).
Remarks. Host called *Otaria hookeri* in this paper.

Parasite name: *Corynosoma* sp.

Synonyms.
Hosts. *Arctophoca australis forsteri* (2), *Cephalorhynchus hectori* (3), *Delphinus delphis* (1), *Hydrurga Leptonyx* (2), *Neophoca cinerea* (4).
Locality. (1) St. Vincent Gulf, SA; (2) Auckland/Campbell Island, NZ; (3) Canterbury coast, NZ; (4) Port Adelaide, SA.
Infection site. Intestine.
Stage.
References. (1) Johnston & Deland (1929); (2) Johnston & Edmonds (1953); (3) McKenzie & Blair (1983); (4) Smales (1986).
Remarks. The specimens of Johnston and Deland (1929) were later designated as *C. cetaceum* (Johnston & Best, 1942). Host called *Otaria forsteri* in Johnston and Edmonds (1953). McKenzie & Blair (1983) reported finding seven specimens in one of three dolphins.

Phylum: Nemathelminthes
Class: Nematoda Rudolphi, 1808
Order: Ascaridida Sprehn, 1927
Family: Anisakidae Railliet & Henry, 1912

Parasite name: *Anisakis berlandi* Mattiucci, Nascetti, Cianchi, Paggi, Arduino, Margolis, Brattey, Webb, D'Amelio, Orecchia & Bullini, 1997

Synonyms. *Anisakis simplex* C, of Mattiucci *et al.* (1997).
Hosts. *Kogia sima*.
Locality. Coast of NSW.
Infection site. Stomach.
Stage. Larva.
References. Shamsi *et al.* (2012).
Remarks. Molecular data available (ITS1&2). The specimens in this paper referred to as *A. simplex C* following Mattiucci *et al.* (1997) were later assigned to *A. berlandi* by Mattiucci *et al.* (2014).

Parasite name: *Anisakis brevispiculata* Dollfus, 1966

Synonyms.
Hosts. *Kogia sima*.
Locality. Coast of NSW.
Infection site. Stomach.
Stage. Adult.
References. Shamsi *et al.* (2012).
Remarks. Molecular data available (ITS1&2).

Parasite name: *Anisakis nascettii* Mattiucci, Paoletti & Webb, 2009

Synonyms. *Anisakis* sp. of Pontes *et al.* (2005) and Iglesias *et al.* (2008); *Anisakis* sp. of Valentini *et al.* (2006).
Hosts. *Mesoplodon bowdoini*, *M. grayi*, *M. layardii*.
Locality. South Pacific Ocean, off NZ.
Infection site. Stomach.
Stage. Adult.
References. Mattiucci *et al.* (2009).
Remarks. Molecular data available (*cox2*). The intermediate host was confirmed molecularly as the squid, *Onykia ingens* by Mattiucci *et al.* (2009) (then *Moroteuthis ingens*).

Parasite name: *Anisakis oceanica* (Johnston & Mawson, 1951) Davey, 1971

Synonyms. *Stomachus oceanicus* Johnston & Mawson, 1951.
Hosts. *Globicephala melas*.
Locality. Coast of NSW.
Infection site. Stomach.
Stage.
References. Johnston & Mawson (1951).
Remarks. Described as *S. oceanicus* in this paper, with the host called *Globicephalus ventricosas*. Davey (1971) synonymized this species with *A. physeteris*, but Shamsi *et al.* (2012) and Shamsi (2014) have kept the species separate as a *sp. inq.* Species is also accepted by Mattiucci *et al.* (2005).

Parasite name: *Anisakis pegreffii* Campana-Rouget & Biocca, 1955

Synonyms.
Hosts. *Delphinus delphis*, *Tursiops truncatus*.
Locality. Blairgowrie and Apollo Bay, VIC.
Infection site. Stomach.
Stage. Adult plus immatures in *D. delphis*, larvae in *T. truncatus*.
References. Shamsi *et al.* (2012).
Remarks. Molecular data available (ITS1&2).

Parasite name: *Anisakis physeteris* Baylis, 1923

Synonyms. *Anisakis skrjabini* Mozgovoi, 1949 [WoRMS].
Hosts. *Kogia breviceps*.
Locality. Wellington Beach, NZ.
Infection site. Stomach.
Stage.
References. Hurst (1980).
Remarks. A single host harboured 61 specimens.

Parasite name: *Anisakis simplex sensu lato*

Synonyms. *Anisakis catodontis* Baylis, 1929; *A. ivanizkii* Mozgovoi, 1949; *A. kogiae* Johnston & Mawson, 1939; *A. kuekenthalii* (Cobb, 1889) Baylis, 1920; *A. marina* (Linnaeus, 1767) van Thiel, 1966; *A. patagonica* (von Linstow, 1880) Davey, 1971; *A. rosmari* (Baylis, 1916) Baylis, 1920; *A. similis* (Baird, 1853) Baylis, 1920; *A. simplex* (Rudolphi, 1809) Dujardin, 1845; *A. tridentata* Kreis, 1939; *Ascaris kuekenthalii* Cobb, 1889; *As. similis* Baird, 1853; *Capsularia marina* (Linnaeus, 1767) Johnston & Mawson, 1943; *Stomachus similis* (Baird, 1853) Davey, 1971 and many more [WoRMS; Davey 1971].
Hosts. *Arctophoca australis forsteri* (11), *Delphinus delphis* (2), *Globicephala melas* (14), *Hydrurga leptonyx* (2, 5, 6), *Kogia breviceps* (1, 11), *Lagenodelphis hosei* (12), *Lagenorhynchus obscurus* (3, 7), *Mirounga leonine* (4, 6, 9, 10), *Peponocephala electra* (8), *Tursiops truncatus* (13).

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Locality. (1) Port Victoria, Spencer Gulf, SA; (1) Moreton Bay, QLD; (2) Sydney Harbour, NSW; (2) Port Adelaide, SA; (3) Cook Strait, NZ; (4, 6, 9) Macquarie Island, TAS; (5) Campbell Island, NZ; (6) Heard Island, Australia; (7) NZ coast; (8) Moreton Island, QLD; (8) Tweed Heads, NSW; (10) in captivity, NZ; (11) Wellington Beach, NZ; (12) Corio Bay, VIC; (13) Otago Harbour, NZ; (14) McIntyres Beach, Falmouth, and Macquarie Harbour, TAS.
Infection site. Stomach.
Stage. All stages are reported from larvae to adults.
References. Johnston & Mawson ((1) 1939, (2) 1941, (3) 1942, (4) 1945, (5) 1953); (6) Mawson (1953); (7) Brundson (1956); (8) Cannon (1977); (9) Morgan *et al.* (1978); (10) Cordes & O'Hara (1979); (11) Hurst (1980); (12) McColl & Obendorf (1982); (13) Bowie (1984); (14) McManus *et al.* (1984).
Remarks. *Anisakis simplex* is widely accepted to be a complex of closely related species (Nascetti *et al.*, 1986; Mattiucci *et al.*, 1997, 2009, 2014; D'Amelio *et al.*, 2000; Abe *et al.*, 2006; Abe, 2008), and the name has been attached to specimens the world over and in numerous hosts. Davey (1971) alone lists 34 different hosts from both Cetacea and Pinnipedia. While it is not possible to assign specimens reported in the literature over the years, Mattiucci *et al.* (2014) have made worthy inroads into resolving some of the ambiguity. As a result of their findings, it is likely that at least some of those specimens found in NZ will be their newly erected *A. berlandi* Mattiucci, Cipriani, Webb, Paoletti, Marcer, Bellisario, Gibson & Nascetti, 2014 (See entry for *Anisakis berlandi* above). Without further information, or examining each of the specimens mentioned in the literature, we here assign all references to *A. simplex* in the Australasian region, except those of Mattiucci *et al.* (2014), which have been characterized to *A. simplex sensu lato*. *Anisakis simplex* has been shown to occur as a larva in many species of fish under various names (Johnston & Mawson, 1943a, b, 1945, 1951, 1953). Brundson (1956) was able infect eels with encapsulated *A. simplex* from barracouta, where they re-established, demonstrating that horizontal infection is possible. This is not surprising in a system where the species complex appears to be highly generalist in its choice of host and where there exists a cascade in size of predatory fish. The larva must be able to withstand being eaten by a succession of fish before being finally taken by a cetacean, where it can mature in the stomach. Hurst (1980) completed the life cycle of *A. simplex* with *Nyctiphanes australis* (first intermediate host), large fish – for example, *Thyrsites atun*, *Trachurus* sp. (second intermediate host) – and squid or small fish – for example, hoki, anchovy, sprat (paratenic host). While host specificity does appear extremely broad when all reports are taken into account, this effect may be exaggerated by the fact that *A. simplex* is, in fact, many cryptic species that are yet to be fully disentangled. In the above references the species is called *A. kogiae* (1), *A. similis* (2), *S. marinus* (7) and *S. similis* (4, 6). Host species are called *D. forsteri* (2). In the literature cited in this section, the maximum number of worms per infection amounted to several hundred (13). The species is widely reported to cause gastric ulceration and, according to some sources, mortality (10, 11).

Parasite name: *Anisakis* sp.

Synonyms.
Hosts. *Arctocephalus pusillus doriferus* (1), *Arctophoca australis forsteri* (2), *Balaenoptera acutorostrata* (3), *Globicephalus melas* (6), *Kogia breviceps* (7), *Mesoplodon grayi* (5), *M. hectori* (4), *Phocoena dioptrica* (7).
Locality. (1) Franklin Island Derwent Heads, TAS; (2) in captivity, NZ; (3) Pigeon Bay, Banks Peninsula, NZ; (4) Oneroa Bay, Waiheke Island Hauraki Gulf, NZ; (5) NZ coast; (6) Farewell Spit, Golden Bay, NZ; (7) Moeraki Beach, NZ; (7) Caroline Bay, Timaru, NZ.
Infection site. Stomach and intestine. Mouth (*K. breviceps*).[7]
Stage. Larva, immature, adult.
References. (1) Johnston & Mawson (1941); (2) Cordes & O'Hara (1979); (3) Dawson & Slooten (1990); (4) Baker *et al.* (2001); (5) Valentini *et al.* (2006); (6) Beatson & O'Shea (2009); (7) Lehnert *et al.* (2017).
Remarks. Molecular data available (*cox2*) (5). The specimens from Grey's beaked whale (Valentini *et al.*, 2006) grouped with some from the South African coast, also unnamed. They were closest to *Anisakis ziphidarum* in phylogenic analyses. A lack of adult specimens limited the morphological description and proper naming of this new species. Type 1 larvae were identified from *Aphanopus carbo* (black scabbard fish) from Madeira and from *Trachurus trachurus* (Atlantic horse mackerel) from the North Atlantic. The host in Johnston & Mawson's (1941) report is called *Gypsophoca tasmanica*.

Parasite name: *Anisakis typica* (Diesing, 1860) Baylis, 1920

Synonyms. *Anisakis alexandri* Hsü & Hoeppli, 1933; *A. tursiopis* Crusz, 1946; *Ascaris typica* (Diesing, 1860) Jägerskiöld, 1894; *Conocephalus typicus* Diesing, 1860; *Peritracheilus typicus* (Diesing, 1860) Jägerskiöld, 1894 [WoRMS; Li *et al.*, 2016].
Hosts. *Peponocephala electra*.
Locality. Moreton Island, QLD; Tweed Heads, NSW.
Infection site. Stomach.
Stage. Adults and immatures.
References. Cannon (1977).
Remarks. Shamsi (2014) note that *A. typica* specimens in Australia appear to be genetically different from those reported in other countries. Jabbar *et al.* (2012) found larval stages (confirmed by DNA sequence) in a number of different fish species.

Parasite name: *Anisakis ziphidarum* Paggi, Nascetti, Webb, Mattiucci, Cianchi & Bullini, 1988

Synonyms.
Hosts. *Mesoplodon bowdoini*.
Locality. South Pacific Ocean, off NZ.
Infection site. Stomach.
Stage. Adult.
References. Mattiucci *et al.* (2009).
Remarks. Molecular data available (*cox2*).

Parasite name: *Contracaecum mirounga* Nikolskii, 1974

Synonyms.
Hosts. *Hydrurga leptonyx*, *Mirounga leonina*.
Locality. Heard Island and Macquarie Island, Australia.
Infection site. Stomach.
Stage.
References. Fagerholm (1988).
Remarks. Using the arrangement of the male caudal papillae, this study found that *C. mirounga* was restricted to southern

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hemisphere hosts, compared to *C. osculatum* and *C. ogmorhini*, which were more widespread in both hemispheres.

Parasite name: *Contracaecum ogmorhini* Johnston & Mawson, 1941

Synonyms. *Contracaecum corderoi* Lent & Freitas, 1948; *C. ogmohini* Johnston & Mawson, 1941 (*lapsus*); *C. osculatum* of Flores-Barroeta *et al*., 1961 [Fagerholm & Gibson, 1987].
Hosts. *Arctocephalus pusillus doriferus* (2), *Hydrurga leptonyx* (1).
Locality. (1) Port Adelaide, SA; (2) coast of NZ.
Infection site.
Stage. Adult.
References. (1) Johnston & Mawson (1941); (2) Mattiucci *et al*. (2003).
Remarks. Molecular data available (*cytb*) (2). Described as new species in Johnston & Mawson (1941), but with a lapsus in the main heading of '*ogmohini*'. Has been accepted as *ogmorhini* ever since.

Parasite name: *Contracaecum osculatum* (Rudolphi, 1802) Baylis, 1920

Synonyms. *Ascaris osculata* Rudolphi, 1802; *C. antarcticum* Johnston, 1937; *C. gypsophocae* Johnston & Mawson, 1941; *Phocascaris hydrurgae* Johnston & Mawson, 1941 [WoRMS].
Hosts. *Arctocephalus pusillus doriferus* (3), *Arctophoca australis forsteri* (3, 5, 6), *Hydruruga leptonyx* (2, 3), *Mirounga leonine* (3, 4), *Neophoca cinerea* (1).
Locality. (1) Pearson Island, SA; (2) Port Adelaide, SA; (3) Franklin Island Derwent Heads, TAS; (3, 4) Macquarie Island, TAS; (3) Heard Island, Australia; (5) in captivity, NZ; (6) Open Bay Island, Wellington, NZ.
Infection site. Stomach and small intestine.
Stage. Adults and immatures.
References. (1) Johnston (1937); (2) Johnston & Mawson (1941); (3) Mawson (1953): (4) Morgan *et al*. (1978); (5) Cordes & O'Hara (1979); (6) Hurst (1980).
Remarks. Described as new species, *C. gypsophocae* and as *P. hydrurgae* in Johnston & Mawson (1941). Both synonymized by Johnston & Mawson (1945). Original host recorded as *Gypsophoca tasmanica*. Hosts recorded as *Arctocephalus forsteri* (5, 6). Johnston's (1937) original description stated the host as *A. forsteri*, but this was corrected to *N. cinerea* in Johnston and Best (1942). Hurst (1980) recorded 100% prevalence for this anisakid in the NZ fur seal. They found an infection range of 5–344 in the seals examined, and the presence of *C. osculatum* was associated with gastric ulcers.

Parasite name: *Contracaecum radiatum* (von Linstow, 1907) Baylis 1920

Synonyms. *Ascaris falcigera* Railliet & Henry, 1907; *A. osculaia* von Linstow, 1892; *A. radiata* von Linstow, 1907; *Contracaecum falcigerum* (Railliet & Henry, 1907) Baylis, 1920; *Kathleena radiata* Leiper & Atkinson, 1915 [WoRMS; Baylis 1937].
Hosts. *Hydrurga leptonyx*, *Mirounga leonina*.
Locality. Heard Island, Australia.
Infection site.
Stage.
References. Mawson (1953).
Remarks.

Parasite name: *Contracaecum* sp.

Synonyms.
Hosts. *Cephalorhynchus hectori*.
Locality. Canterbury coast, NZ.
Infection site. Stomach.
Stage.
References. McKenzie & Blair (1983).
Remarks. The material reported in this paper may have been two different species of *Contracaecum* from three dolphins. One was found as a single immature female in one dolphin, the second species was in all three dolphins, and 15 specimens were taken in total.

Parasite name: *Phocascaris* sp.

Synonyms.
Hosts. *Cephalorhynchus hectori*.
Locality. Canterbury coast, NZ.
Infection site. Stomach.
Stage. Immature.
References. McKenzie & Blair (1983).
Remarks. A single, female, specimen in one of three dolphins.

Parasite name: *Pseudoterranova decipiens* (Krabbe, 1878) Gibson, 1983

Synonyms. *Agamonema piscium* Schneider, 1862; *Ag. campbelli* Chatin, 1885; *Ascaris bulbosa* Cobb, 1888; *A. capsularia* Stiles and Hasall, 1899, in part; *A. capsularia* Baylis, 1916, in part; *A. decipiens* Krabbe, 1878; *A. rectangula* Linstow, 1888; *A. simplex* von Linstow, 1888; *Phocanema decipiens* (Krabbe, 1878) Myers, 1959; *Physaloptera guiarti* Garin, 1913; *Porrocaecum decipiens* (Krabbe, 1878) Baylis, 1920; *Por. piscium* Johnston & Mawson, 1943; *Por. capsularia* Dogiel, 1932; *Terranova decipiens* (Krabbe, 1878) Mozgovoi, 1953; *T. piscium* (Rudolphi, 1809) Johnston and Mawson, 1943 [Johnston & Mawson, 1945; Myers, 1959].
Hosts. *Arctophoca australis forsteri* (3, 5), *Hydrurga leptonyx* (3, 4), *Mirounga leonine* (2, 3), *Kogia breviceps* (5), *Phocarctos hookeri* (1, 3, 5).
Locality. (1, 3) Campbell Island, NZ; (2, 4) Macquarie Island, TAS; (3, 5) Auckland Island, NZ; (5) Wellington Beach, NZ.
Infection site. Stomach.
Stage. Adult plus immatures.
References. (1) Johnston & Mawson (1943a); (2) Johnston & Mawson (1945); (3) Johnston & Mawson (1953); (4) Mawson (1953); (5) Hurst (1980).
Remarks. Mawson (1953) reported a prevalence of seven out of nine leopard seals from Macquarie Island. Hurst reported a range of infection between one and 122 per host animal. Hurst's (1980) data include both pinniped and cetacean hosts. Johnston & Mawson (1943a) referred to this species as *Por. decipiens* (Krabbe, 1878) Baylis, 1920 and (1945, 1953) *T. piscium*. Various fish are recorded as intermediate hosts; *Thyrsites atun* (5), notothenioid species (1, 3) and the flounder *Rhombosolea* sp. (3). Hosts variously called *Arctocephalus hookeri* (1), *Otaria forsteri* (3), *O. hookeri* (3). Mawson (1953) also reported this species from the Royal penguin *Eudyptes schlegeli* Finsch, 1876.

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Parasite name: *Pseudoterranova kogiae* (Johnston & Mawson, 1939) Mozgovoi, 1951

Synonyms. *Porrocaecum kogiae* Johnston & Mawson, 1939; *Terranova kogiae* (Johnston & Mawson, 1939) Johnston & Mawson, 1945 [Johnston & Mawson, 1945; Deardorff & Overstreet, 1981].
Hosts. *Kogia breviceps* (1, 2).
Locality. (1) Port Victoria, Spencer Gulf, SA and Moreton Bay, QLD; (2) Wellington Beach, NZ.
Infection site. Stomach.
Stage. Adults and larvae.
References. (1) Johnston & Mawson (1939); (2) Hurst (1980).
Remarks. Called *P. kogiae* in Johnston & Mawson (1939). Intermediate fish hosts include the barracouta (*Thyrsites atun*), subantarctic cod (*Notothaenia* sp.) (Hurst, 1984), hoki (*Macruronus novaezelandiae*) and ling (*Genypterus blacodes*) (Grabda & Ślósarczyk, 1981).

Family: Ascarididae Baird, 1853

Parasite name: *Paradujardinia halicoris* (Owen, 1833) Travassos, 1933

Synonyms. *Ascaris dugonis* Brandt, 1846; *A. halichoris* Owen, 1833; *Dujardinia halicoris* (Owen, 1833) Baylis, 1920; *Dujardinascaris halicoris* (Owen, 1833) Baylis, 1947 [Sprent, 1980].
Hosts. *Dugong dugon* (1–4).
Locality. (1) Wallum Creek, North Stradbroke Island, QLD; (2) Yarrabah, near Cairns, QLD; (3) north coast of QLD; (4) coast of QLD.
Infection site. Stomach and intestine.
Stage.
References. (1) Dexler & Freund (1906); (2) Johnston & Mawson (1941); (3) Sprent (1980); (4) Owen *et al*. (2012).
Remarks. Johnston & Mawson (1941) called their specimens *Dujardinia halicoris*. Owen *et al*. (2012) reported the presence of 5500 to 6000 worms in a single dugong, with the massive impaction possibly the cause of death of the individual.

Order: Spirurida Chitwood, 1933
Family: Acuariidae Railliet, Henry & Sisoff, 1912

Parasite name: *Acuaria* sp.

Synonyms.
Hosts. *Cephalorhynchus hectori*.
Locality. Canterbury coast, NZ.
Infection site. Stomach.
Stage. Larva.
References. McKenzie & Blair (1983).
Remarks. A single specimen was found in one of three dolphins.

Family: Filariidae Weinland, 1858

Parasite name: *Filaria sensu lato* sp.

Synonyms.
Hosts. *Mirounga leonina*.
Locality. Heard Island, Australia.
Infection site. Blood vessels.
Stage. Adult.
References. Mawson (1953).
Remarks.

Family: Gnathostomatidae Railliet, 1895

Parasite name: *Echinocephalus overstreeti* Deardorff & Ko, 1983

Synonyms.
Hosts. *Delphinus delphis*.
Locality. St. Vincent Gulf, SA.
Infection site. Intestine.
Stage. Immature.
References. Johnston & Mawson (1941).
Remarks. This species is usually found as adults in elasmobranchs, with the larval stages in molluscs and teleosts. This finding of a larval stage in the intestine of a dolphin almost certainly represents an accidental infection from predation on a paratenic fish host. Johnston and Mawson (1941) listed this as *Echinocephalus uncinatus* Molin, 1858. However, Beveridge (1987) showed that all adult and larval specimens found in elasmobranchs in Australian waters belonged to *E. overstreeti*, and that earlier records of *E. uncinatus* can probably be attributed to *E. overstreeti*. Moravec and Justine (2006), however, questioned this decision.

Family: Tetrameridae Travassos, 1914

Parasite name: *Crassicauda boopis* Baylis, 1920

Synonyms. *Crassicauda pacifica* Margolis & Pike, 1955 [WoRMS].
Hosts. *Ziphius cavirostris*.
Locality. Kiritehere Beach, Purakanui Bay, Mahia Peninsula, NZ.
Infection site. Kidneys.
Stage. Adult.
References. Duignan (2003).
Remarks. *Crassicauda boopis* is recorded as pathogenic in this paper. The worms destroy functional renal elements and cause physical obstruction of the urinary ducts, likely causing renal failure in some cases.

Parasite name: *Crassicauda grampicola* Johnston & Mawson, 1941

Synonyms.
Hosts. *Grampus griseus*.
Locality. Manley, NSW.
Infection site. Pterygoid sinus.
Stage. Adults and immatures.
References. Johnston & Mawson (1941).
Remarks.

Parasite name: *Crassicauda magna* Johnston & Mawson, 1939

Synonyms. *Crassicauda duguyi* Dollfuss, 1966 [Jabbar *et al*., 2015].
Hosts. *Kogia breviceps* (1, 2).
Locality. (1, 2) Moreton Bay, QLD; (1) Port Victoria and Spencer Gulf, SA.
Infection site. Subcutaneous tissue and connective tissue of neck.
Stage. Adult.

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References. (1) Johnston & Mawson (1939); (2) Jabbar *et al.* (2015).
Remarks. Molecular data available (18S) (2). The phylogeny in Jabbar *et al.* (2015) moves the genus *Crassicauda* from Tetrameridae to Acuariidae. This huge worm seems to be found only in fragments due to the difficulty of extracting it whole from the subcutaneous flesh.

Parasite name: *Crassicauda* sp.

Synonyms.
Hosts. *Lagenorhynchus obscurus* (1, 2), *Ziphius cavitostris* (1), *Pseudorca crassidens* (3), *Delphinus delphis* (4, 5).
Locality. (1, 2, 4) NZ; (3) NSW; (5) Buckland's Beach, Howick, NZ.
Infection site. (1, 3) Pterygoid sinus; (1, 2) kidneys; (1, 2) urogenital system; (1, 2) cranial sinuses; (1, 5) fascia; (3) middle ear; (4) mammary ducts.
Stage.
References. Duignan ((1) 2000, (2) 2003); (3) J. Boulton in Ladds (2009); (4) Stockin *et al.* (2009); (5) Lehnert *et al.* (2017).
Remarks. Undoubtedly, based upon infection site alone, these records refer to different species of *Crassicauda*. Most records agree that worms of this genus embed their cephalic end into the tissues of their favoured organ, with the body of the worm projecting freely into the lumen or sinus for the release of the eggs. The species occurring in kidneys of *Z. cavirostris* caused '…massive destruction of reniculi with fibrosis and necrosis…' (Duignan, 2000 p. 452). Twenty specimens were present in this host animal (1).

Order: Strongylida Molin, 1861
Family: Ancylostomatidae Looss, 1905

Parasite name: *Uncinaria hamiltoni* Baylis, 1933

Synonyms.
Hosts. *Neophoca cinerea*.
Locality. Kangaroo Island, SA.
Infection site.
Stage.
References. Beveridge (1980).
Remarks. *Uncinaria hamiltoni sensu* Beveridge (1980) should be treated as a synonym of *U. sanguinis* (Professor Ian Beveridge, pers. comm.).

Parasite name: *Uncinaria sanguinis* Marcus, Higgins, Slapeta & Gray, 2014

Synonyms.
Hosts. *Neophoca cinerea* (1, 2).
Locality. (1, 2) Dangerous Reef, Spencer Gulf, SA; (1) South Page Island, Backstairs Passage, SA; (1, 2) Seal Bay, Kangaroo Island, SA.
Infection site. Intestine.
Stage. Adults and immatures.
References. (1) Haynes *et al.* (2014); (2) Marcus *et al.* (2014).
Remarks. Molecular data available (*cox1*) (1). Haynes *et al.* (2014) found that all pups examined were infected and that the infection route was trans-mammary. They also found that hookworms were genetically highly variable, but female host natal site fidelity and the transmammary route of infection do not restrict hookworm gene flow between *N. cinerea* populations.

Parasite name: *Uncinaria* sp.

Synonyms.
Hosts. *Phocarctos hookeri* (1, 2, 4, 5), *Arctophoca australis forsteri* (3, 7), *Neophoca cinerea* (6, 7).
Locality. (1, 2) NZ; (3) Ohau Point, Kaikoura, NZ; (4, 5) Sandy Bay, Enderby Island, Auckland Island, NZ; (6) Adelaide Zoo, SA; (7) Kangaroo Island, Dangerous Reef, Spencer Gulf, SA.
Infection site. Stomach, intestine.
Stage. Adults and immatures.
References. (1) Duignan (1998); (2) Duignan (2000); (3) Boren (2005); Castinel *et al.* ((4) 2006, (5) 2007); (6) I. Beveridge in Ladds 2009); (7) Ramos *et al.* (2013).
Remarks. Molecular data available (ITS1&2) (7). Hookworms are the cause of haemorrhagic enteritis and are the main cause of death to pups in some seasons and localities. Sources report up to 7000 worms in a single pup. Route of infection is trans-mammary and worms develop into adults within three weeks of infection (4). Castinel *et al.* (2006) found a high level of size variability within adult worm populations in a single host. We suspect that most or all of the specimens reported in these papers could be referred to *U. sanguinis* or to the unnamed species of Nadler *et al.* (2013) in the following.

Parasite name: *Uncinaria* sp. NZSL of Nadler *et al.*, 2013

Synonyms.
Hosts. *Phocarctos hookeri*.
Locality. Sandy Bay Beach, Enderby Island, NZ.
Infection site.
Stage.
References. Nadler *et al.* (2013).
Remarks. Molecular data available (ITS1&2, 28S, 12S). The phylogeny of Nadler *et al.* (2013) included *Uncinaria* spp. from pinniped hosts worldwide and recovered seven independent evolutionary lineages or species, including the two described species (*U. hamiltoni* and *U. lucasi*) and five undescribed species, each from a different host. *Uncinaria* sp. NZSL was restricted to the NZ sea lion. Note, however, that Ramos *et al.* (2013) concluded that the three species found in Australian hosts *A. p. doriferus*, *A. forsteri* and *N. cinerea* were not distinguishable.

Parasite name: *Uncinaria* sp. AFS of Nadler *et al.*, 2013

Synonyms.
Hosts. *Arctocephalus pusillus doriferus* (1, 2).
Locality. (1, 2) Lady Julia Percy Island and Seal Rocks, Phillip Island, VIC; (2) Kanowna Island, VIC.
Infection site.
Stage.
References. (1) Nadler *et al.* (2013); (2) Ramos *et al.* (2013).
Remarks. Molecular data available (ITS1&2, 28S, 12S) (1, 2). Although not explicitly stated in their paper, we understand that the specimens from *A. p. doriferus* of Ramos *et al.* (2013) are the same as those of Nadler *et al.* (2013) from the same host.

Parasite name: *Uncinaria* sp. SES of Nadler *et al.*, 2013

Synonyms.
Hosts. *Mirounga leonine* (1, 2).

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Locality. (1) Macquarie Island, TAS; (2) Possession Island, QLD and Lady Julia Percy Island, VIC.
Infection site.
Stage.
References. (1) Nadler *et al.* (2013); (2) Ramos *et al.* (2013).
Remarks. Molecular data available (ITS1&2, 28S, 12S) (1, 2). Although not explicitly stated in their paper, we understand that the specimens from *M. leonina* of Ramos *et al.* (2013) are equivalent to those of Nadler *et al.* (2013) from the same host.

Family: Filaroididae Schultz, 1951

Parasite name: *Parafilaroides decorus* Dougherty & Herman, 1947

Synonyms.
Hosts. *Phocarctos hookeri*.
Locality. NZ.
Infection site. Lungs.
Stage.
References. Duignan (2000).
Remarks. Duignan reported mild sub-pleural lesions caused by *P. decorus*.

Parasite name: *Parafilaroides hydrurgae* Mawson, 1953

Synonyms.
Hosts. *Hydrurga leptonyx*.
Locality. Heard Island, Australia.
Infection site. Lungs and bronchi.
Stage.
References. Mawson (1953).
Remarks.

Parasite name: *Parafilaroides normani* Dailey, 2009

Synonyms.
Hosts. *Arctocephalus pusillus doriferus* (1, 2), *Arctophoca australis forsteri* (1).
Locality. (1) Dog Beach, Ocean Grove, VIC; (1) Foxton Beach, Palmerston North, NZ; (2) Phillip Island, VIC.
Infection site. Lungs.
Stage. Adult.
References. (1) Dailey (2009); (2) Jabbar *et al.* (2014).
Remarks. Molecular data available (mitochondrial genome) (2).

Parasite name: *Parafilaroides* sp.

Synonyms.
Hosts. *Arctocephalus pusillus doriferus* (3), *Arctophoca australis forsteri* (2, 3), *Delphinus delphis* (4), *Hydrurga leptonyx* (3), *Neophoca cinerea* (1).
Locality. (1) Dangerous Reef, Spencer Gulf and Seal Bay, Kangaroo Island, SA; (2) Ohau Point, Kaikoura, NZ; (3) Cape Woollamai and Ocean Grove, VIC; (3) Taranaki Bight, NZ; (3) Geelong, VIC; (4) coast of NZ.
Infection site. Lungs.
Stage. Adults and larvae.
References. (1) Nicholson & Fanning (1981); (2) Boren (2005); (3) Norman in McFarlane *et al.* (2009); (4) Stockin *et al.* (2009).
Remarks. Nicholson & Fanning (1981) stated that their specimens were probably a new species of *Parafilaroides*, but did not describe or name them. These authors also reported that, although the animals appeared healthy when captured, they showed signs of acute verminous pneumonia. The report of Stockin *et al.* (2009) seems unlikely in a dolphin host, and may represent an accidental infection or possible misidentification.

Family: Pseudaliidae Railliet & Henry, 1909

Parasite name: *Halocercus lagenorhynchi* Baylis & Daubney, 1925

Synonyms.
Hosts. *Delphinus delphis* (2), *Tursiops aduncus* (2), *Tursiops truncatus* (1).
Locality. (1) Encounter Bay, SA; (2) coast of SA.
Infection site. Lungs.
Stage.
References. (1) Johnston & Mawson (1941); (2) Tomo *et al.* (2010).
Remarks. Tomo *et al.* (2010) report 'necrotic microabscesses, in serious acute to chronic infections, lung function would have been compromised' in lungworm infections of dolphins, 'moderate and heavy burdens may have contributed to animals' deaths.' Predominantly calves and juveniles were infected. During the 18-year study, the prevalence of lung nematode infections increased in 2005–2006 fourfold from 14% before the outbreak to 63% in short-beaked common dolphins; some cases were also recorded in Indo-Pacific bottlenose dolphins and common bottlenose dolphins.

Parasite name: *Halocercus delphini* Baylis & Daubney, 1925

Synonyms.
Hosts. *Stenella coeruleoalba*.
Locality. Carter's Beach, Te Akau, NZ.
Infection site. Lungs.
Stage.
References. Lehnert *et al.* (2017).
Remarks.

Parasite name: *Halocercus* sp.

Synonyms.
Hosts. *Cephalorhynchus hectori* (1, 2), *Delphinus delphis* (3), *Stenella coeruleoalba* (3).
Locality. (1) Canterbury coast, NZ; (2) NZ; (3) Kawaa Kawaa Bay, NZ; (3) Muriwai Beach, NZ.
Infection site. Lung.
Stage. Adult.
References. (1) McKenzie & Blair (1983); (2) Duignan (2000); (3) Lehnert *et al.* (2017).
Remarks.

Parasite name: *Pharurus alatus* (Leuckart, 1848) Stiles & Hassall, 1905

Synonyms. *Prosthecosacter alatus* (Leuckart, 1848) Diesing, 1851; *Pseudalius alatus* (Leuckart, 1848) Diesing, 1851; *Stenurus alatus* (Leuckart, 1848) Yorke & Maplestone, 1926; *Strongylus*

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alatus Leuckart, 1848; *Str. (Pharurus) alatus* (Leuckart, 1848) Diesing, 1851; *Torynurus alatus* (Leuckart, 1848) Delyamure, 1952 [WoRMS; Baylis & Daubney, 1925].
Hosts. *Delphinus delphis*.
Locality. Coast of SA.
Infection site. Lungs.
Stage.
References. Tomo *et al.* (2010).
Remarks.

Parasite name: *Skrjabinalius cryptocephalus* Delyamure, 1942

Synonyms.
Hosts. *Tursiops truncatus*.
Locality. Otago Harbour, NZ.
Infection site. Lungs.
Stage.
References. Bowie (1984).
Remarks. The anterior end of this nematode was tightly knotted, embedded in the parenchyma of the lung and surrounded by purulent fluid in a fibrous or calcified capsule (Bowie, 1984).

Parasite name: *Stenurus globicephalae* Baylis & Daubney, 1925

Synonyms.
Hosts. *Globicephala melas* (3, 5), *Globicephala* sp. (1), *Grampus griseus* (4), *Peponocephala electra* (2).
Locality. (1) Prosperine, QLD; (2) Moreton Island and Tugun Beach, QLD; (3) McIntyres Beach, Falmouth, TAS; (4) NSW; (5) Big River, Kahurangi National Park, NZ; (5) Kaka Point, NZ.
Infection site. Guttural pouch, ear canals, auditory sinuses.
Stage. Adult.
References. (1) Arnold in Cannon (1977); (2) Cannon (1977); (3) McManus *et al.* (1984); (4) J. Boulton in Ladds (2009); (5) Lehnert *et al.* (2017).
Remarks. Molecular data available (ITS2) (5). McManus *et al.* (1984) reported 'huge masses of worms: average 2300, range 1140–4200 per ear' in the lead bulls, and their data led them to conclude that this auditory parasitism played a significant role in the mass stranding of 183 pilot whales on this occasion. However, a study on by-caught porpoises with good nutritional status has revealed high loads of *Stenurus minor*, with no apparent effect on echo-location or hunting ability, and no pathological changes (Faulkner *et al.*, 1998). Another recent study on *S. minor* in the inner ear of harbour porpoises highlights the need of further research to assess the impact these nematodes may have on hearing (Morell *et al.*, 2017). Host named *G. malaenas* in McManus *et al.* (1984).

Parasite name: *Stenurus minor* (Kuhn, 1829) Baylis & Daubney, 1925

Synonyms. *Pharurus minor* (Kuhn, 1929) Cobbold, 1879; *Prosthecosacter minor* (Kuhn, 1829) Diesing, 1851; *Pseudalius minor* (Kuhn, 1829) Schneider, 1866; *Stenurus inflexus* Dujardin, 1845; *Stenurus phocoenae* Dougherty, 1943; *Stenurus vagans* Dougherty, 1943; *Strongylus minor* Kuhn, 1829 [WoRMS; Baylis & Daubney, 1925].
Hosts. *Phocoena dioptrica*.
Locality. Pipikaretu, Otago Peninsula, NZ.
Infection site. Sinuses and tympanic cavity.
Stage. Adult.
References. Lehnert *et al.* (2017).
Remarks. Molecular data available (ITS2).

Parasite name: *Stenurus ovatus* (von Linstow, 1910) Baylis & Daubney, 1925

Synonyms. *Pseudalius ovatus* von Linstow, 1910 [WoRMS].
Hosts. *Delphinus delphis* (3), *Lagenodelphis hosei* (1), *Tursiops aduncus* (3), *T. truncatus* (2, 3).
Locality. (1) Corio Bay, VIC; (2) Otago Harbour, NZ; (3) coast of SA.
Infection site. Lungs.
Stage. Adults and larvae.
References. (1) McColl & Obendorf (1982); (2) Bowie (1984); (3) Tomo *et al.* (2010).
Remarks. McColl & Obendorf (1982) report the lungs of their host specimen were highly congested with worms, causing verminous pneumonia and greatly impairing respiratory function.

Parasite name: *Stenurus* sp.

Synonyms.
Hosts. *Cephalorhynchus hectori*.
Locality. NZ.
Infection site. Lungs.
Stage.
References. Duignan (2000).
Remarks.

Phylum: Platyhelminthes
Class: Cestoda
Order: Diphyllobothriidea Kuchta, Scholz, Brabec & Bray, 2008
Family: Diphyllobothriidae Lühe, 1910

Parasite name: *Adenocephalus pacificus* Nybelin, 1931

Synonyms. *Adenocephalus septentrionalis* Nybelin, 1931; *Bothriocephalus* sp. of Stiles & Hassall (1899); *B. macrophallus* von Linstow, 1905, in part; *Dibothriocephalus atlanticum* Delyamure & Parukhin, 1968; *Diphyllobothrium glaciale* (Cholodkovsky, 1915) Markowski, 1952; *Dip. krotovi* Delyamure, 1955; *Dip. pacificum* (Nybelin, 1931) Margolis, 1956; *Dip. septentrionalis* Nybelin, 1931 [WoRMS; Hernández-Orts *et al.*, 2015].
Hosts. *Arctocephalus pusillus doriferus* (1), *Neophoca cinerea* (2).
Locality. (1) Lady Julia Percy Island, VIC; (2) Pearson Island, SA.
Infection site. Intestine.
Stage. Adult plus immatures.
References. (1) Drummond (1937); (2) Johnston (1937).
Remarks. Described in Drummond (1937) as *Dip. arctocephali* n. sp., and host called *A. tasmanicus*. Described in Johnston (1937) as *Dip. arctocephalinum* n. sp. and host called *A. forsteri*, but Johnston corrected this to *N. cinerea* in Johnston & Mawson (1941) and Johnston & Best (1942). Johnston (1937) described the worms as a 'tangled mass' in the intestine.

Parasite name: *Diphyllobothrium* sp.

Synonyms.
Hosts. *Arctophoca australis forsteri*, *Hydrurga leptonyx*.
Locality. In captivity, NZ.

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Infection site. Intestine.
Stage. Adult.
References. Cordes & O'Hara (1979).
Remarks. Cordes & O'Hara (1979) described these worms as occurring in huge masses, their scoleces embedded in a cyst in the colon wall and their strobilae free in the lumen. In the leopard seal, they described a 2–3 lb mass of worms blocking the intestine.

Order: Phyllobothriidea Caira, Jensen, Waeschenbach, Olson & Littlewood, 2014
Family: Phyllobothriidae Braun, 1900

Parasite name: *Monorygma chamissonii* (Linton, 1905) Meggitt, 1924

Synonyms. *Cysticercus delphini* Rudolphi, 1819; *Phyllobothrium chamissonii* (Linton, 1905) Southwell & Walker, 1936; *Taenia chamissonii* Linton, 1905.
Hosts. *Peponocephala electra*.
Locality. Moreton Island and Tugun Beach, QLD.
Infection site. Stomach wall and peritoneum.
Stage. Encysted larvae.
References. Cannon (1977).
Remarks. Called *Phyllobothrium chamissonii* in this paper. Found in cysts 20–25 mm in diameter with thick fibrous walls. The inner blastocysts (metacestode) were almond-shaped, with fat droplets in the wall giving them an orange colour.

Parasite name: *Monorygma grimaldii* (Moniez, 1899) Meggitt, 1924

Synonyms. *Cephalocotyleum delphini delphis* Diesing, 1850; *Cysticercus delphini* Rudolphi, 1819; *Cysticercus grimaldii* Braun, 1898; *Cysticercus Taenia grimaldii* Moniez, 1889; *Cysticerque du groupe grimaldii* Baer, 1932; *Dubium delphini* Rudolphi, 1810; *Phyllobothrium* sp. Beneden, 1868; *P. delphini* Beneden, 1870; *Taenia grimaldii* Moniez, 1889; *T. schamissoni* Linton, 1905 [Baylis 1932; Delyamure, 1955].
Hosts. *Delphinus delphis* (2, 3), *Lagenodelphis hosei* (1), *Stenella coeruleoalba* (4).
Locality. (1) Corio Bay, VIC; (2) Barwon Heads, VIC; (3) coast of NZ; (4) Carter's Beach, Te Akau, NZ; (4) Kawera Parade, Paramon East, NZ; (4) Miruwai Beach, NZ.
Infection site. (1) Abdominal muscle; (2, 3) peritoneal cavity; (4) urogenital area; (4) mammary gland; (4) blubber.
Stage. Merocercoid larva.
References. (1) McColl & Obendorf (1982); (2) Norman (1997); (3) Stockin *et al*. (2009); (4) Lehnert *et al*. (2017).
Remarks. Norman (1997) reported localized lymphoplasmacytic response to the cysts. These metacestodes are merocercoids of marine tapeworms infecting various marine mammals (Agustí *et al*., 2005; Aznar *et al*., 2007); historically, they have been referred to as '*Phyllobothrium delphini*' (Bosc, 1802) and '*Monorygma grimaldii*' (Moniez, 1889), but molecular evidence suggests that they belong to the '*Clistobothrium*' clade (Aznar *et al*., 2007; Randhawa, 2011; Randhawa & Brickle, 2011). Recently, they were found in subcutaneous blubber from fur seals and shown to be intermediate stages of the cestode *Clistobothrium*, infecting sharks (Klotz *et al*., 2018). The merocercoids represented the *delphini*-morphotype but were identified as *grimaldii*-genotype using 18S and 28S sequences.

Parasite name: *Phyllobothrium delphini* (Bosc, 1802) Gervais, 1885

Synonyms. *Cephalocotyleum delphini delphis* Diesing, 1850; *Cysticercus delphini* Laennec, 1804; *Cy. delphini* Rudolphi, 1810; *Cy. mysticeti* Diesing, 1850; *Cy. physeteris* Diesing, 1863; *Cysticercus* sp. Bennett, 1937; *Hydatis delphini* Bosc, 1802; *H. delphinii* Bosc, 1802; *Phyllbothrium* sp. Beneden, 1868; *Phyllobothrium* sp. Carnot, 1822; *Phyllobothrium* sp. Rennie and Reid, 1912; *P. inchoatum* Leidy, 1891; *P. tumidum* Linton, 1922; *Scolex delphini* Stossich, 1897; *Vermis delphini delphis* Rudolphi, 1810 [Baylis, 1932; Delyamure, 1955; Williams, 1968].
Hosts. *Cephalorhynchus hectori* (3), *Delphinus delphis* (4, 5, 6), *Kogia breviceps* (1), *Lagenorhynchus obscurus* (6), *Mirounga leonina* (2), *Phocoena dioptrica* (6), *Stenella coeruleoalba* (6).
Locality. (1) Port Victoria, Spencer Gulf, SA; (2) Macquarie Island, TAS; (3) Kaikoura coast, NZ; (4) Barwon Heads, VIC; (5) coast of NZ; (6) Sandspit Estuary, Green's Point, NZ; (6) Portobello Bay, Otago Harbour and off Kaikoura, NZ; (6) Caroline Bay, Timaru, NZ; (6) Carter's Beach, Te Akau, NZ.
Infection site. Blubber, especially around tail and genital area.
Stage. Merocercoid larva.
References. (1) Johnston & Mawson (1939); (2) Morgan *et al*. (1978); (3) McKenzie & Blair (1983); (4) Norman (1997); (5) Stockin *et al*. (2009); (6) Lehnert *et al*. (2017).
Remarks. Morgan *et al*. (1978) found this cestode encysted in each of three elephant seals examined. As evidenced by the long list of synonyms, this cestode has a complicated history. Reviews of the literature can be found in Delyamure (1955), Dollfus (1964), Johnston & Mawson (1939) and Williams (1968). Molecular evidence suggests that this species belongs to the '*Clistobothrium*' clade (Aznar *et al*., 2007; Randhawa, 2011; Randhawa & Brickle, 2011). See also *Monorygma grimaldii*.

Parasite name: *Phyllobothrium* sp.

Synonyms.
Hosts. *Arctophoca australis forsteri* (3), *Balaenoptera acutorostrata* (2), *Cephalorhynchus hectori* (3), *Delphinus delphis* (3), *Lagenorhynchus obscurus* (3), *Phocartctos hookeri* (3), *Tursiops truncatus* (1).
Locality. (1) Otago Harbour, NZ; (2) Pigeon Bay, Banks Peninsula, NZ; (3) NZ.
Infection site. Ventral blubber.
Stage. Merocercoid larva.
References. (1) Bowie (1984); (2) Dawson & Slooten (1990); (3) Duignan (2000).
Remarks. Duignan (2000) found that prevalence was higher in dusky dolphins than in common or Hector's dolphins. In pinnipeds they found a higher prevalence in NZ fur seals than in NZ sea lions. They also reported granulomatous mastitis associated with the cysts that resulted in underfed pups. Dawson and Slooten (1990) reported several hundred cysts in the blubber of a dwarf minke whale.

Parasite name: Phyllobothriidae gen. sp.

Synonyms.
Hosts. *Arctophoca australis forsteri*.
Locality. In captivity, NZ.
Infection site. Ventral blubber.

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Stage. Merocercoid larva.
References. Cordes & O'Hara (1979).
Remarks.

Order: Tetrabothriidea Baer, 1954
Family: Tetrabothriidae Linton, 1891

Parasite name: *Tetrabothrius forsteri* (Krefft, 1871) Fuhrmann, 1904

Synonyms. *Prosthecotyle forsteri* (Krefft, 1871) Monticelli, 1892; *Taenia forsteri* Krefft, 1871; *Tetrabothrius dalli* Yamaguti, 1952 [Linton, 1923; WoRMS].
Hosts. *Delphinus delphis* (1), *Mesoplodon hectori* (2).
Locality. (1) Port Jackson, NZ; (2) Oneroa Bay, Waiheke Island, NZ.
Infection site. Stomach and intestine.
Stage.
References. (1) Krefft (1871); (2) Baker *et al.* (2001).
Remarks. Described in Krefft (1871) as *Taenia forsteri* n. sp., and host recorded as *D. forsteri*.

Parasite name: *Tetrabothrius* sp.

Synonyms.
Hosts. *Delphinus delphis* (2), *Lagenodelphis hosei* (1).
Locality. (1) Corio Bay, VIC; (2) unknown locality, Australia.
Infection site. Stomach and intestine.
Stage.
References. (1) McColl & Obendorf (1982); (2) Ladds (2009).
Remarks. McColl & Obendorf (1982) reported minor haemorrhaging in pancreatic ducts caused by this cestode.

Class: Trematoda Rudolphi, 1808
Order: Diplostomida Olson, Cribb, Tkach, Bray & Littlewood, 2003
Family: Brauninidae Wolf, 1903

Parasite name: *Braunina cordiformis* Wolf, 1903

Synonyms.
Hosts. *Cephalorhynchus hectori* (1, 2).
Locality. (1) Canterbury coast, NZ; (2) unknown locality, NZ.
Infection site. Stomach.
Stage.
References. (1) McKenzie & Blair (1983); (2) Duignan (2000).
Remarks. McKenzie & Blair (1983) found a maximum of 57 worms in one of three dolphins, attached to the stomach wall.

Family: Cyathocotylidae Mühling, 1898

Parasite name: *Mesostephanus neophocae* Dubois & Angel, 1976

Synonyms.
Hosts. *Mirounga leonina*, *Neophoca cinerea*.
Locality. In captivity and St. Vincent Gulf, SA.
Infection site. Intestine.
Stage. Adult.
References. Dubois & Angel (1976).
Remarks. Dubois & Angel (1976) put forward the suggestion that species of this genus are more usually parasites of phalacrocoracid birds, and that perhaps the sea lion had taken on the parasite after predating a bird.

Family: Spirorchiidae Stunkard, 1921

Parasite name: Spirorchiidae gen. sp.

Synonyms.
Hosts. *Dugong dugon*.
Locality. Mornington Island and Townsville, QLD.
Infection site. Ovaries, myometrial blood vessels.
Stage. Eggs.
References. Marsh *et al.* (1984).
Remarks. Found in 18 of 46 dugongs. Lesions were found on ovaries, containing refractile eggs 25–30 µm in diameter. Pigmented eyespots of miracidia were visible. Marsh *et al.* (1984) postulate that these could be the eggs of a spirorchid trematode, members of which parasitize the circulatory system of aquatic reptiles in the same habitat as dugongs.

Order: Echinostomida La Rue, 1957
Family: Cladorchiidae Fischoeder, 1901

Parasite name: *Solenorchis travassosi* Hilmy, 1949

Synonyms. *Indosolenorchis hirudinaceus* Crusz, 1951; *Solenorchis baeri* Hilmy, 1949; *S. gohari* Hilmy, 1949; *S. naguibmahfouzi* Hilmy, 1949 [WoRMS].
Hosts. *Dugong dugon* (1, 2).
Locality. (1) Mornington Island and Townsville, QLD; (2) Lucinda, QLD.
Infection site. Caecum and large intestine.
Stage. Adult.
References. (1) Blair (1980); (2) Olson *et al.* (2003).
Remarks. Molecular data available (18S, 28S) (2). In his redescription of *I. hirudinaceus*, Blair (1980) is adamant that it is a separate species and genus. He states that Hilmy's (1949) specimens should be *S. travassosi* but still retains his specimens as distinct. He mentions that their size range is large and that the Australian specimens do not overlap the Indian ones in size. Sey (1980) synonymized *I. hirudinaceus* with *S. travassossi*, and now only one species, *S. travassossi*, is accepted from dugong.

Family: Labicolidae Blair, 1979

Parasite name: *Labicola cf. elongata*

Synonyms.
Hosts. *Dugong dugon*.
Locality. Lucinda, QLD.
Infection site.
Stage.
References. Olson *et al.* (2003).
Remarks. Molecular data available (18S, 28S).

Parasite name: *Labicola elongata* Blair, 1979

Synonyms.
Hosts. *Dugong dugon* (1, 2).
Locality. (1) Mornington Island and Townsville, QLD; (2) unknown locality, Australia.
Infection site. Upper lip.

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Stage. Adult.
References. (1) Blair (1979); (2) Blanshard (2001).
Remarks. Blair (1979) found these trematodes in all 21 specimens he observed. They were so unusual that he erected the Family Labicolidae to contain the species. Several worms together formed pus-filled abscesses along the sides of the upper lip, with pores to the outside.

Family: Notocotylidae Lühe, 1909

Parasite name: *Ogmogaster* sp.

Synonyms.
Hosts. *Caperea marginata*.
Locality. Fotheringate Bay, Flinders Island, TAS.
Infection site. Intestine.
Stage.
References. McManus *et al*. (1984).
Remarks.

Family: Opisthotrematidae Poche, 1926

Parasite name: *Folitrema jecoris* Blair, 1981

Synonyms.
Hosts. *Dugong dugon*.
Locality. Mornington Island, Thursday Island and Townsville, QLD.
Infection site. Gall bladder and bile ducts.
Stage. Adult.
References. Blair (1981).
Remarks.

Parasite name: *Lankatrema macrocotyle* Blair, 1981

Synonyms.
Hosts. *Dugong dugon*.
Locality. Mornington Island, Thursday Island and Townsville, QLD.
Infection site. Intestine.
Stage. Adult.
References. Blair (1981).
Remarks. *Lankatrema* spp. are found encapsulated in the wall of the intestine. Different species may be found in the same capsule (Blair, 1981).

Parasite name: *Lankatrema mannarense* Crusz & Fernand, 1954

Synonyms.
Hosts. *Dugong dugon* (1, 2).
Locality. (1) Mornington Island, QLD; (2) Townsville, QLD.
Infection site. Stomach and intestine.
Stage. Adult.
References. (1) Blair (1981); (2) Olson *et al*. (2003).
Remarks. Molecular data available (18S, 28S) (2). Blair (1981) admits they are poor specimens in his paper, and that the record is questionable.

Parasite name: *Lankatrema microcotyle* Blair, 1981

Synonyms.
Hosts. *Dugong dugon*.
Locality. Mornington Island, Thursday Island and Townsville, QLD.
Infection site. Intestine.
Stage. Adult.
References. Blair (1981).
Remarks. Found encapsulated in wall of ileum, 2–7 in each capsule.

Parasite name: *Lankatrema minutum* Blair, 1981

Synonyms.
Hosts. *Dugong dugon*.
Locality. Mornington Island and Townsville, QLD.
Infection site. Stomach.
Stage. Adult.
References. Blair (1981).
Remarks. Occurs in pairs in the wall of the stomach glands with their posterior ends towards the lumen of the gland. Their capsules are similar to those reported by Crusz & Fernand (1954) for *L. mannarense*. There appears to be no host response to their presence (Blair, 1981).

Parasite name: *Lankatrematoides gardneri* Blair, 1981

Synonyms.
Hosts. *Dugong dugon*.
Locality. Mornington Island, Thursday Island and Townsville, QLD.
Infection site. Pancreatic ducts.
Stage. Adult.
References. Blair (1981).
Remarks.

Parasite name: *Opisthotrema australe* Blair, 1981

Synonyms.
Hosts. *Dugong dugon*.
Locality. Mornington Island, Thursday Island and Townsville, QLD.
Infection site. Eustachian tubes and middle ear.
Stage. Adult.
References. Blair (1981).
Remarks.

Parasite name: *Opisthotrema dujonis* (Leuckart, 1874) Price, 1932

Synonyms. *Monostomum dujonis* Leuckart, 1874; *Opisthotrema cochleare* Fischer, 1883; *O. cochleariforme* Travassos and Vogelsang, 1931 (*lapsus*) [WoRMS; Blair, 1981].
Hosts. *Dugong dugon* (1–4).
Locality. (1) Wallum Creek, North Stradbroke Island, QLD; (2) coast of QLD; (3) Mornington Island, QLD; (3) Thursday Island, QLD; (3, 4) Townsville, QLD.
Infection site. (1, 3) Eustachian tubes; (3) middle ear; (2, 3) oesophagus.
Stage. Adult and immature.
References. (1) Dexler & Freund (1906); (2) Johnston (1913); (3) Blair (1981); (4) Olson *et al*. (2003).
Remarks. Molecular data available (18S, 28S) (4). Dexler and Freund (1906) and Johnston (1913) record this species as *O. cochleare*.

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Parasite name: *Pulmonicola pulmonalis* (von Linstow, 1904) Poche, 1926

Synonyms. *Cochleotrema indicum* (Sharma & Gupta, 1971); *Opisthotrema nasalis* (*n. n.*) Purnomo, Palmieri & Budiarso in Budiarso, Palmieri, Imes, Allen & Lepes, 1979; *Opisthotrema pulmonale* von Linstow, 1904; *Paracochleotrema indicum* Sharma & Gupta, 1971; *Pulmonicola indicus* (Sharma & Gupta, 1971); *Pulmonicola pulmonale* (von Linstow, 1904) Ruiz, 1946 [WoRMS; Blair, 1981].
Hosts. *Dugong dugon* (1–4).
Locality. (1) Torres Strait, Australia; (2) Mornington Island, Thursday Island, Townsville, QLD; (3) unknown location, Australia; (4) coast of QLD.
Infection site. (2) Nasal passages and lungs; (4) bronchi and trachea.
Stage. Adult.
References. (1) von Linstow (1904); (2) Blair (1981); (3) Blanshard (2001); (4) Owen *et al.* (2012).
Remarks. Described as *Opisthotrema pulmonale* by von Linstow (1904). Called *Cochleotrema indicum* in Blanshard (2001) and Owen *et al.* (2012). Cause of chronic bronchitis, tracheitis and bronchopneumonia (3, 4).
Family: Rhabdiopoeidae Poche, 1926

Parasite name: *Faredifex clavata* Blair, 1981

Synonyms.
Hosts. *Dugong dugon*.
Locality. Mornington Island, Thursday Island and Townsville, QLD.
Infection site. Small intestine.
Stage. Adult.
References. Blair (1981).
Remarks. Found in abscesses in wall of ileum.

Parasite name: *Rhabdiopoeus taylori* Johnston, 1913

Synonyms.
Hosts. *Dugong dugon* (1–3).
Locality. (1) Coast of QLD; (2) Mornington Island, Thursday Island and Townsville, QLD; (3) Lucinda, QLD.
Infection site. Intestine.
Stage. Adult.
References. (1) Johnston (1913); (2) Blair (1981); (3) Olson *et al.* (2003).
Remarks. Molecular data available (18S, 28S) (3). Johnston (1913) found *R. taylori* in both dugongs he examined, ten in one and 16 in the other.

Parasite name: *Haerator caperatus* Blair, 1981

Synonyms.
Hosts. *Dugong dugon*.
Locality. Mornington Island, Thursday Island and Townsville, QLD.
Infection site. Intestine and caecum.
Stage. Adult.
References. Blair (1981).
Remarks.

Parasite name: *Taprobanella bicaudata* Crusz & Fernand, 1954

Synonyms.
Hosts. *Dugong dugon* (1, 2).
Locality. (1) Mornington Island, QLD; (1) Thursday Island, QLD; (1, 2) Townsville, QLD.
Infection site. Large intestine.
Stage. Adult.
References. (1) Blair (1981); (2) Olson *et al.* (2003).
Remarks. Molecular data available (18S, 28S) (2).

Order: Plagiorchiida La Rue, 1957
Family: Brachycladiidae Odhner, 1905

Parasite name: *Brachycladium delphini* (Poirier, 1886) Looss, 1899

Synonyms. *Campula delphini* (Poirrier, 1886) Bittner & Sprehn, 1928; *Cladocoelium delphini* (Poirier, 1886) Stossich, 1892; *Distomum delphini* Poirier, 1886; *Lecithodesmus delphini* (Poirier, 1886) Yamaguti, 1958 [WoRMS; Felix, 2013].
Hosts. *Delphinus delphis*.
Locality. Bethell's Beach, Auckland, NZ.
Infection site. Liver.
Stage. Adult.
References. Lehnert *et al.* (2017).
Remarks.

Parasite name: *Brachycladium palliatum* (Looss, 1885) Looss, 1899

Synonyms. *Campula palliata* (Looss, 1885) Looss, 1899; *Cladocoelium palliatum* (Looss, 1885) Stossich, 1892; *Distomum palliatum* Looss, 1885; *Lecithodesmus palliatus* (Looss, 1885) Yamaguti, 1958 [WoRMS; Felix, 2013].
Hosts. *Delphinus delphis* (1, 2).
Locality. (1) In captivity NZ; (2) Battey's Beach, Warkworth, NZ; (2) Shakespeare Peak and Waiake Beach, Auckland, NZ.
Infection site. Liver and bile ducts.
Stage. Adult.
References. (1) Cordes & O'Hara (1979); (2) Lehnert *et al.* (2017).
Remarks. Cordes and O'Hara (1979) found over 100 of this species in one dolphin. The worms were associated with parasitic hepatitis in four dolphins with lesions, but no worms were found in the livers of two more. Worms and lesions blocked bile ducts, and were either contributory to, or the cause of, death.

Parasite name: *Campula* sp.

Synonyms.
Hosts. *Cephalorhynchus hectori* (2, 3), *Lagenodelphis hosei* (1).
Locality. (1) Corio Bay VIC; (2) New Brighton Beach, Christchurch and Gillespies Point, NZ; (3) NZ.
Infection site. (1) Pancreatic ducts; (2, 3) mesenteric lymph nodes.
Stage. Adult and eggs.
References. (1) McColl & Obendorf (1982); (2) Hutton *et al.* (1987); (3) Duignan (2000).
Remarks. Both Duignan (2000) and Hutton *et al.* (1987) found these worms encapsulated within the mesenteric lymph nodes of the host. The lymph node had granulomatous lesions with inflammatory response associated with eggs/was enlarged with a tumour-like mass which contained purulent necrotic debris and a single parasitic worm. A secondary bacterial infection, *Eikenella corrodens*, was cultured from the lesion (2).

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Parasite name: *Nasitrema* sp.

Synonyms.
Hosts. *Lagenodelphis hosei*.
Locality. Corio Bay, VIC.
Infection site. Blowhole.
Stage. Eggs.
References. McColl & Obendorf (1982).
Remarks.

Parasite name: *Synthesium tursionis* (Marchi, 1873) Stunkard & Alvey, 1930

Synonyms. *Distomum longissimum* Poirier, 1886 *nec D. longissimum* von Linstow, 1896; *D. tursionis* Marchi, 1873; *Hadwenius tursionis* (Marchi, 1873) Fernández, Balbuena & Raga, 1994; *Orthosplanchnus tursionis* (Marchi, 1873) Odhner, 1926; *Synthesium tursionis* (Marchi, 1873) [Price, 1932; Marigo *et al*., 2008].
Hosts. *Tursiops truncatus*.
Locality. Otago Harbour, NZ.
Infection site. Small intestine.
Stage. Adult.
References. Bowie (1984).
Remarks.

Parasite name: *Synthesium* sp.

Synonyms.
Hosts. *Neophoca cinerea*.
Locality. St. Vincent Gulf, SA.
Infection site. Intestine.
Stage.
References. Dubois & Angel (1976).
Remarks. Genus *Hadwenius* in this paper. This genus was synonymized with *Synthesium* by Gibson (2005).

Family: Heterophyidae Leiper, 1909

Parasite name: *Galactosomum angelae* Pearson, 1973

Synonyms.
Hosts. *Neophoca cinerea*.
Locality. St. Vincent Gulf, SA.
Infection site. Intestine.
Stage. Adult.
References. Dubois & Angel (1976).
Remarks. This species was originally described by Pearson (1973) from the Caspian tern – as mentioned in the passing reference to *G. angelae* in Dubois and Angel (1976). There is a perpetuated error in the citation of this species and the referencing of this paper. Note that both Dailey *et al.* (2002) and Hernández-Orts *et al.* (2012) list Dubois and Angel (1976) with the title '*Galactosomum angelae* Pearson 1973 in *Neophoca cinerea* (Péron, 1816) the Australian sea-lion.' There does not appear to be any paper with this title. The 1976 paper is actually entitled '*Mesostephanus neophocae* n. sp. (Strigeata: Prohemistomidae), parasite d'une otarie d'Australie, *N. cinerea* (Péron et Lesueur)'. In addition, the volume and page reference given in both of these works – that is, '82: 191–229' – apply to a paper by Dubois and Mahon published in the Bulletin de la Société Neuchâteloise des Sciences Naturelles in 1959. The corrected reference for the Dubois and Angel (1976) paper is '99: 29–32'.

Parasite name: Heterophyidae 'Gen.' sp.

Synonyms.
Hosts. *Delphinus delphis*.
Locality. In captivity, NZ.
Infection site. Adipose tissue of omasum.
Stage.
References. Cordes & O'Hara (1979).
Remarks.

Parasite name: *Stictodora diplacantha* Johnston, 1942

Synonyms.
Hosts. *Neophoca cinerea*.
Locality. St. Vincent Gulf, SA.
Infection site. Intestine.
Stage.
References. Dubois & Angel (1976).
Remarks. This species was originally described from the pied cormorant.

In addition to the above records, 'gastrointestinal parasites' were reported in *Arctophoca australis forsteri* from Ohau Point, NZ (Boren, 2005); 'lung worms' in *Delphinus delphis* from Mooloolaba Beach, QLD (Greenland & Limpus, 2008); 'cestodes' in *Tursiops truncatus* from Otago Harbour, NZ (Bowie, 1984) and *Globicephala melas* from McIntyres Beach, TAS (McManus *et al*., 1984); and 'trematodes' in *A. a. forsteri* from Ohau Point, NZ (Boren, 2005), *Lagenodelphis hosei* from Corio Bay, VIC (McColl & Obendorf, 1982) and *Dugong dugon* from Wallum Creek, QLD (Dexler & Freund, 1906).

Phylum: Arthropoda
Class: Arachnida Lamarck, 1801
Subclass: Acari Leach, 1817
Order: Parasitiformes
Family: Halarachnidae Oudemans, 1906

Parasite name: *Halarachne miroungae* Ferris, 1925

Synonyms. *Halarachne erratica* Fain & Mortelmans, 1959; *H. taita* Eichler, 1958 [Domrow, 1962].
Hosts. *Mirounga leonine*.
Locality. Macquarie Island, TAS.
Infection site. Respiratory tract.
Stage. Adult, larvae.
References. Domrow (1979).
Remarks.

Parasite name: *Orthohalarachne attenuata* (Banks, 1910) Newell, 1947

Synonyms. *Halarachne attenuata* Banks, 1910; *H. magellanica* Finnegan, 1934; *H. reflexa* Tubb, 1937; *H. rosmari* Oudemans, 1916; *H. zalophi* Oudemans, 1916; *Orthohalarachne reflexa* (Tubb, 1937) Strandtmann and Wharton, 1958 [Newell, 1947; Domrow, 1974].
Hosts. *Arctocephalus pusillus doriferus* (1–4), *Neophoca cinerea* (4–6).

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Locality. (1) Lady Julia Percy Island, VIC; (2) Portarlington, VIC; (3) Newcastle, NSW; (4–6) Dangerous Reef, SA; (4) Seal Rocks and Geelong, VIC; (6) Kangaroo Island, SA.
Infection site. Nasopharynx, anterior and ethmoid nasal turbinates, distal third of the trachea and in the proximal 10 cm of both bronchi.
Stage. Adults, larva.
References. (1) Tubb (1937); (2) Domrow (1963); (3) Seawright (1964); (4) Domrow (1974); (5) Marlow (1975); (6) Nicholson & Fanning (1981).
Remarks. Tubb (1937) reports heavy infestations, cephalothorax and legs embedded in the mucous membrane, abdomen protruding, the locus of infection was inflamed and swollen, impossible to dislodge the mites without causing extensive damage to the mucous membrane. The host in Tubb's (1937) report is named *A. tasmanicus*. Seawright (1964) cites the host name as *Gypsophoca tasmanica*.

Parasite name: *Orthohalarachne diminuata* (Doetschman, 1944) Newell, 1947

Synonyms. *Halarachne diminuata* Doetschman, 1944; *Orthohalarachne chabaudi* Gretillat, 1960; *O. letalis* Popp, 1961 [Newell, 1947; Domrow, 1974].
Hosts. *Arctocephalus pusillus doriferus* (1), *Neophoca cinerea* (2).
Locality. (1) Seal Rocks and Geelong, VIC; (2) Dangerous Reef and Kangaroo Island, SA.
Infection site. Nasopharynx, nasal turbinates, lungs.
Stage. Adult, larvae.
References. (1) Domrow (1974); (2) Nicholson & Fanning (1981).
Remarks. Domrow (1974) reports mixed infections with *O. attenuata*.

Order: Trombidiformes Reuter, 1909
Family: Demodecidae Nicolet, 1855

Parasite name: *Demodex zalophi* Dailey & Nutting, 1980

Synonyms.
Hosts. *Zalophus californianus*.
Locality. Australia.
Infection site. Skin, hair follicles.
Stage. Adult, larvae.
References. Dailey & Nutting (1980).
Remarks. In Californian sea lion in captivity in Australia. First record of a demodecid in marine mammals.

Class: Insecta Linnaeus, 1758
Order: Phthiraptera Haeckel, 1896
Family: Echinophthiriidae Enderlein, 1904

Parasite name: *Antarctophthirus microchir* (Trouessart & Neumann, 1888) Enderlein, 1906

Synonyms. *Echinophthirius microchir* Trouessart & Neumann, 1888 [Leonardi, 2009].
Hosts. *Phocarctos hookeri* (1–3), *Neophoca cinerea* (4, 6), *Arctophoca australis forsteri* (5).
Locality. (1) Auckland Island, NZ; (2) Campbell Island, NZ; (3) Snares Island, NZ; (4, 6) Kangaroo Island and Dangerous Reef, SA; (4) Pages Island, SA.
Infection site. Fur/skin, body.
Stage. Adults.
References. (1) Enderlein (1906); (2) Clay (1964); (3) Horning *et al.* (1980); (4) McIntosh & Murray (2007); (5) Leonardi *et al.* (2009); (6) Marcus *et al.* (2015).
Remarks. Leonardi *et al.* (2009) report examining a group of specimens from a NZ fur seal in the Te Papa collection. Te Papa collection data show that these specimens were from Kaikoura and Open Bay Islands, NZ. This species has been found in otariids the world over and Leonardi and Palma (2013) suggest that the existing records may represent a complex of cryptic species. Host is called *Arctocephalus forsteri* in Leonardi *et al.* (2009).

Parasite name: *Antarctophthirus ogmorhini* Enderlein, 1906

Synonyms. *Echinophthirius setosus* Rothschild, 1902 (*nec E. setosus* Burmeister 1838 = *E. phocae* Lucas, 1834) [Harrison, 1937].
Hosts. *Hydrurga leptonix* (1, 2).
Locality. (1, 2) Macquarie Island, TAS.
Infection site. Fur/skin, body.
Stage. Adults.
References. (1) Harrison (1937); (2) Watson (1967).
Remarks. Leonardi *et al.* (2014) erected *Antarctophthirius carlinii* for specimens from the Weddell seal (*Leptonychotes weddelli* (Lesson, 1826)). *Antarctophthirius carlinii* was, in turn, listed by Palma (2017) who included, as synonyms, many occurrences of *A. ogmorhini* in the literature.

Parasite name: *Lepidophthirus macrorhini* Enderlein, 1904

Synonyms.
Hosts. *Mirounga leonina* (1, 2–6).
Locality. (1, 2–4, 6) MacQuarie Island, TAS; (5) Snares Island, NZ.
Infection site. Fur/skin.
Stage. Adult.
References. (1) Harrison (1937); (2) Murray & Nicholls (1965); (3) Watson (1967); (4) Lowry *et al.* (1978); (5) Horning *et al.* (1980); (6) Palma & Horning (2002).
Remarks. Host named *Macrorhinus leoninus* in Harrison (1937). A specimen in Te Papa Museum was collected from Kaikoura NZ.

Subphylum: Crustacea
Class: Hexanauplia Oakley, Wolfe, Lindgren & Zaharof, 2013
Order: Sessilia Lamarck, 1818
Family: Platylepadidae Newman & Ross, 1976

Parasite name: *Platylepas hexastylos* (Fabricius, 1798) Pilsbry, 1916

Synonyms. *Coronula bissexlobata* Blainville, 1824; *C. californiensis* Chenu, 1825; *Lepas hexastylos* Fabricius, 1798; *Platylepas bissexlobata* (Blainville, 1824) Darwin, 1854; *P. pulchra* Gray, 1825 [Pilsbry, 1916].
Hosts. *Dugong dugon* (1, 2).
Locality. (1) Sydney Harbour, Australia; (2) Magnetic Island, QLD.
Infection site. Skin, ventral surface.
Stage.
References. (1) Marlow (1962); (2) Zann & Harker (1978).
Remarks.

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Order: Lepadiformes Buckeridge & Newman, 2006
Family: Lepadidae Darwin, 1852

Parasite name: *Lepas australis* Darwin, 1851

Synonyms.
Hosts. *Arctocephalus tropicalis*.
Locality. Adelaide, SA.
Infection site. Body and flippers.
Stage.
References. Shaughnessy *et al*. (2014).
Remarks. Shaughnessy *et al*. (2014) reported this barnacle from the pelage of the subantarctic fur seal, a vagrant in Australian waters.

Family: Balanidae Leach, 1817

Parasite name: *Balanus* sp.

Synonyms.
Hosts. *Dugong dugon*.
Locality. Wallum Creek, North Stradbroke Island, QLD.
Infection site. Skin of back.
Stage.
References. Dexler & Freund (1906).
Remarks. The authors state, 'The dugong is the host of great numbers of parasites, both external and internal. On its back, as with whales, numerous barnacles establish themselves; a few *Balanus* but mostly *Chelonobia* [sic].'

Family: Chelonibiidae Pilsbry, 1916

Parasite name: *Chelonibia* sp.

Synonyms.
Hosts. *Dugong dugon*.
Locality. Wallum Creek, North Stradbroke Island, QLD.
Infection site. Skin of back.
Stage.
References. Dexler & Freund (1906).
Remarks. The authors report, 'The dugong is the host of great numbers of parasites, both external and internal. On its back, as with whales, numerous barnacles establish themselves; a few *Balanus* but mostly *Chelonobia* [sic].'

Class: Malacostraca Latreille, 1802
Order: Amphipoda Latreille, 1816
Family: Cyamidae Rafinesque, 1815

Parasite name: *Cyamus boopis* Lütken, 1870

Synonyms. *Cyamus ceti* Chilton, 1883; *C. elongatus* Hiro, 1938; *C. pacificus* Lütken, 1873; *C. suffuses* Dall, 1872 [WoRMS].
Hosts. *Megaptera novaeangliae* (1), unidentified South Australian whale (2), unidentified NZ whale (2).
Locality. (1) Picton, NZ; (1) Carnarvon, WA; (2) unknown locality, SA, and unknown locality, NZ.
Infection site. Skin.
Stage. Adults, juveniles.
References. (1) Leung (1965); (2) Sedlak-Weinstein (1991).
Remarks. This species has been found to be highly specific in its choice of host, the humpback whale, *M. novaeangliae* (Carvalho *et al*., 2010), so it seems probable that the unidentified whales belonged to this species.

Parasite name: *Cyamus catadontis* Margolis, 1954

Synonyms.
Hosts. *Physeter macrocephalus*.
Locality. Albany, WA.
Infection site.
Stage.
References. Leung (1965).
Remarks. In his paper, Leung (1965) lists a large number of cyamid specimens from all over the world, collected for a study of ectocommensal protozoans. No details are given other than the locality, date and collector. Leung names the sperm whale host as *P. catodon*.

Parasite name: *Isocyamus delphinii* (Guérin-Méneville, 1836) Gervais & Beneden, 1859

Synonyms. *Cyamus delphinii* Guérin-Méneville, 1836; *C. globicipitis* Lütken, 1873; *Isocyamus globicipitis*, Hiro, 1938 [Leung, 1967].
Hosts. *Globicephala melas* (1), *Phocoena phocoena* (2), *Pseudorca crassidens* (3).
Locality. (1) Jarvis Bay, NSW; (2) Australia; (3) Little Manly and Crowdy Heads, NSW.
Infection site. Skin.
Stage. Adults, juveniles.
References. (1) Leung (1965); (2) Berzin & Vlasova (1982); (3) Sedlak-Weinstein (1991).
Remarks. Leung (1965) names the host *G. malaena*. Berzin and Vlasova (1982) list this species as occurring in *Phocoena phocoena*, which is probably a host identification error, as this porpoise does not inhabit the Australasian region. It seems probable that this host was *Phocoena dioptrica*.

Parasite name: *Isocyamus deltobranchium* Sedlak-Weinstein, 1992

Synonyms.
Hosts. *Globicephala melas*.
Locality. Coast of TAS.
Infection site. Skin.
Stage. Adults.
References. Sedlak-Weinstein (1992b).
Remarks. Host named *G. malaena* in Sedlak-Weinstein (1992b).

Parasite name: *Isocyamus kogiae* Sedlak-Weinstein, 1992

Synonyms.
Hosts. *Kogia breviceps*.
Locality. Moreton Island, QLD.
Infection site. Skin.
Stage. Adults.
References. Sedlak-Weinstein (1992a).
Remarks.

Parasite name: *Platycyamus thompsoni* (Gosse, 1855) Lütken, 1870

Synonyms. *Cyamus thompsoni* Gosse, 1855 [WoRMS].
Hosts. *Mesoplodon grayi*.
Locality. Younghusband Peninsula, SA.

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Infection site. Skin.
Stage. Adults.
References. Sedlak-Weinstein (1991).
Remarks. New location and new host record.

Parasite name: *Scutocyamus antipodensis* Lincoln & Hurley, 1980

Synonyms.
Hosts. *Cephalorhynchus hectori* (1), *Phocoena dioptrica* (2).
Locality. (1) Cook Strait, NZ; (2) Caroline Bay, NZ.
Infection site. Skin.
Stage. Adults, juveniles.
References. (1) Lincoln & Hurley (1980); (2) Lehnert *et al.* (2017).
Remarks.

Parasite name: *Syncyamus aequus* Lincoln & Hurley, 1981

Synonyms.
Hosts. *Tursiops truncatus*, *Stenella longirostris*.
Locality. Arafura Sea, north-west Australia.
Infection site. Skin.
Stage. Adults, juveniles.
References. Sedlak-Weinstein (1991).
Remarks. New host location in Arafura Sea for this species.

Parasite name: *Syncyamus pseudorcae* Bowman, 1955

Synonyms.
Hosts. *Pseudorca crassidens*.
Locality. Crowdy Heads, NSW.
Infection site. Skin.
Stage. Adults, juveniles.
References. Sedlak-Weinstein (1991).
Remarks.

Subphylum: Apicomplexa
Class: Conoidasida Levine, 1988
Order: Eucoccidiorida Léger & Duboscq, 1910
Family: Sarcocystidae Poche, 1913

Parasite name: *Cryptosporidium hominis* Morgan-Ryan, Fall, Ward, Hijawi, Sulaiman, Fayer, Thompson, Olson, Lal & Xiao, 2002

Synonyms. *Cryptosporidium parvum* Tyzzer, 1912 (in part).
Hosts. *Dugong dugon* (1, 2).
Locality. (1, 2) Hervey Bay, QLD.
Infection site. Small intestine.
Stage.
References. (1) Hill *et al.* (1997); (2) Morgan *et al.* (2000).
Remarks. Hill *et al.* (1997) do not give a species name for *Cryptosporidium*. Three animals were found dead, one euthanized with anorexia and lethargy, putative oocysts found. Using the same specimens, Morgan *et al.* (2000) provide molecular data leading to identification as *C. parvum* 'human' genotype. This genotype was later described as *C. hominis* by Morgan-Ryan *et al.* (2002).

Parasite name: *Toxoplasma gondii* Nicolle & Manceaux, 1908

Synonyms.
Hosts. *Tursiops aduncus* (1), *Sousa chinensis* (2), *Dugong dugon* (3), *Arctophoca australis forsteri* (4), *Phocarctos hookeri* (5).
Locality. (1) In captivity, Australia; (2) Townsville and Gladstone Harbour, QLD; (3) south-east QLD; (4) Sydney, NSW; (5) Otago, NZ.
Infection site. Brain (tissue cysts), heart, lungs, liver, spleen, adrenal glands (tachyzoite stages).
Stage.
References. (1) Jardine & Dubey (2002); (2) Bowater *et al.* (2003); (3) Owen *et al.* (2012); (4) Donahoe *et al.* (2014); (5) Roe *et al.* (2017).
Remarks. Congenital toxoplasmosis in a stillborn late-term foetus with myocardial necrosis and nonsuppurative necrotizing encephalitis were associated with tachyzoites and tissue cysts (Jardine & Dubey, 2002); systemic toxoplasmosis, molecular data (Donahoe *et al.*, 2014); encephalitis associated with *T. gondii* cysts, emaciation, ataxia in one live stranded animal (Bowater *et al.*, 2003). Host called *Arctocephalus forsteri* in Donahoe *et al.* (2014).

Family: Hexamitidae Kent, 1880

Parasite name: *Giardia duodenalis* (Lambl, 1859) Kofoid & Christiansen, 1915

Synonyms. *Cercomonas intestinalis* Lambl, 1859; *Giardia agilis* Kunstler, 1882; *G. lamblia* Stiles, 1914; *Hexamita duodenalis* Davaine, 1875; *Lamblia intestinalis* Blanchard, 1888.
Hosts. *Neophoca cinerea*.
Locality. WA, SA, in captivity QLD and NSW.
Infection site. Intestine.
Stage.
References. Delport *et al.* (2014).
Remarks. Analysed from faecal samples, molecular data (18S).

Host–parasite list

Host taxon: Pinnipedia

Family: Otariidae

Host name: *Arctocephalus pusillus* doriferus (Australian fur seal)

Acanthocephala
Corynosoma australe
Corynosoma cetaceum
Nematoda
Anisakis sp.
Contracaecum ogmorhini
Contracaecum osculatum
Parafilaroides normani
Parafilaroides sp.
Uncinaria sp. 2 of Nadler *et al.* (2013)
Cestoda
Adenocephalus pacificus
Arachnida
Orthohalarachne attenuata
Orthohalarachne diminuata

Host name: *Arctocephalus tropicalis* (subantarctic fur seal)

Crustacea
Lepas australis

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Host name: *Arctophoca australis forsteri* (NZ fur seal)

Gastrointestinal parasites
Acanthocephala
Corynosoma australe
Corynosoma sp.
Nematoda
Anisakis simplex s.l.
Anisakis sp.
Contracaecum osculatum
Parafilaroides normani
Parafilaroides sp.
Pseudoterranova decipiens
Uncinaria sp.
Cestoda
Diphyllobothrium sp.
Phyllobothrium sp.
Trematoda gen. sp.
Insecta
Antarctophthirus microchir
Protozoa
Toxoplasma gondii

Host name: *Neophoca cinerea* (Australian sea lion)

Acanthocephala
Corynosoma australe
Corynosoma sp.
Nematoda
Contracaecum osculatum
Parafilaroides sp.
Uncinaria hamiltoni
Uncinaria sanguinis
Uncinaria sp.
Cestoda
Adenocephalus pacificus
Trematoda
Galactosomum angelae
Mesostephanus neophocae
Stictodora diplacantha
Synthesium sp.
Arachnida
Orthohalarachne attenuata
Orthohalarachne diminuata
Insecta
Antarctophthirus microchir
Protozoa
Giardia duodenalis

Host name: *Phocarctos hookeri* (NZ sea lion)

Acanthocephala
Corynosoma australe
Corynosoma semerme
Nematoda
Anisakis simplex s.l.
Pseudoterranova decipiens
Parafilaroides decorus
Uncinaria sp.
Uncinaria sp. 1 of Nadler *et al.* (2013)
Cestoda
Phyllobothrium sp.
Insecta
Antarctophthirus michrochir
Protozoa
Toxoplasma gondii

Host name: *Zalophus californianus* (Californian sea lion) captive animal

Arachnida
Demodex zalophi

Family: Phocidae

Host name: *Hydrurga leptonyx* (Leopard seal)

Acanthocephala
Corynosoma australe
Corynosoma bullosum
Corynosoma sp.
Nematoda
Anisakis simplex s.l.
Contracaecum mirounga
Contracaecum ogmorhini
Contracaecum osculatum
Contracaecum radiatum
Parafilaroides hydrurgae
Parafilaroides sp.
Pseudoterranova decipiens
Cestoda
Diphyllobothrium sp.
Insecta
Antarctophthirus ogmorhini

Host name: *Mirounga leonina* (Southern elephant seal)

Acanthocephala
Corynosoma bullosum
Nematoda
Anisakis simplex s.l.
Contracaecum mirounga
Contracaecum osculatum
Contracaecum radiatum
Filaria s.l. sp.
Pseudoterranova decipiens
Uncinaria sp. 3 of Nadler *et al.* (2013)
Cestoda
Phyllobothrium delphini
Trematoda
Mesostephanus neophocae
Arachnida
Halarachne miroungae
Insecta
Lepidophthirus macrorhini

Host taxon: Cetacea
Family: Balaenopteridae

Host name: *Balaenoptera acutorostrata* (Minke whale)

Nematoda
Anisakis sp.

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Cestoda
Phyllobothrium sp.

Host name: *Megaptera novaeangliae* (Humpback whale)

Acanthocephala
Bolbosoma balaenae
Crustacea
Cyamus boopis

Family: Neobalaenidae

Host name: *Caperea marginata* (pygmy right whale)

Trematoda
Ogmogaster sp.

Family: Delphinidae

Host name: *Cephalorhynchus hectori* (Hector's dolphin)

Acanthocephala
Corynosoma sp.
Nematoda
Acuaria sp.
Contracaecum sp.
Halocercus sp.
Phocascaris sp.
Stenurus sp.
Cestoda
Phyllobothrium delphini
Phyllobothrium sp.
Trematoda
Braunina cordiformis
Campula sp.
Crustacea
Scutocyamus antipodensis

Host name: *Delphinus delphis* (short-beaked common dolphin)

Acanthocephala
Corynosoma cetaceum
Corynosoma sp.
Nematoda
lung worms
Anisakis pegreffii
Anisakis simplex s.l.
Crassicauda sp.
Echinocephalus overstreeti
Halocercus lagenorhynchi
Halocercus sp.
Parafilaroides sp.
Pharurus alatus
Stenurus ovatus
Cestoda
Monorygma grimaldii
Phyllobothrium delphini
Phyllobothrium sp.
Tetrabothrius forsteri
Tetrabothrius sp.
Trematoda
Brachycladium delphini
Brachycladium palliatum
Heterophyidae gen. sp.

Host name: *Globicephala melas* (long-finned pilot whale)

Acanthocephala
Bolbosoma capitatum
Nematoda
Anisakis oceanica
Anisakis simplex s.l.
Anisakis sp.
Stenurus globicephalae
Crustacea
Isocyamus delphinii
Isocyamus deltobranchium

Host name: *Globicephala* sp.

Nematoda
Stenurus globicephalae

Host name: *Grampus griseus* (Risso's dolphin)

Nematoda
Crassicauda grampicola
Stenurus globicephalae

Host name: *Lagenodelphis hosei* (Fraser's dolphin)

Nematoda
Anisakis simplex s.l.
Stenurus ovatus
Cestoda
Monorygma grimaldii
Tetrabothrius sp.
Trematoda
Campula sp.
Nasitrema sp.

Host name: *Lagenorhynchus obscurus* (dusky dolphin)

Nematoda
Anisakis simplex s.l.
Crassicauda sp.
Cestoda
Phyllobothrium delphini
Phyllobothrium sp.

Host name: *Peponocephala electra* (melon-headed whale)

Nematoda
Anisakis simplex s.l.
Anisakis typica
Stenurus globicephalae
Cestoda
Monorygma chamissonii

Host name: *Pseudorca crassidens* (false killer whale)

Acanthocephala
Bolbosoma capitatum
Nematoda

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Crassicauda sp.
Crustacea
Isocyamus delphinii
Syncyamus pseudorcae

Host name: *Sousa chinensis* (Indo-Pacific humpbacked dolphin)

Protozoa
Toxoplasma gondii

Host name: *Stenella coeruleoalba* (striped dolphin)

Nematoda
Halocercus sp.
Halocercus delphinii
Cestoda
Monorygma grimaldii
Phyllobothrium delphini

Host name: *Stenella longirostris* (spinner dolphin)

Crustacea
Syncyamus aequus

Host name: *Tursiops aduncus* (Indo-Pacific bottlenose dolphin)

Nematoda
Halocercus lagenorhynchi
Stenurus ovatus
Protozoa
Toxoplasma gondii

Host name: *Tursiops truncatus* (common bottlenose dolphin)

Acanthocephala
Bolbosoma sp.
Corynosoma cetaceum
Nematoda
Anisakis pegreffii
Anisakis simplex s.l.
Halocercus lagenorhynchi
Skrjabinalius cryptocephalus
Stenurus ovatus
Cestoda
Phyllobothrium sp.
Trematoda
Synthesium tursionis
Crustacea
Syncyamus aequus

Family: Kogiidae

Host name: *Kogia breviceps* (pygmy sperm whale)

Nematoda
Anisakis physeteris
Anisakis simplex s.l.
Anisakis sp.
Crassicauda magna
Pseudoterranova decipiens
Pseudoterranova kogiae
Cestoda
Phyllobothrium delphini
Crustacea
Isocyamus kogiae

Host name: *Kogia sima* (dwarf sperm whale)

Nematoda
Anisakis berlandi
Anisakis brevispiculata

Family: Phocoenidae

Host name: *Phocoena dioptrica* (spectacled porpoise)

Nematoda
Anisakis sp.
Stenurus minor
Cestoda
Phyllobothrium delphini
Crustacea
Scutocyamus antipodensis

Host name: *Phocoena* (harbour porpoise)

Crustacea
Isocyamus delphinii

Family: Physeteridae

Host name: *Physeter macrocephalus* (sperm whale)

Crustacea
Cyamus catadontis

Family: Ziphiidae

Host name: *Mesoplodon bowdoini* (Andrew's beaked whale)

Nematoda
Anisakis nascetti
Anisakis ziphidarum

Host name: *Mesoplodon grayi* (Gray's beaked whale)

Nematoda
Anisakis nascetti
Anisakis sp.
Crustacea
Platycyamus thompsoni

Host name: *Mesoplodon hectori* (Hector's beaked whale)

Nematoda
Anisakis sp.
Cestoda
Tetrabothrius forsteri

Host name: *Mesoplodon layardii* (strap-toothed whale)

Nematoda
Anisakis nascetti

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Host name: *Ziphius cavirostris* (Cuvier's beaked whale)

Nematoda
Crassicauda boopis
Crassicauda sp.

Host taxon: Sirenia
Family: Sirenidae

Host name: *Dugong dugon* (dugong)

Nematoda
Paradujardinia halicoris
Trematoda
Faredifex clavata
Folitrema jecoris
Haerator caperatus
Labicola cf. elongata
Labicola elongata
Lankatrema macrocotyle
Lankatrema mannarense
Lankatrema microcotyle
Lankatrema minutum
Lankatrematoides gardneri
Opisthotrema australe
Opisthotrema dujonis
Pulmonicola pulmonalis
Rhabdiopoeus taylori
Solenorchis travassosi
Spirorchidae gen. sp.
Taprobanella bicaudata
Crustacea
Platylepas hexastylos
Balanus sp.
Chelonibia sp.
Protozoa
Cryptosporidium hominis
Toxplasma gondii

Discussion

In this first host–parasite checklist, information about metazoan and protozoan parasites of marine mammals in NZ and Australian waters was collated. From 51 species of cetacean known from Australian and NZ waters, only 27 species have recorded parasites. From 11 species of pinnipeds known from Australian and NZ waters, eight have recorded parasites. The absence of records certainly does not signify that the remaining hosts are parasite free. There is still a lot left to learn. However, checklists such as this one remain valuable tools to ecologists and can help to further our understanding of parasite diversity and be a practical resource for scientists.

Nematodes were the most diverse group reported, with 30 different species determined, and many more records where identification was restricted to the genus or family level. Anisakid stomach nematodes (14 species) represented the family most often found in a wide range of host species, reflecting their generalist nature, followed by pseudaliid lungworms (seven species), specific to the respiratory tract of odontocetes. Trematodes (22 species), mostly from the gastro-intestinal tract, were found in sirenians (15 species), cetaceans (six species) and pinnipeds (six species). Six species of acanthocephalans were identified from pinniped ($n = 6$) and cetacean ($n = 3$) hosts. Adult cestodes (five species) were recorded in the intestinal tract of three cetacean and two pinniped species. Cestode larvae within the subcutaneous blubber and the peritoneum were recorded from multiple cetacean ($n = 9$) and pinniped ($n = 3$) species. Thirteen different ectoparasitic crustacean species were found on cetaceans and sirenians. Other arthropod ecto- (Insecta, three species) and endoparasites (Arachnida, four species) were recorded from pinniped species. Three protozoan species were encountered in several marine mammal species including sirenians, pinnipeds and cetaceans within studies dating from 1997 to 2017. This may reflect, on the one hand, the relatively recent occurrence of some of these pathogens in the marine environment due to human activities and, on the other hand, new survey and diagnostic techniques (Lasek-Nesselquist *et al.*, 2010), as well as growing awareness of these emerging zoonotic agents in the research community.

Thirty-four parasite records were from dugongs and 25 species were found in common dolphins, while leopard seals with 17 parasite species were the pinnipeds most often infected. This reflects the opportunistic nature of sampling these animals. The findings indicate that, for example, sperm whales with one crustacean ectoparasite record or elusive beaked whales with 2–3 species records are seldom encountered hosts.

Many old records have complicated histories with multiple synonyms, which need updating. Also, the advent of molecular tools has identified several species complexes (Mattiucci *et al.*, 2014; Klotz *et al.*, 2018), for which retrospective analyses would be useful. New techniques will likely also continue to improve the identification of parasite fragments and minute larvae (Jabbar *et al.*, 2015), as well as provide insights on the phylogeny of parasite species (Hernández-Orts *et al.*, 2017).

The protozoans *Toxoplasma*, *Giardia* and *Cryptosporidium* are emerging parasites in marine mammals. In the future, the combination of prevalence surveys with molecular techniques will probably identify further protozoans and provide knowledge on host specificity and transmission pathways (Fayer *et al.*, 2004; Applebee *et al.*, 2005; Grilo *et al.*, 2018).

Foodborne parasites like cestodes (*Diphyllobothrium* sp.) and anisakids (*Anisakis* sp., *Pseudoterranova* sp.) are abundant in marine mammals in Australasia and pathogenic for humans when infective larvae are accidentally consumed with undercooked fish (Yamasaki & Kuramochi, 2009; Shamsi & Butcher, 2011). Human health concerns as well as implications for fisheries and seafood control underline the importance of better understanding the epidemiology of relevant species (Cipriani *et al.*, 2016).

Opportunistic parasite surveys of dead or live stranded cetaceans, in cooperation with established stranding networks (e.g. that of NZ's Department of Conservation) and systematic, minimally invasive studies to monitor live and free ranging pinnipeds (e.g. analysing faeces from pinniped colonies; Presswell & Lagrue, 2016), would enable a better overview of prevalence, intensity of infections and emerging parasite species. The importance of well-maintained and curated museum collections cannot be underestimated in their contribution towards our ongoing knowledge of parasite biodiversity (Lehnert *et al.*, 2017). It remains unclear how contaminant exposure causing immune suppression or cumulative effects of human-induced pressures (shipping, fisheries, global change) make marine mammals more susceptible to infectious disease in Australasian waters (Van Bressem *et al.*, 2009). Studies combining ecotoxicological analyses with systematic monitoring of parasite prevalence and impact (Lehnert

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et al., 2018) would help to elucidate these relationships in the future.

Parasites should be an integral part of biodiversity and conservation research in their marine mammal hosts (Aznar *et al.*, 2010; Poulin *et al.*, 2016). Ultimately, this research can inform managers and may guide species, habitat and population assessment and conservation, as well as encourage further investigations into the biodiversity and ecology of marine mammal parasites.

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