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Guide to the Parasites of Fishes of Canada
Part V: Nematoda

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***Editors of the series:**

MICHAEL D. B. BURT & DONALD F. McALPINE

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In Memory of

Norma Rose Smith
06 May 1943–21 November 2005
Wife, Mother, Grandmother, Best Friend

Dr Rod Wootten
17 May 1946–08 November 2013
Good Friend, Colleague

Andrew Charles Hood-Morris
01 December 1968–30 August 2013
Good Friend

PREFACE

The current volume, dealing with the nematode parasites of Canadian fresh-water, brackish-water and marine fishes, is part V of a series initiated in 1984 under the editorship of noted Canadian parasitologists Leo Margolis (1927–1997) and Zbigniew "Bob" Kabata (1924–2014). The first four parts dealt with Monogenea and Turbellaria (Beverley-Burton 1984), Copepoda and Branchiura (Kabata 1988), Isopoda (Rafi 1988), Amphipoda (Bousfield & Kabata 1988), Acanthocephala (H. P. Arai 1989), Cnidaria (M. N. Arai 1989) and Trematoda (Gibson 1996). Contributions I to III were published by the Canadian Federal Department of Fisheries and Oceans under the Canadian Special Publications of Fisheries and Aquatic Sciences banner, while part IV was published by the NRC Research Press. We are pleased to provide part V through the journal *Zootaxa*. Our cover design has been adapted from Dr. Greg Klassen's original artwork for the cover of Part I. The use of this design for volumes II–IV, with modifications tailored to specific taxa, has permitted visual continuity in the series, regardless of the imprint under which the volumes have been published. With a nod of thanks to Dr. Klassen, we have chosen to continue this tradition.

The founding editors recognized the need for "a compendium allowing for relatively easy identification of the parasites of fishes of Canada" and we believe that Hisao P. Arai and John W. Smith (JWS) have ably met that goal for the 88 nematode species included here. Nonetheless, readers will recognize that in a work that seeks to synthesise more than 800 references there may well be errors of omission or commission. While JWS has advised us that he accepts sole responsibility for such errors, as Editors we recognize that we would be remiss in allowing one or both authors to carry this burden alone.

The Editors

Abstract

Keys are provided for the identification of the nematode species known to be parasites of Canadian fishes. The nematodes are described and illustrated, with a note of the site(s) they occupy in named fish host(s) and their geographical distribution. Parasite records are given by author and date, full details of which can be found in a bibliography of over 800 references. Diagnoses and keys for 22 Families, 47 genera and 88 species of nematodes are also given, together with a glossary of terms, a host-parasite list, and indices to both nematode parasites and hosts.

Key words: Nematoda, Dioctophymatidae, Capillariidae, Cystoopsidae, Trichosomoididae, Anguillicoloidea, Dracunculoidea, Gnathostomatoidea, Oxyuroidea, Camallanoidea, Thelazioidea, Spiruroidea, Habronematoidea, Acuarioidea, Ascaridoidea, Seuratoidea, Metastrongyloidea, fishes, Canada, biodiversity, nematode parasites, host-parasite list, parasite list, host list

Résumé

Des clés sont fournies pour identifier les de nématodes, connues pour être des parasites de poissons canadiens. Les nématodes sont décrits et illustrés, avec une note de l'endroit, ou des endroits, qu'ils occupent dans les poissons hôtes et leur répartition géographique. Les données sur les parasites sont classées par auteur et date, et les détails se trouvent dans une bibliographie de plus de 800 références. Les diagnoses et les clés de 22 Familles, 47 genres et 88 espèces de nématodes sont également données, ainsi qu'un glossaire de termes, une liste hôte-parasite et un index des parasites et des hôtes.

Introduction

"If all the matter in the universe except the nematodes was swept away, our world would still be dimly recognizable and if, as disembodied spirits, we could then investigate it, we should find its mountains, hills, vales, rivers, lakes and oceans represented by a film of nematodes" Cobb (1915)

Nematodes are probably the most abundant multicellular organisms on earth (Cobb 1915). They vary in size from free-living species less than one millimetre long to *Placentonema gigantissima* parasitic in the placenta of sperm whales that, according to Gubanov (1951), is over eight *metres* long!

Free-living nematodes occupy the soil, seas, brackish water or fresh water, and some are regarded as "extremophiles" (Wharton 2003). One of them, *Caenorhabditis elegans*, was the first animal to have its entire genome sequenced (Hodgkin *et al*. 1998). Some plant-parasitic species are economically important as pests of crops (Lee 2002). Nematodes are also parasites of animals, including some from humans that have been known from antiquity. For example, Gibbons (2010) noted that nematodes are mentioned in the Egyptian *Papyrus Ebers* as early as *circa* 1550 BC. The "Staff of Aesculapius with Serpent Entwined" and the "Caduceus with Double Serpents" are universal symbols of medical and pharmaceutical services; both symbols evoke the time-honoured method of extracting female guinea worms, *Dracunculus medinensis*, from the lower limb of humans (Old Testament, Numbers **21**: 6–9).

This part of the Guide series concerns the identification of larval and adult nematodes of fishes inhabiting all of Canada's diverse aquatic environments. In an introduction to Part I of the Guide series the then Editors Margolis & Kabata (1984) indicated that the various parts are intended for fish parasitologists and for those concerned with fish and human health.

Wild and farmed fish species are important sources of protein for human consumption and are likely to remain so in the future (Greenberg 2010), so the safety of such products is important. Indeed, the larvae of some marine anisakid nematodes (species of *Anisakis*, *Pseudoterranova* and *Contracaecum*) have considerable public health and commercial significance (J. W. Smith & Wootten 1978; Bowen 1990; J. W. Smith 1999; Hochberg & Hamer 2010). A recent Canadian report by S. Vaughan *et al.* (2015) is pertinent. A 50-year-old Albertan man suffered severe epigastric pain one hour after eating raw wild salmon that evidently contained anisakid larvae; endoscopy subsequently revealed several larvae in his stomach mucosa. Earlier Canadian and other North American examples of accidental infection of humans with larval marine anisakids were summarised by J. W. Smith (1999) in a worldwide review of pathology associated with ascaridoid infection of the alimentary tract of vertebrates, including humans.

Agnathan fishes contribute significantly to the fish fauna of Canada (www.fishbase.org) so a brief review follows: it relies heavily on the host-parasite lists provided in the various parts of this Guide. Lampreys (Petromyzontiformes) have been recorded with nematodes (pages 153–155, 178) and with copepods, acanthocephalans and digeneans (Kabata 1988; Arai 1989; Gibson 1996). Hagfishes (Myxiniformes) in Canada comprise *Myxine glutinosa*, *Eptatretus deani* and *E. stoutii*, the host roles of which appear neglected because hagfish species are not listed anywhere in the Guide series. Parasitological examination of Canadian hagfishes might be rewarding because Luo *et al*. (2016) reported anisakid nematodes in *Eptatretus* from Taiwanese waters, and monogeneans were reported on *Eptatretus* from Californian and South African waters by Malmberg & Afzelius (1990) and D. B. Vaughan *et al*. (2010).

From an environmental viewpoint, nematodes and other macroparasites of fishes might serve as biological indicators in assessing climate change and attempts to ameliorate its effects (Palm 2011), especially as water supplies are likely to become a universal priority (Radkau 2014).

The *CIH Keys to the Nematode Parasites of Vertebrates* and other major works on nematode taxonomy and systematics were consulted during preparation of this part of the Guide. Spencer Jones & Gibson (1987) updated the *CIH Keys* that had originally appeared in 10 parts under different authorship between 1974 and 1983 (see Anderson 1978; Anderson & Bain 1976, 1982; Anderson *et al.* 1974; Chabaud 1974, 1975a,b, 1978; Durette-Desset 1983; Hartwich 1974; Lichtenfels 1980a,b; Petter & Quentin 1976; Willmott 1974). The publication by Anderson *et al.* (2009) of an "*Archival Volume*" for the *CIH Keys* was followed by Gibbons' (2010) "*Supplementary Volume*" that brought together the various parts, drew attention to new taxa described after the originals were completed, and attempted to identify the current position of some of the older taxa excluded from the original *Keys*. Superfamilies and the arrangement of Families within them in this part of the Guide are generally as recommended in the *CIH Keys* with one exception: Moravec's (2001) keys to Families in the Trichinelloidea Ward, 1907, are followed, including recognition of the Family Capillariidae Railliet, 1915, rather

than Trichuridae (Ransom, 1911) Railliet, 1915. Following proposals by Hartwich (1974, 1975) raphidascaridids are treated not as a Family (Raphidascarididae—see De Ley & Blaxter 2002) but as a Subfamily (Raphidascaridinae) within the Family Anisakidae.

Holotypes and other type material of nematode taxa of Canadian origin are deposited in one or more curatorial facilities in Canada and sometimes elsewhere. Much Canadian material is housed at the Canadian Museum of Nature, Ottawa, Ontario. The Museum holds some 50,000 lots, including many specimens originally stored at the Institute of Parasitology (McGill University, Sainte-Anne-de-Bellevue, Québec) and the former Arctic Biological Station (Fisheries and Oceans Canada). Type material and voucher specimens may also be lodged at any of the provincial museums and associated institutions listed on the website of the Alliance of Natural History Museums of Canada:

The United States National Collection of Parasites (USNCP) also contains some Canadian type materials. The USNCP, established in 1892 and curated for over 70 years at the Beltsville Area Research Center (Maryland), was transferred in 2013 to the Smithsonian Institution, National Museum of Natural History (Washington, DC, USA).

Attention is drawn to the records herein of *Syncuaria squamata* (Acuarioidea: Acuariidae) and *Pharurus pallasii* (Metastrongyloidea: Pseudaliidae). Inclusion of these nematode species is based solely on experimental infection of fishes; see pages 116–118, 176–177 for further details. Firm evidence that fishes serve as paratenic or intermediate hosts for either of these species in Canadian waters currently appears to be lacking.

Particularly noteworthy contributions to this part of the Guide that have appeared in recent years include descriptions of *Huffmanela canadensis* (Trichosomoididae: pages 34–35), gravid females of *Philometra rubra* (Philometridae: pages 49–50) and the invasive species *Anguillicola crassus* (Anguillicolidae: page 37–38). These nematodes are pathogenic to Canadian fishes and/or have commercial importance. Further information is given below and by Moravec *et al*. (2005) and Moravec (2006) for *H. canadensis*, by Moravec *et al.* (2009a, 2013) for *P. rubra*, and by Wijová *et al.* (2006), Aieta *et al*. (2009), Rockwell *et al*. (2009), Campbell *et al*. (2013), Denny *et al.* (2013) and Li *et al*. (2015) for *A. crassus*.

Studies based on DNA have provided significant insights into relationships between groups within the Phylum Nematoda. For example, recent evidence suggests that Clade III nematodes comprise the orders Gnathostomatomorpha, Ascaridomorpha, Oxyuridomorpha, Rhigonematomorpha and Spiruromorpha (Blaxter *et al*. 1998; Nadler & Hudspeth 2000; Nadler *et al.* 2007; Laetsch *et al*. 2012). More recently, Choudhury & Nadler (2016) reported on the phylogenetic relationships of Cucullanidae, and appealed for greater scrutiny of the conventional classification of the superfamily Seuratoidea. Evolutionary relationships between nematodes and other animals have also been explored (Blair *et al.* 2002; Dunn *et al.* 2008). Ribosomal and mitochondrial sequences including barcodes (Hebert *et al.* 2003; Ferri *et al.* 2009; Packer *et al*. 2009) have proven especially useful in alpha taxonomy (Miller 2007; Schlick-Steiner *et al.* 2010). DNA and allozyme data are particularly valuable in studies requiring species level identification of larval stages or in investigations of cryptic species where morphological criteria alone do not permit identification to species level. For example, some species of *Anisakis*, *Pseudoterranova* and *Contracaecum* appear to be composites of cryptic species that show differences in geographical range and final hosts (Mattiucci *et al*. 1998; Paggi *et al.* 2000; Mattiucci & Nascetti 2007, 2008).

Unfortunately, there are significant gaps in the availability of molecular data for the broader nematode fauna of fishes in general and for Canadian ones in particular. Thus, only 29 (about 62%) of the 47 genera in this part of the Guide are represented in GenBank (Table 1). These include sequences of 161 named species or members of species complexes (e.g. *Anisakis*, *Pseudoterranova* and *Contracaecum*) and sequences for another 272 identified only to genus; 236 (about 87%) of these are unidentified specimens of *Anisakis*, *Hysterothylacium* and *Eustrongylides*, all of which are common as larval stages in fishes. Only 15 (about 31%) of the 47 genera included in this part of the Guide are represented in GenBank (19 species with one to three species per genus). No doubt more sequence data will accumulate over time but studies on fish nematodes will continue to depend heavily for the foreseeable future on morphology-based identifications. The universal shortage of "classical" parasite taxonomists and systematists (Brooks & Hoberg 2001; Poulin & Leung 2010; Šlapeta 2013; Scholz & Choudhury 2014) is therefore particularly regrettable.

Not surprisingly, DNA-based studies over the past several decades have also led to significant improvements in our understanding of fish systematics. Therefore, users of this Guide will find in the older literature cited here that the host scientific names used by authors are sometimes not those now in use. For the scientific names of fishes we have followed the nomenclature of Page *et al.* (2013). We refer to the on-line resource FishBase (www.fishbase.org) for fishes from depths greater than 200 m, that is, in areas not dealt with by Page *et al*. (2013).

TABLE 1. Nematode genera for species of which sequence data are available in GenBank (accessed 31 March 2014) and for which keys to species are provided in this part of the Guide.

	Number of sequences of species in each genus in GenBank		Number of species in the Guide with sequences in GenBank	Species in the Guide with sequences in GenBank
	Identified species	unidentified species		
Anguillicola	5	0	1	*A. crassus*
Anisakis	13	64	1	*A. simplex*
Ascarophis	2	0	1	*A. arctica*
Caballeronema	0	0	0	none
Camallanus	7	3	1	*C. oxycephalus*
Capillaria	7	5	0	none
Capillospirura	0	0	0	none
Clavinema	1	0	0	none
Contracaecum	37	19	3	*C. osculatum* *C. rudolphii* *C. spiculigerum*
Cosmocephalus	0	0	0	none
Cucullanellus	0	0	0	none
Cucullanus	3	2	0	none
Cystidicola	2	0	2	*C. farionis* *C. stigmatura*
Cystoopsis	1	0	0	none
Daniconema	0	0	0	none
Dichelyne	1	0	0	none
Dioctophyme	1	0	1	*D. renale*
Eustrongylides	1	82	0	none
Haplonema	0	0	0	none
Hedruris	1	0	0	none
Huffmanela	0	0	0	none
Hysterothylacium	11	90	1	*H. aduncum*
Ichthyofilaria	0	0	0	none
Metabronema	1	1	0	none
Oncophora	0	0	0	none
Paracapillaria	0	0	0	none
Paracuaria	0	0	0	none
Paraquimperia	1	0	0	none
Pharurus	0	0	0	none
Philometra	25	4	1	*P. rubra*
Philometroides	9	0	0	none
Philonema	1	1	1	*P. oncorhynchi*
Phocascaris	2	1	0	none
Piscicapillaria	0	0	0	none
Pseudanisakis	1	0	0	none
Pseudocapillaria	0	0	0	none

.....continued on the next page

TABLE 1. (Continued)

	Number of sequences of species in each genus in GenBank		Number of species in the Guide with sequences in GenBank	Species in the Guide with sequences in GenBank
	Identified species	unidentified species		
Pseudodelphis	0	0	0	none
Pseudoterranova	7	0	2	*P. bulbosa* *P. decipiens*
Raphidascaris	5	0	1	*R. acus*
Rhabdochona	10	0	0	none
Salmonema	1	0	1	*S. ephemeridarum*
Salvelinema	0	0	0	none
Spinitectus	3	0	1	*S. carolini*
Spiroxys	0	0	0	none
Syncuaria	0	0	0	none
Tetrameres	1	0	0	none
Truttaedacnitis	1	0	1	*T. truttae*
Totals	161	272	19	19

Collection and examination of nematodes

Thorough search of the tissues and organs of individual fish is recommended in view of the great variety of sites (*sensu* Bush *et al*. 1997) that may be occupied by nematodes. Ideally, live specimens should be collected from freshly-killed hosts and processed immediately. Worms should be dissected free from capsules of host origin, and freed from any host debris by vigorous shaking in physiological saline. Recipes for fresh-water and marine saline are given by Hoar & Hickman (1975). Nematodes collected from long-dead and unprocessed fish, from frozen and then thawed fish, or from fish preserved in formaldehyde for example may yield useful material. However, the body of such worms may be contorted such that examination for features of significance for identification is difficult or impossible.

Larvae of marine ascaridoids that mature in fish-eating birds or mammals (cormorants, gulls, seals, cetaceans, etc) may be recovered from fishes by pepsin/trypsin-HCl digest (for technique see J. W. Smith & Wootten 1975). Such larvae represent species of *Anisakis*, *Pseudoterranova*, *Contracaecum* and *Phocascaris*. At high temperatures the digest technique might not work for larvae that mature in poikilothermic vertebrates as they may not survive the digestion process. However, the digest technique can be used with poikilothermic hosts at lower temperatures, the process merely taking longer.

Records should be kept of the distribution (geographical locality) and number of fish of a given species examined and the number infected with given nematode species. Such information, together with the number of worms found in individual fish, yield valuable epidemiological data such as the prevalence and intensity of infection (Bush *et al.* 1997).

Berland (1970), Pritchard & Kruse (1982), Dailey (1996) and Moravec (2011, 2013) discussed the merits and demerits of various techniques for processing nematodes for identification. Fixation in hot (about 60˚ C) 70% ethanol works well, at least on large specimens, the worms dying in an extended state. They may then be preserved in 70% ethanol with added glycerine for long-term storage. If the ethanol evaporates over time the specimens remain pliable, and fresh 70% ethanol may be added. Nematodes may also be fixed in hot 10% buffered formaldehyde, and transferred subsequently to 70% ethanol; this technique allows processing for scanning electron microscopy (SEM) and histology, and also for clearing in glycerine-ethanol or lactophenol. Given the importance of molecular data for modern taxonomy, a subsample of nematodes should be fixed and stored in 95% or 100% ethanol that lack harmful additives like methanol, ketones or acetates (Naem *et al*. 2010). Because delicate

nematodes may collapse into unrecognizable wisps after prolonged storage in 95% ethanol they may be fixed for short-term storage (weeks to a few months) in 70% or 80% ethanol, and portions used for molecular work or morphological observations. Specimens that have been frozen or fixed in formaldehyde (or any other agent) may be transferred to 70% glycerine-ethanol for subsequent preservation.

Before microscopical examination large nematodes should be cleared in lactophenol; such treatment renders the specimens translucent for study of internal morphological features of significance for identification. After examination the specimens may be returned to glycerine-ethanol. For delicate nematodes lactophenol should be used with caution as it may lead to their collapse. Delicate worms may be cleared in a solution of 5% glycerine and 70% ethanol, allowing the ethanol to evaporate gradually over several days at room temperature. Then the cleared specimens may be mounted on a slide using the residual glycerine; use of fresh glycerine should be avoided as it may be a higher concentration than the residual glycerine and specimens may collapse owing to unequal osmotic pressure. Along these lines, Moravec (2001, 2013) discussed the best approaches to fixing small worms like capillariids, including their subsequent "elusiveness" in, and retrieval from, vials of preservative. One method is to mount them on slides under coverslips as semi-permanent preparations. Permanent preparations of nematodes are not recommended as it is difficult (or impossible) to rotate the specimens to view significant morphological features. If worms become distended in certain fixatives, and if sufficient material is available, it is useful to fix some in other agents to compare the effects.

Identification of species of certain genera, *Rhabdochona* and *Cystidicola* for example, require dissection of mature eggs from the female's body to allow examination for filaments and other superficial structures.

En face views of nematodes have been considered to be of taxonomic value but their use in the present work is restricted for the following reasons. Taking the cystidicolid genus *Spinitectus* as an example, Jilek & Crites (1982c) pointed out that some workers have omitted descriptive details of the head or have provided incomplete or misleading *en face* drawings. Scanning electron microscopy (SEM) may provide accurate representations of nematode head anatomy, tail anatomy and cuticular ornamentation but this technology is not readily available to field workers for whom this Guide is mainly intended.

Geographical distribution

A list of jurisdictions, arranged alphabetically, from which nematodes of fishes have been recorded in Canada is provided. The jurisdictions include five broad geographical regions (Atlantic—AT, Canada—CA, Central Canada—CC, Hudson Bay Drainage—HBD, Pacific—PA), where authors have not reported the site of their investigations more specifically. Otherwise we list distribution by political jurisdictions as follows; Alberta—AB, British Columbia—BC, Labrador—LB, Manitoba—MB, New Brunswick—NB, Newfoundland (Island only)—NF, Northwest Territories—NT, Nova Scotia—NS, Nunavut—NU, Ontario—ON, Prince Edward Island—PE, Quebec—QC, Saskatchewan—SK, Yukon—YT. Experimental infections (EX) carried out at Canadian laboratories are also included, although in some cases the geographical source of the parasite material is not stated. Nevertheless, such papers often contain important morphological descriptions and life-history information.

Glossary of terms

By kind permission of the Commonwealth Agricultural Bureau International (CABI) the following Glossary of Terms, including Figures 1 to 14, has been adapted from that given by Dr Sheila Willmott in Anderson *et al.* (1974). New entries are marked with a dagger (†). Inconsistencies in terminology should be noted—see, for example, pharynx/oesophagus and buccal capsule/cavity in Gibbons (2002). Some entries have been modified in the light of recent advances in our understanding of nematode systematics and phylogeny.

ala: alae (plural)	thin, cuticular projection or fin, running longitudinally, usually lateral or sublateral, frequently paired: *cervical alae* are confined to the anterior end; *caudal alae* occur on the posterior end of males
amphidelphic	having two opposed sets of female reproductive organs, one extending anteriorly, and the other posteriorly to the vulva

amphids	pair of glandular sensory organs situated laterally in the cephalic region and opening through the cuticle—see Fig. 8
annulations	deep, transverse grooves occurring at regular intervals in the cuticle giving the body a segmented appearance—see Fig. 1
annules	the intervals or rings of cuticle between the annulations—see Fig. 1
area rugosa	ornamentation of the cuticle, sometimes present on the ventral surface in front of the cloaca on the coiled part of the posterior extremity of the male—see Fig. 2

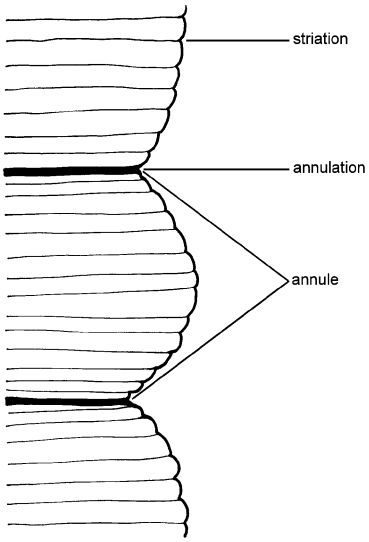

Fig. 1

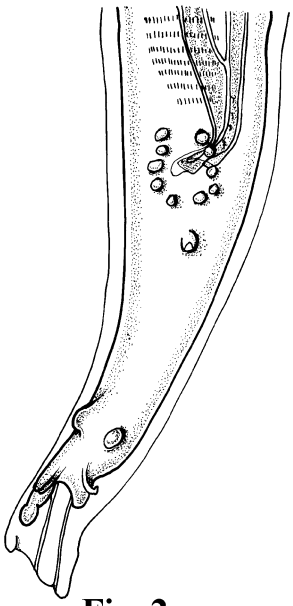

Fig. 2

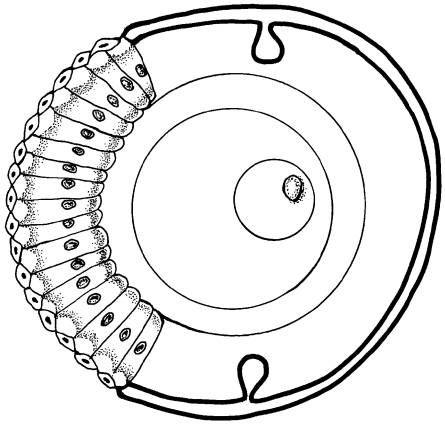

Fig. 3

†aspinose	lacking spines
bacillary band	a modification of the hypodermis in Trichinelloidea, consisting of longitudinal rows of columnar cells that have pore-like openings to the surface of the cuticle (= hypodermal glands of some authors)—see Fig. 3
bacillary layer	a non-vibratile form of ciliary lining of the intestine—see Fig. 4
ballonets	cuticular inflations in the cephalic region assuming a swollen band-shape immediately posterior to the lips (= head bulb of some authors)
bosses	small, round or oval, blister-like inflations of the cuticle
buccal cavity	part of digestive canal between mouth opening and oesophagus; the stoma
buccal capsule	anterior enlarged portion of the buccal cavity with heavily sclerotized walls
bulb	posterior part of muscular oesophagus, generally swollen, containing a valvular apparatus—see Fig. 11
bursa copulatrix (= copulatory bursa)	modified caudal ala or alae found in males of some nematodes, may be circular or oval, often divided into two symmetrical or asymmetrical lateral lobes, separated by a dorsal lobe, and supported by rays or papillae—see Fig. 5
caecum (= intestinal caecum)	a blind diverticulum or pouch from the intestine—see Fig. 6
cardia	oesophago-intestinal valve
cephalic papillae	see under "head papillae"
cervical	applied to structures connected with the "neck" region
cheilorhabdion	wall of cheilostom(e)
cheilostom(e)	first portion of the buccal cavity of a rhabditid-like nematode
circumoesophageal	encircling the oesophagus
circumoral	encircling the mouth

circomyarian	a type of muscle cell in which the muscle fibre completely surrounds the sarcoplasm
claviform	club-shaped
cloaca	the common chamber into which the intestinal and genital canals open
coelomyarian	body musculature consisting of cells of which the internal non-contractile part is well developed and protrudes into the pseudocoelom; the muscle fibres extend to the sides of the muscle cells for varying distances—see Fig. 7

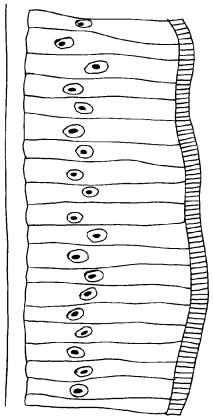

Fig. 4

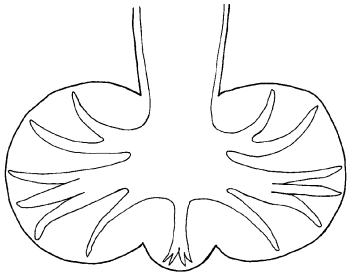

Fig. 5

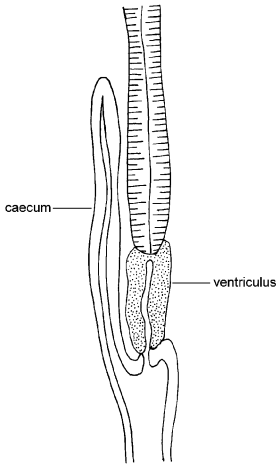

Fig. 6

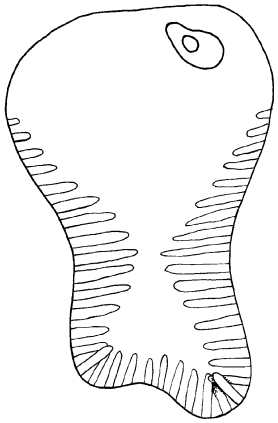

Fig. 7

copulatory bursa	see *bursa copulatrix*
cord (chord)	dorsal, ventral or lateral longitudinal thickenings of the hypodermis
cordon	longitudinal, cuticular cord-like thickening extending posteriorly from the mouth and may be straight, recurved or form loops, present mainly in the acuarioid Family Acuariidae
corona radiata	the border of the labial region divided into a series of leaf-like structures, found in certain strongyles. There may be two circles of leaf-like structures termed the internal and external corona (= internal and external leaf crowns of some authors)
corpus	anterior end of the oesophagus, often separated from the posterior bulb by the isthmus—see Fig. 11
deirids	a pair of sensory organs found laterally in the cervical region and usually protruding above the surface of the cuticle (= cervical papillae of some authors)
didelphic	with two sets of female reproductive organs
diorchic	with two testes
diverticulum	a tube or sac, blind at distal end, branching off from a canal or cavity
epaulets	specialized, ribbon-shaped, paired bands of cuticle at anterior end (= cordons of most authors)
genital papillae	tactile papillae or setae in the anal region of the male which may be pre-cloacal, post-cloacal or caudal in position (see also pedunculated papillae, plectanes, rosettes)
gubernaculum	an accessory male copulatory piece which is formed by sclerotization of the dorsal wall of the spicule pouch, variable in shape but generally with incurved margins
head papillae	tactile sense organs usually located on the lips or labial region, including two circles of six labial papillae and one circle of four cephalic papillae—see Fig. 8. *cephalic papillae*–outer circle of four head papillae (= latero-ventral and latero-dorsal of Chitwood & Wehr 1934)—see Fig. 8. *Externo-labial papillae*–median circle of six head papillae (= dorso-dorsal, ventro-ventral and ventro-lateral of Chitwood & Wehr 1934)—see Fig. 8. *Interno-labial papillae*–inner circle of six head papilla—see Fig. 8
†hemizonid	a band of highly refractive tissue near the excretory pore formed by subventral commissures connecting the nerve ring to the ventral nerve cord

†hologonic	condition in which germ cells proliferate throughout the length of an ovary or testis (*cf* telogonic)
interlabia	cuticular outgrowths (neoformations) originating at the base of the lips or pseudolabia and extending between them, occurring in some ascaridids and spirurids

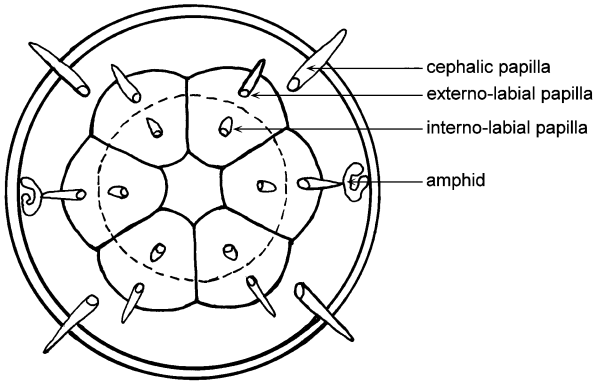

Fig. 8

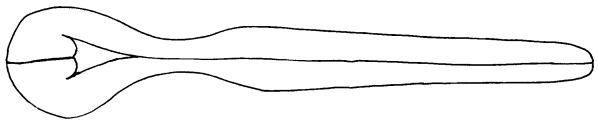

Fig. 9

isthmus	middle part of a muscular oesophagus, often constricted—see Fig. 11
labia	lobes or lips (primitively six) which surround the mouth
†mesostom(e)	third portion of the buccal cavity of a rhabditid-like nematode
†metastom(e)	fourth portion of the buccal cavity of a rhabditid-like nematode
monodelphic	with one set of female reproductive organs
monorchic	with one testis
†mucron	terminal tail spine
oesophago-intestinal valve	situated at opening between the oesophagus and intestine (= cardia of some authors)
†oesophastom(e)	portion of the buccal cavity (stoma) surrounded by oesophageal tissue
opisthodelphic	uteri parallel, directed posteriad
ovijector	part of the female genital system between the end of the uterus and the vulva, modified (also spelt ovejector *in litt*.) to aid in the expulsion of eggs
oxyuroid (or bulboid) oesophagus	cylindrical anteriorly and terminating in a basal bulb—see Fig. 9
pedunculated papillae	modified, stalked, genital papillae in cloacal region of male
pharynx	narrow, posterior part of the buccal cavity with thick sclerotized walls
phasmids	pair of glandular sensory organs situated laterally in the caudal region and opening to the surface by a slit or pore
plaques	cuticular "warts"
platymyarian	body musculature consisting of cells not protruding individually into pseudocoelom—see Fig. 10
plectanes	cross striated cuticular plates functioning as supports for the genital papillae in some males
polydelphic	with more than two sets of female reproductive organs
pre-cloacal (pre-anal) sucker	ventral, pre-cloacal structure, sucker-like in form
preventriculus	proximal portion of the alimentary tract that, together with the ventriculus, comprises the oesophagus
prodelphic	uteri parallel, directed anteriad
prostom(e)	second portion of the buccal cavity of a rhabditid-like nematode
pseudobulb	muscular swelling of the oesophagus without valvular arrangement
pseudolabia	cuticular outgrowths (neoformations) arising around mouth opening and which, during development, overlie and then replace the primitive lips. The anterior extremity of numerous Rhabditida has two lateral pseudolabia (= probolae of some authors)

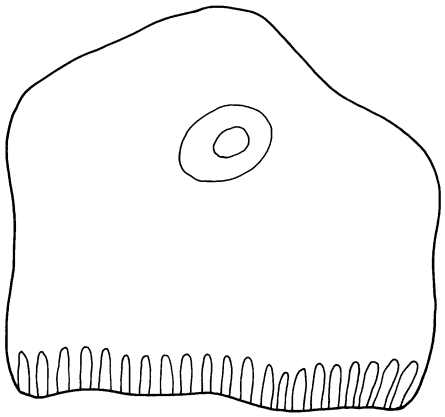

Fig. 10

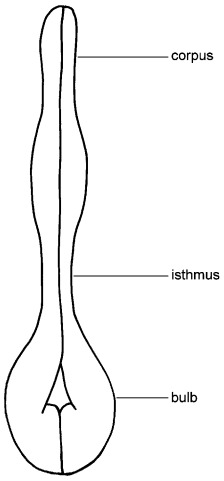

Fig. 11

rays	genital papillae and their accompanying muscles embedded in the bursa of some males
rhabditoid (rhabditiform) oesophagus	oesophagus consisting of two swellings, one forming the end of the corpus, the other posteriorly forming the bulb. The region between the corpus and the bulb is known as the isthmus—see Fig. 11
ridges	raised cuticular areas which run the length of the body, very pronounced in some trichostrongyloids—see Fig. 12
rosettes	punctation patterns of cuticle surrounding genital papillae
sarcoplasm	cytoplasm of any muscle cell
spicule	sclerotized, accessory copulatory organ of male nematodes, usually paired but sometimes single
stichocyte	glandular oesophageal cell not incorporated into oesophageal tissue—see Fig. 14
stichosome	collection of stichocytes arranged in a longitudinal row—see Fig. 14
stoma	see buccal cavity
striations	fine transverse grooves occurring at regular intervals—see Fig. 1
strongyloid (filariform) oesophagus	slender, cylindrical, without bulb—see Fig. 13
supplements	in males, ventro-median papillae anterior to cloaca, as well as an ad-cloacal pair of papillae in some nematodes
synlophe	the ensemble of enlarged longitudinal or oblique cuticular ridges which serve to hold the nematodes in place on the gut wall, found in numerous trichostrongylids
telamon	slightly sclerotized, immovable formation of complicated shape in the ventral and lateral cloacal walls that also aids in directing the spicules during copulation
†telogonic	condition in which germ cells proliferate only from the blind proximal end of an ovary or testis (*cf* hologonic)
telostom(e)	most posterior (fifth) portion of the buccal cavity of a rhabditid-like nematode
trichuroid oesophagus	narrow muscular tube with associated glandular stichosome made up of stichocytes—see Fig. 14
trophosome	reserve organ formed by the transformation of the digestive canal; often appears to be syncytial
ventriculus	glandular modification of the distal portion of the oesophagus of some nematodes; it may have a solid appendage of varying length extending posteriorly dorsal to the intestine (ventricular appendix)
†vestibule	anterior portion of buccal cavity

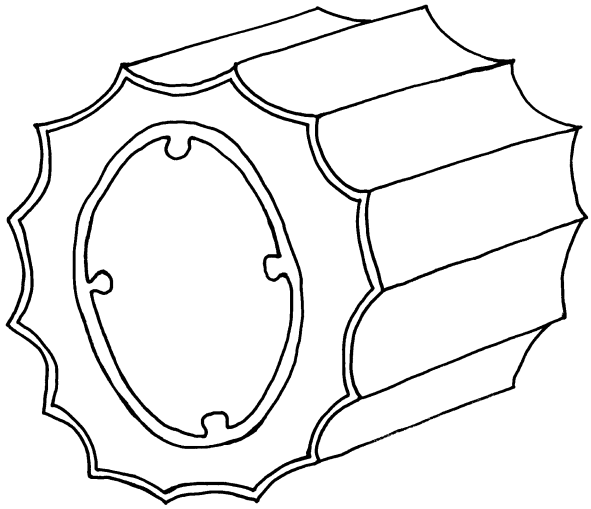

Fig. 12

Fig. 13

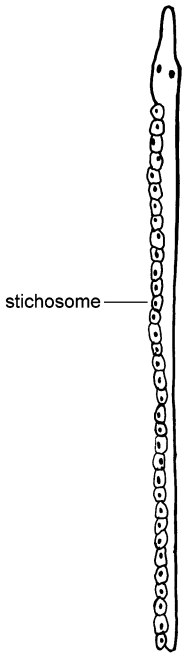

Fig. 14

Keys and descriptions

For reasons beyond the writers' control, it was impossible to standardise the format of keys and descriptions. For example, the descriptions of only some species warrant a preamble and/or subsequent comments. Furthermore, only ranges in length are given in the original descriptions for most species. For those few species where measurements of the holotype, a paratype or an allotype were provided, these are given in parentheses. It is also relevant to note that some nematode species are relatively rare, and that males are unknown for certain philometrids.

Measurements are given in mm unless otherwise stated. Readers should note that the scale bars given for some illustrations are in µm or cm rather than mm, and that some Figures lack scale bars because they were not provided in the original description.

Nematode and other taxonomists have used a variety of styles to illustrate new taxa. Efforts have been made here to standardise the manner in which some organs are portrayed in the Figures—the muscular oesophagus, glandular oesophagus, intestine, and nerve ring in particular.

Those Figures where only the vaginal/vulvar region is illustrated bear the abbreviation "ant" for anterior in the appropriate place lest the anterior-posterior orientation of a female worm is in doubt.

HIGHER CLASSIFICATION of the PHYLUM NEMATODA POTTS 1932, ACCORDING to De LEY & BLAXTER 2002

(Only those Families with representatives parasitic in Canadian fishes are included)
Class Enoplea Inglis, 1983
Subclass Dorylaimia Inglis, 1983
Order Dioctophymatida Baylis & Daubney, 1926

Suborder Dioctophymatina Skryabin, 1927
Family Dioctophymatidae Castellani & Chalmers, 1910
Order Trichinellida Hall, 1916
Superfamily Trichinelloidea Ward, 1907
Family Capillariidae Railliet, 1915
Family Cystoopsidae Skryabin, 1923
Family Trichosomoididae Hall, 1916
Class Chromadorea Inglis, 1983
Subclass Chromadoria Pearse, 1942
Order Rhabditida Chitwood, 1933
Suborder Spirurina Railliet & Henry, 1915
Superfamily Anguillicoloidea Yamaguti, 1935 [*incerta sedis*]
Family Anguillicolidae Yamaguti, 1935
Superfamily Dracunculoidea Stiles, 1907 [*incerta sedis*]
Family Philometridae Baylis & Daubney, 1926
Family Guyanemidae Petter, 1975
Family Daniconematidae Moravec & Køie, 1987
Infraorder Gnathostomatomorpha De Ley & Blaxter, 2002
Superfamily Gnathostomatoidea Railliet, 1895
Family Gnathostomatidae Railliet, 1895
Infraorder Oxyuridomorpha De Ley & Blaxter, 2002
Superfamily Oxyuroidea Cobbold, 1864
Family Oxyuridae Cobbold, 1864
Infraorder Spiruromorpha De Ley & Blaxter, 2002
Superfamily Camallanoidea Railliet & Henry, 1915
Family Camallanidae Railliet & Henry, 1915
Superfamily Thelazioidea Skryabin, 1915
Family Rhabdochonidae Travassos, Artigas & Pereira, 1928
Superfamily Spiruroidea Orley, 1885
Family Spiruridae Orley, 1885
Superfamily Habronematoidea Chitwood & Wehr, 1932
Family Hedruridae Railliet, 1916
Family Tetrameridae Travassos, 1914
Family Cystidicolidae Skryabin, 1946
Superfamily Acuarioidea Railliet, Henry & Sisoff, 1912
Family Acuariidae Railliet, Henry & Sisoff, 1912
Infraorder Ascaridomorpha De Ley & Blaxter, 2002
Superfamily Ascaridoidea Baird, 1853
Family Raphidascarididae Hartwich, 1954*
Family Anisakidae Railliet & Henry, 1912
Family Acanthocheilidae Wülker, 1929
Superfamily Seuratoidea Hall, 1916
Family Cucullanidae Cobbold, 1864
Family Quimperiidae Gendre, 1928
Superfamily Metastrongyloidea Cram, 1927
Family Pseudaliidae Railliet, 1916

*but see page 7 above

Phylum NEMATODA Potts, 1932: diagnosis

Known commonly as nematodes, eelworms, threadworms or roundworms, members of the Phylum Nematoda are probably the most abundant multicellular animals on earth. Free-living species occur in terrestrial, fresh-water,

brackish or marine environments. Parasitic species (facultative or obligate) live in association with plants, or with invertebrate and vertebrate animals, including humans. Life cycles of nematodes parasitic in animals or humans may be direct or involve two or more hosts. Usually unsegmented, round or ovoid in cross section, and tapered at both ends, nematodes range from less than one millimetre to over eight metres long. Female adults are usually larger than male adults. The anterior end is radially symmetrical but most organs are bilaterally symmetrical. A non-cellular cuticle, secreted by syncytial hypodermis, is shed four times during ontogeny. The hypodermis usually has four cords (chords): one dorsal, one ventral, and two lateral. Body-wall musculature one layer thick, longitudinal only. Pseudocoelom derived from embryonic blastocoel. Various external sensillae and ornamentations, including papillae, setae, amphids, phasmids, and annulations present or absent. Ganglia are associated with a circumpharyngeal nerve ring. Usually four major longitudinal nerves are present: one ventral, one dorsal, and at least one pair lateral. Mouth anterior, the anus at or near the posterior end. In some parasitic nematodes the pharynx is transformed into a glandular organ (stichosome), or mid-gut into a reserve organ (trophosome). In some nematodes the oesophagus is divided into an anterior muscular portion and a posterior glandular portion. The excretory-secretory system is glandular or tubular, a ventral pore opening near the anterior end [this system is referred to as the excretory system/pore/duct/cell throughout the rest of this part of the Guide]. Most nematodes are dioecious, some hermaphroditic or parthenogenetic. Most are oviparous, some ovoviviparous. Females usually have two ovaries, though there may be from one to six or more, and the female pore opens ventrally. The male system, usually with two testes, opens with anus into cloaca. Male tail curved or broadened into a fan-shaped bursa usually with one or two chitinized spicules; spicules sometimes absent. During copulation spicule or spicules enter the female pore, and amoeboid sperm are transferred.

KEYS to NEMATODA

The following keys are designed to aid identification of larval and/or adult nematodes recovered from Canadian fishes from any aquatic environment, be it fresh water, brackish water or marine. The keys may be unsuitable for identifying material from other areas.

A single asterisk (*) preceding a nematode's scientific name denotes that the taxon has been recorded only in its larval stage in given fish host(s), a double asterisk (**) denotes records of both larvae and adults in given host(s), whilst an unadorned taxon denotes records of only adults in given host(s).

Key to Classes of NEMATODA

1 Phasmids absent; amphids pocket-like; caudal papillae absent or few in number; oesophagus cylindrical or with oesophageal glands free in the pseudocoelom forming a stichosome; excretory system without lateral canals, terminal duct not lined with cuticle . . . . . Enoplea

\- Phasmids present; amphids pore-like; caudal papillae usually numerous (basic number 21); oesophagus never in the form of a stichosome; excretory system with lateral canals, terminal duct lined with cuticle . . . . . Chromadorea

Key to Orders of the Class ENOPLEA and Subclass DORYLAIMIA

1 Oesophagus cylindrical and well developed; stichosome or trophosome absent; monodelphic. . . . . .Dioctophymatida Baylis & Daubney, 1926

\- Stichosome or trophosome present; intestine and rectum well developed; sexes separate; monodelphic . . . . . .Trichinellida Hall, 1916

Comments. dioctophymatid nematodes that occur in Canadian fishes are larval stages representing the Suborder Dioctophymatina Skryabin, 1927 (Family Dioctophymatidae Castellani & Chalmers, 1910). A key to the genera of this Family is given below.

Key to genera of larvae in the Family DIOCTOPHYMATIDAE

1 L3 encapsulated in fish hosts, mostly in hypaxial musculature; six inner labial papillae single and button-like, with central pore-like depression; outer six labial papillae twice as large as the inner, four of them single and two double. Male L3: mean 5.9 (range 4.1–7.4) long; width at oesophago-intestinal junction 0.15 (0.11–0.19). Female L3: 6.5 (5.1–8.6) long; width at oesophago-intestinal junction 0.18 (0.16–0.20); vulva just behind oesophago-intestinal valve. Intestinal region of live L3 red in colour. . . . . **Dioctophyme*

- L3 and L4 encapsulated in fish hosts, on mesenteries; six inner labial papillae single with narrow bases and spike-like apices; four of six outer labial papillae single, two of them double, with broad bases and nipple-like apices. Outer labial papillae double. Male L3: 21.3 (12.0–29.7) long; width at oesophago-intestinal junction 0.22 (0.14–0.30). Female L3: 21.5 (11.5–34.8) long; width at oesophago-intestinal junction 0.21 (0.10–0.30). Male L4: 55.1 (32.2–66.0) long; width at oesophago-intestinal junction 0.35 (0.29–0.40). Female L4: 69.5 (45.1–83.4) long; width at oesophago-intestinal junction 0.42 (0.37–0.46); vulva just behind intestine-rectal junction. Live L3 white or pink in colour, live L4 bright red in colour. . . . . **Eustrongylides*

**Dioctophyme* Collet-Meygret, 1802

Generic diagnosis (after Mace & Anderson 1975, and Measures & Anderson 1985). Dioctophymatidae. Encapsulated L3 occur most commonly in hypaxial musculature of fishes, some in body cavity. Two circles of labial papillae surround mouth. Inner circle comprises six single papillae. Outer circle comprises four single and two double papillae. Amphids situated laterally between the interno- and externo-lateral papillae (Fig. 15A). Three large cells (one dorsal, two subventral) surround narrow buccal capsule and anterior end of oesophagus (Fig. 15B). Average length of oesophagus about 40% of total body length. A large circular muscle constitutes the oesophago-intestinal sphincter (Fig. 15C). For length and width of male L3 from pumpkinseed *Lepomis gibbosus* see key above. Genital primordium diorchic and opisthorchic. For length and width of female L3 from pumpkinseed see key above. Vagina evident; non-patent vulva near oesophago-intestinal valve. Genital primordium monodelphic and opisthodelphic. Anus terminal in both sexes. Cuticles of 1st and 2nd moults retained.

One species, **D. renale*, has been found as L3 in Canadian fresh-water fishes. Adult *D. renale* occur in the kidneys of piscivorous mammals, especially mustelids and wild canids.

**Dioctophyme renale* (Goeze, 1782) Stiles, 1901

Sites: musculature, mesenteries, viscera
Hosts: *Ameiurus nebulosus* (1, 2); *Lepomis gibbosus* (2)
Distribution: Ontario
Records: 1. Mace & Anderson 1975; 2. Measures & Anderson 1985

**Dioctophyme* sp.

Site: body cavity
Host: *Micropterus salmoides*
Distribution: Ontario
Record: Bangham & Hunter 1939

**Eustrongylides* Jägerskiöld, 1909

Generic diagnosis (after Measures 1988b). Dioctophymatidae. Encapsulated L3 and L4 occur on mesenteries of fish hosts, including pumpkinseed *Lepomis gibbosus*, rock bass *Ambloplites rupestris*, and yellow perch *Perca flavescens*. L3 retain 2nd stage cuticle. Two circles of labial papillae surround mouth. Six papillae of the inner circle single with narrow bases and spike-like apices. Six papillae of outer circle have broad bases and nipple-like apices. In males the spicule primordium enters rectum dorsally (Fig. 16A); genital primordium enters ventrally, and

extends anteriad almost to oesophago-intestinal valve where it curves posteriad and terminates bluntly. Caudal sucker of males more developed in L4 than in L3. In females, genital primordium extends anteriad (Fig. 16B), and curves posteriad, with its blunt extremity ending behind intestine-rectal junction. For length and width of male and female L3 see key above. L4 retain 2nd and 3rd stage cuticles. Labial papillae of L4 similar in shape and position to those of L3 but larger and more prominent (Fig. 16C). Male and female genital primordia include thin-walled hologonic testis and ovary respectively. For length and width of male and female L4 see key above. One species, **E. tubifex*, has been found as L3 and L4 in various Canadian fresh-water fishes. Adult *E. tubifex* occur in the proventriculus of mergansers and other piscivorous birds.

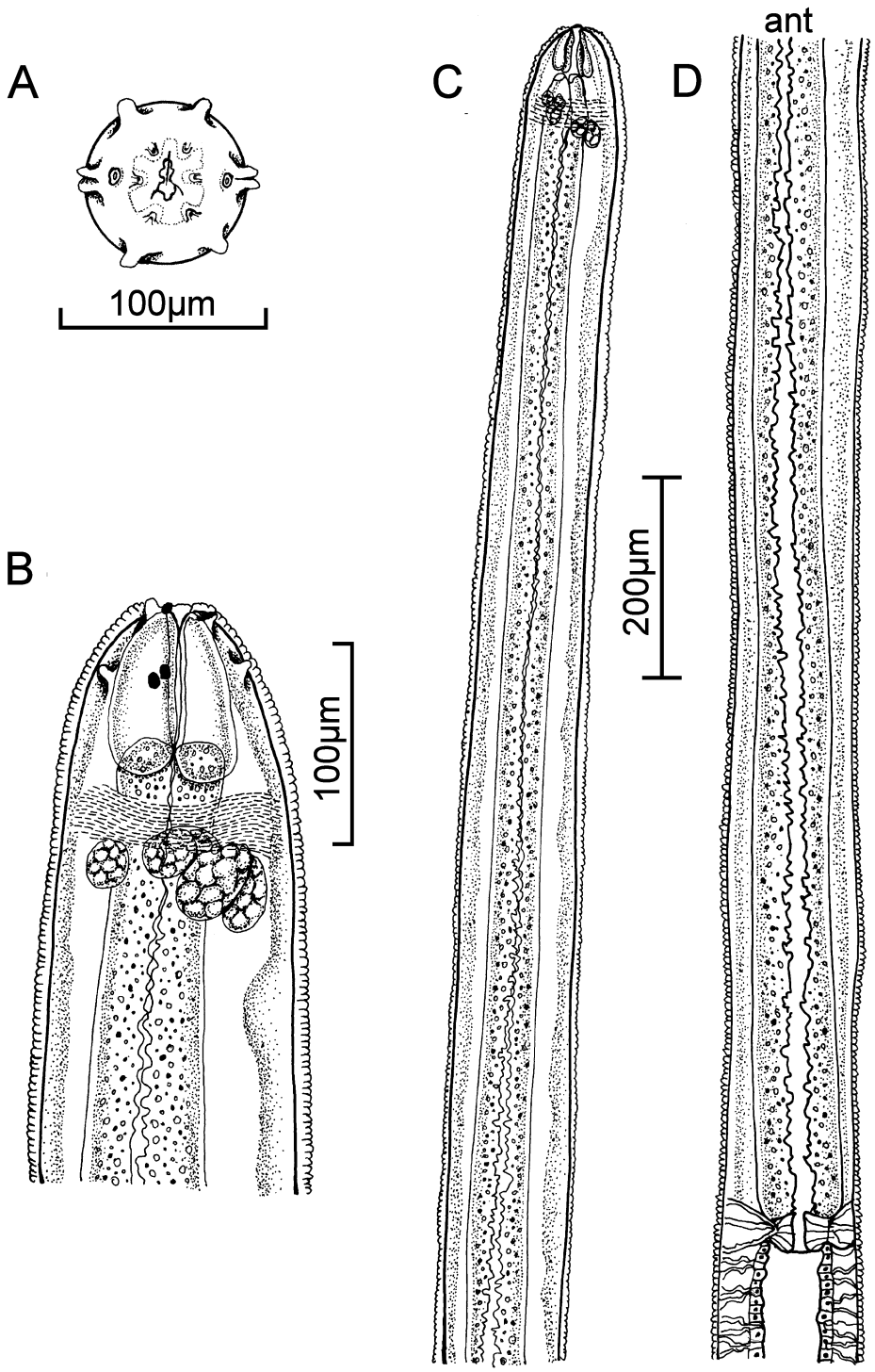

FIGURE 15. **Dioctophyme renale* (Goeze, 1782) Stiles, 1901. A. *en face* view of larva; B. anterior end of larva; C. and D. (contiguous) anterior third of larva. (Redrawn from Mace & Anderson 1975)

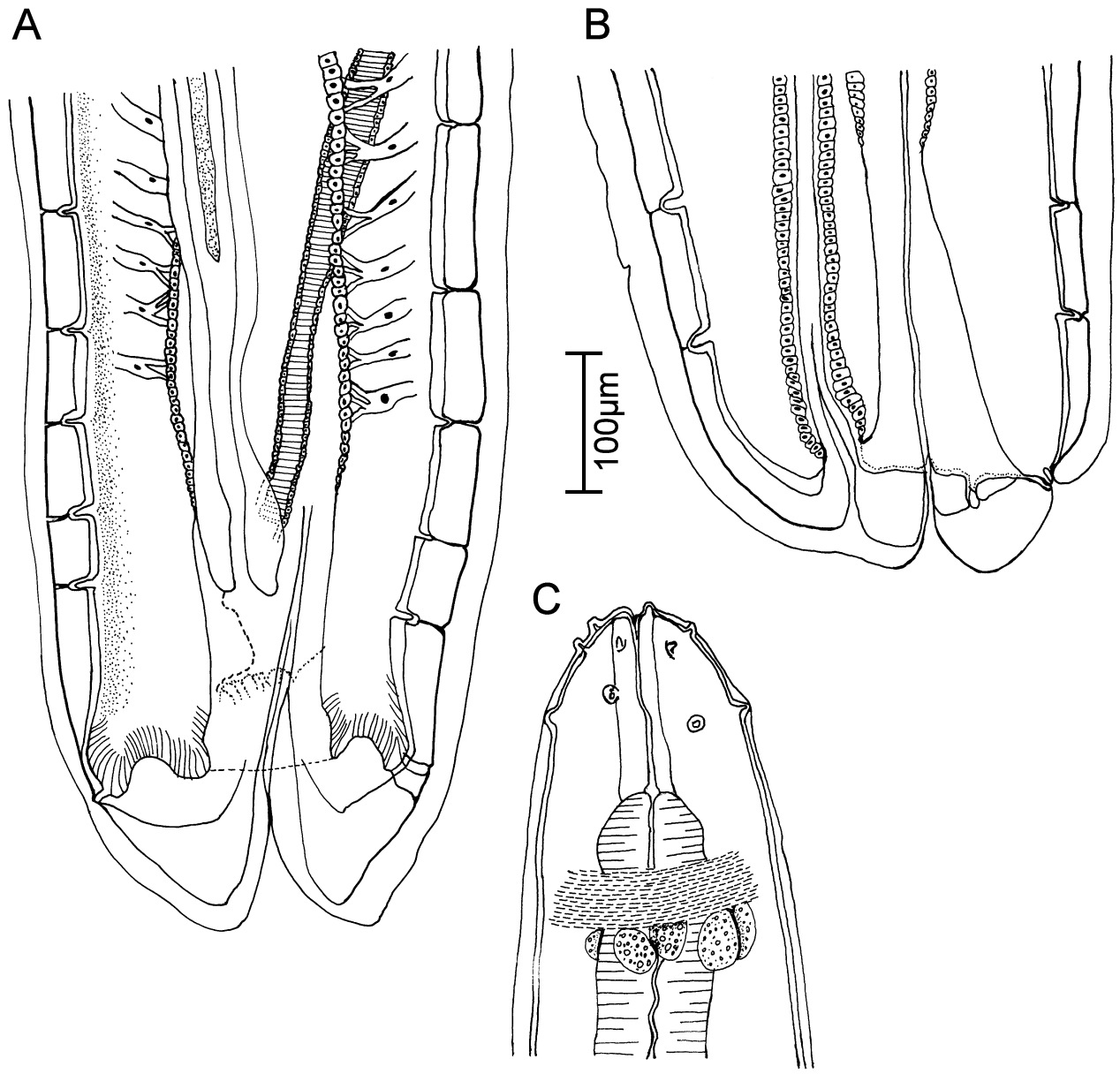

FIGURE 16. **Eustrongylides tubifex* Jägerskiöld, 1909. A. male larva, posterior end, dorsal view; B. female larva, posterior end, lateral view; C. male larva, anterior end, dorsal view. (Redrawn from Measures 1988b)

**Eustrongylides tubifex* (Nitzsch, 1819) Jagerskiöld, 1909

Site: mesenteries

Hosts: *Ambloplites rupestris* (1, 2, 3, 4); *Ameiurus nebulosus* (4, 8); *Aplodinotus grunniens* (4, 6); *Catostomus catostomus* (8); *Catostomus commersonii* (3, 6, 8); *Culaea inconstans* (8); *Fundulus diaphanus* (5); *Ictalurus punctatus* (6); *Lepomis gibbosus* (1, 2, 3, 4, 8); *Micropterus dolomieu* (4, 5, 6); *Morone americana* (4); *Morone chrysops* (6); *Oncorhynchus mykiss* (7); *Perca flavescens* (1, 2, 3, 4, 5, 6, 8); *Sander vitreus* (4); unspecified "fish" (7)

Distribution: Ontario

Records: 1. Measures 1987 (ON); 2. Measures 1988a (ON); 3. Measures 1988b (ON); 4. Dechtiar & Christie 1988 (ON) ; 5. Dechtiar *et al.* 1988 (ON); 6. Dechtiar & Nepszy 1988 (ON); 7. Measures 1988c (EX, ON); 8. Dechtiar *et al.* 1989 (ON)

***Eustrongylides* sp.**

Sites: body cavity, musculature, ovaries, viscera

Hosts: *Catostomus commersonii* (1, 2, 3, 21); *Catostomus macrocheilus* (3); *Cottus asper* (3, 15); *Cottus cognatus* (12, 14); *Gasterosteus aculeatus* (3, 7, 9, 22); *Entosphenus tridentatus* (3); *Lepomis gibbosus* (11); *Lota lota* (12, 13, 14, 15); *Mylocheilus caurinus* (3, 14); *Oncorhynchus clarkii* (3, 10); *Oncorhynchus kisutch* (4); *Oncorhynchus mykiss* (10, 12, 14, 15); *Perca flavescens* (5, 6, 8); *Prosopium cylindraceum* (3); *Prosopium williamsoni* (3, 12, 13, 14, 15, 20); *Ptychocheilus oregonensis* (12, 13, 14, 15); *Salvelinus fontinalis* (16, 17, 18, 19); *Salvelinus malma* (3, 12, 14); *Salvelinus namaycush* (3, 15); *Sander canadensis* (5, 6); *Sander vitreus* (6)

Distribution: British Columbia, New Brunswick, Ontario, Quebec

Records: 1. Bangham 1941 (ON); 2. Bangham & Venard 1946 (ON); 3. Bangham & Adams 1954 (ON); 4. Godfrey 1968 (BC); 5. Dechtiar 1972a (ON); 6. Dechtiar 1972b (ON); 7. Hanek & Molnar 1974 (QC); 8. Molnar *et al.* 1974 (ON); 9. Lester 1974 (BC); 10. Hoskins *et al.* 1976 (BC); 11. Cone & Anderson 1977 (ON); 12. Anon. 1978 (ON); 13. Anon. 1981 (BC); 14. Arai & Mudry 1983 (BC); 15. Anon. 1984 (BC); 16. Frimeth 1986 (BC); 17. Frimeth 1987a (NB); 18. Frimeth 1987b (NB); 19. Marcogliese & Cone 1991a (NB); 20. Nener *et al*. 1995 (BC); 21. Couillard *et al.* 1995 (QC); 22. Reimchen 1997 (BC)

Key to Families of the Order TRICHINELLIDA

1	Digestive tract complete; anus present; vulva near end of oesophagus	2
-	Digestive tract incomplete; anus absent; intestine dilated into sac or modified to form trophosome; vulva near nerve ring	3
2	Spicule and spicular sheath present; stichocytes regularly aligned throughout length of oesophagus	Capillariidae
-	Spicule and spicular sheath absent or vestigial; stichocytes irregularly aligned in posterior region of oesophagus	Trichosomoididae
3	Female body divided into thin, anterior region and posterior globular region; stichocytes unicellular; spicule present, spicular sheath poorly developed	Cystoopsidae

Family CYSTOOPSIDAE Skryabin, 1923

Family diagnosis (after Moravec 2001). Cystoopsidae. Anus atrophied. Adults with pronounced sexual dimorphism. Male body cylindrical. Body of female divided into thread-like anterior region and globular posterior region. Anterior part of body bears transverse rings of numerous minute cuticular tubercles. Oesophagus divided into short anterior muscular portion and long posterior glandular portion.

One genus, *Cystoopsis* Wagner, 1867, is known from one fish species in Canada. The genus is represented by one species, *C. acipenseris*.

Cystoopsis acipenseris Wagner, 1867

Description (after Moravec 2001). Head rounded in both sexes. Mouth opening triangular, surrounded by ring mound with 10 small teeth. Four small cephalic papillae, and pair of lateral amphids. Anterior muscular portion of oesophagus well developed, posterior glandular portion comprising two longitudinal rows of stichocytes (Fig. 17A). Intestine in both sexes ends blindly.

Males: body cylindrical, both ends rounded, 2.10–3.00 long, 0.017–0.024 wide. Cuticle with fine cuticular tubercles. Muscular oesophagus 0.27–0.28 long, glandular one 0.70–0.73 long. Nerve ring encircles muscular oesophagus slightly behind its proximal end. Testis convoluted, filling entire body-cavity. Spicule fine, moderately sclerotized, 0.23–0.26 long. Spicular sheath present (Fig. 17B).

Females: anterior body region thread-like 2.48–2.74 long, posterior globular region 5.0–6.0 in diameter (Fig. 17C). Anterior cuticle with transverse rings of minute tubercles. Muscular oesophagus 0.54–0.57 long, glandular one 1.09–1.18 long. Oesophago-intestinal junction in anterior body region. Intestine continues into posterior globular region ending blindly as a sac 2.0–2.5 wide. Nerve ring 0.48–0.52 from anterior end. Vulva 0.080–0.120 from anterior end (Fig.17A). Muscular vagina passes through thread-like body region. Uterine coils, ovary and

oesophagus fill body-cavity in posterior body region. Uterus contains many eggs at different stages of development, mature ones containing formed larvae. Mature eggs thin-walled with smooth surface, barrel-shaped with polar plugs, 0.063–0.068 x 0.021–0.025 (Fig. 17D).
Site: subcutaneous
Host: *Acipenser transmontanus* (1, 2)
Distribution: British Columbia
Records: 1. Margolis & McDonald 1986; 2. McDonald *et al.* 1989

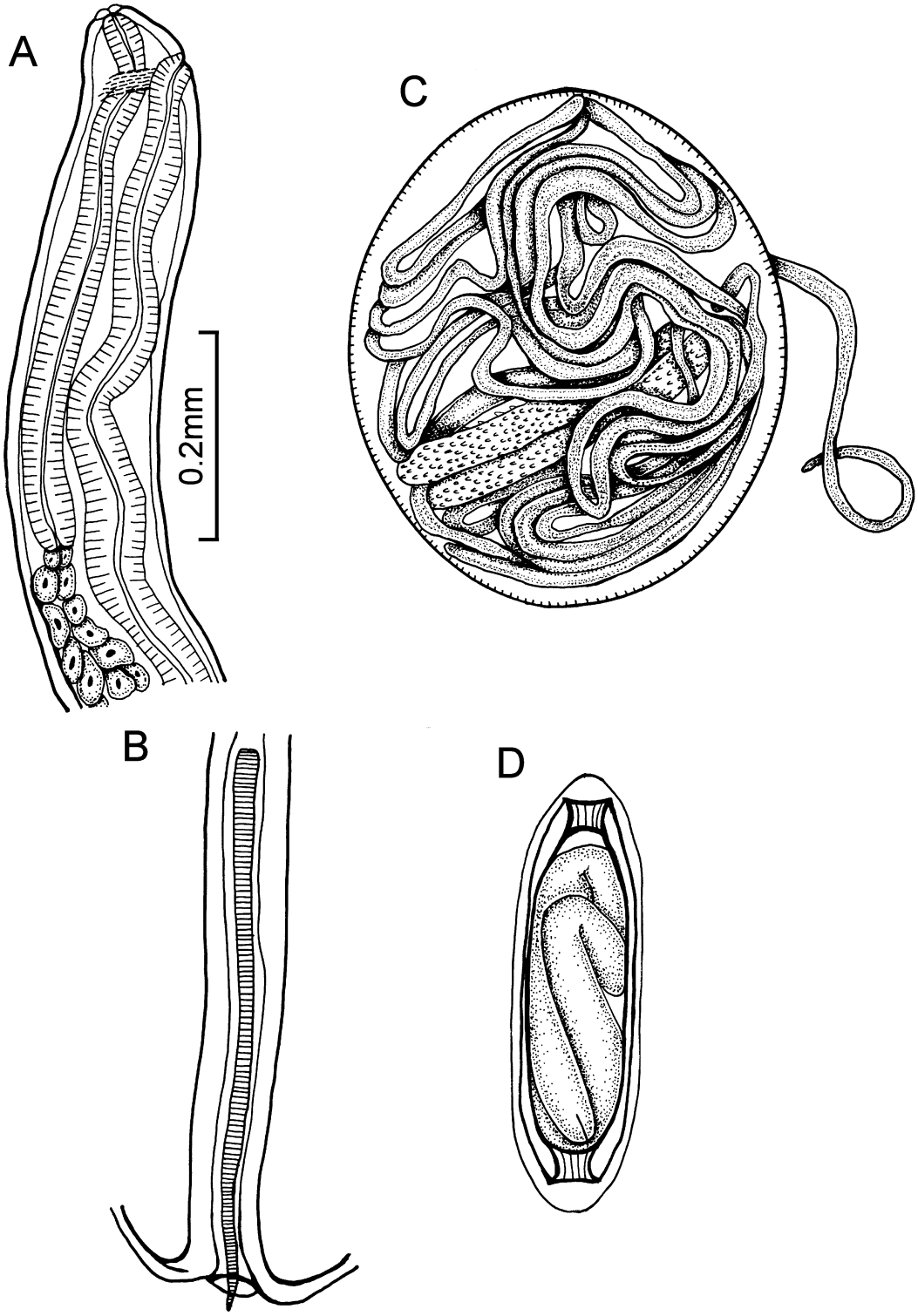

FIGURE 17. *Cystoopsis acipenseri* Wagner, 1867. A. female, anterior end; B. spicule; C. entire female; D. egg. NB: scale bars were not provided in the original for B., C. or D. (Redrawn from Moravec 2001)

Family CAPILLARIIDAE Railliet, 1915

General characteristics (after Moravec 2001). Thread-like nematodes. Cuticle with longitudinal bacillary bands, usually two lateral, one dorsal and one ventral. One sclerotized spicule with smooth or spiny spicular sheath, able to invaginate or evaginate. Posterior end of male with or without small membranous bursa. Vulva near posterior end of oesophagus, sometimes with elevated lips. Eggs usually barrel-shaped with polar plugs, and a smooth or sculptured surface.

Key to genera of CAPILLARIIDAE

1 Spicular sheath covered with small spines 2
- Spicular sheath non-spiny 3
2 Male tail lacks membranous bursa; either two large caudal ventro-lateral lobes each with a papilla at the base, or lobes absent with only one pair of papillae; eggs with short polar plugs either not or only slightly protruding from egg shell. . . . *Capillaria*
- Male tail with membranous bursa supported by two lateral finger-shaped processes (rays) and one pair of papillae at their base; unpaired dorsal caudal projection present; polar plugs slightly protruding from egg shell . . . . . *Piscicapillaria*
3 Male tail with membranous bursa supported by two narrow digital projections (rays) adhering to rounded body end . . . . . *Paracapillaria*
- Male tail without membranous bursa but with two large, spherical ventro-lateral lobes bearing a pair of small indistinct papillae . . . . . *Pseudocapillaria*

Comments: Moravec (2001) recognized 13 subgenera—four of *Capillaria*, two of *Piscicapillaria*, three of *Paracapillaria*, and four of *Pseudocapillaria*. Two of the subgenera of *Capillaria*, one each of *Piscicapillaria* and *Paracapillaria*, and two of *Pseudocapillaria* are represented in Canadian fishes. Whilst the subgenera are given below, they do not need to be defined as the various species key out satisfactorily.

Capillaria Zeder, 1800

Generic diagnosis (after Moravec 2001). Capillariidae. Stichosome comprises one row of stichocytes. Lateral caudal alae absent from males. Posterior end of male rounded, usually with two lateral or ventro-lateral lobes. Membranous bursa absent. One pair of small papillae near cloacal opening. Spicule with many rough transverse grooves on surface. Spicular sheath spiny.

Key to species of *Capillaria*

1 Male tail with large ventro-lateral lobes, and large paired caudal papillae; gravid worms with vulvar appendage; parasitic in marine fishes 2
- Ventro-lateral lobes on male tail indistinct, and large paired caudal papillae; vulvar appendage absent; parasitic in fresh-water fishes 3
2 Spicule relatively short, *ca* 0.2 long. Pacific Ocean . . . . . *Capillaria* (*Procapillaria*) *margolisi*
- Spicule relatively long, *ca* 1.0–1.4 in length. Atlantic Ocean. . . . . *Capillaria* (*Procapillaria*) *gracilis*
3 Evaginated spicular sheath spiny proximally only; mature eggs with non-protruding polar plugs . . . . . *Capillaria* (*Capillaroides*) *catenata*

Capillaria (*Procapillaria*) *margolisi* Moravec & McDonald, 1981

Description (after Moravec 2001). With characteristics of the genus.

Males: Body length 13.57, maximum width 0.074. Muscular oesophagus 0.359 long, stichosome 8.94, 58 stichocytes. Nerve ring 0.161 from anterior end (Fig. 18A). Spicule well sclerotized with rough transverse grooves on middle third, 0.202 long (Fig. 18B). Cloaca opening subterminal. Tail rounded, 0.009 long, with a 0.023 long lobe on either side probably with submerged papillae (Fig. 18C). Pair of small sessile papillae just anterior to cloacal opening.

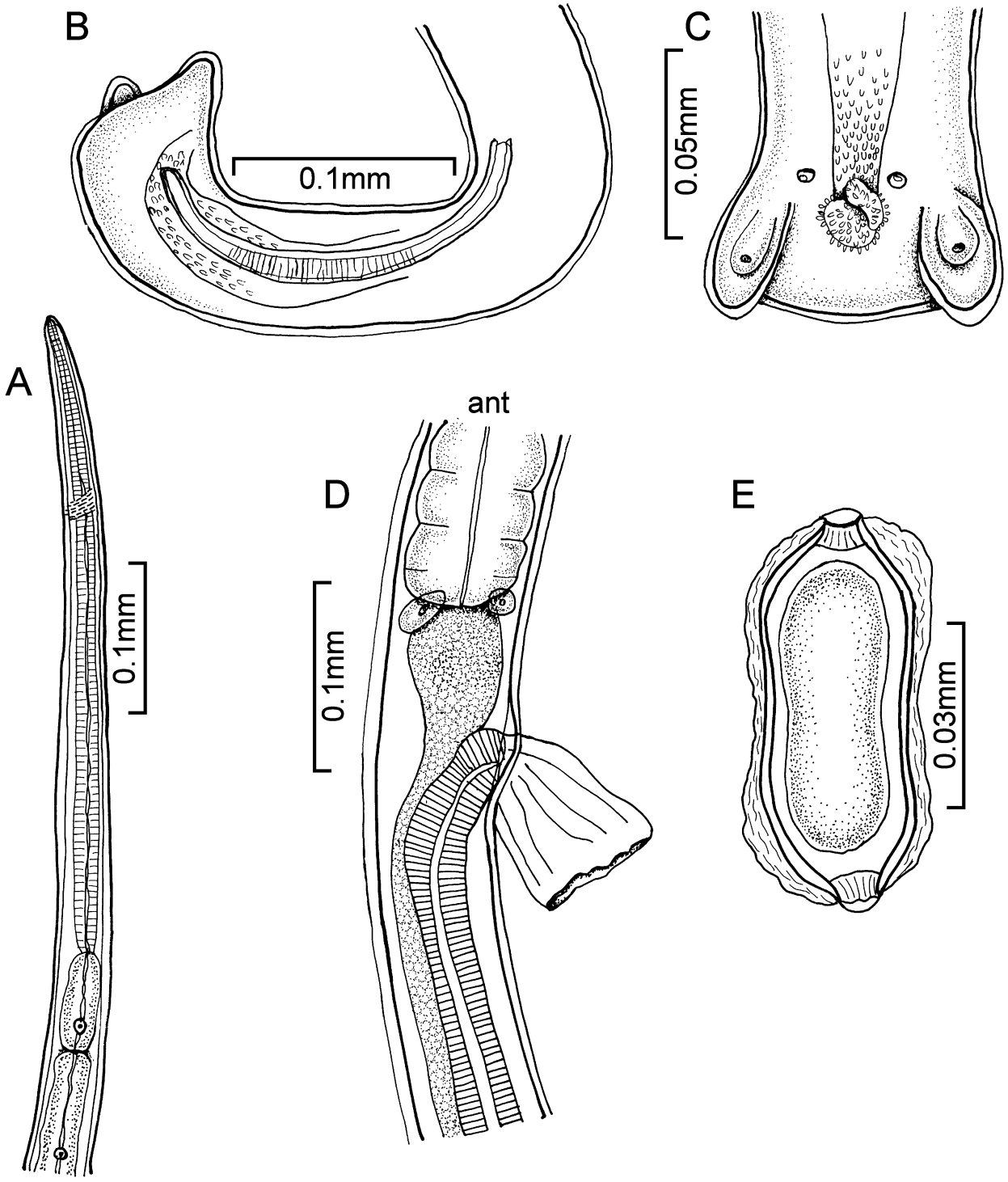

FIGURE 18. *Capillaria* (*Procapillaria*) *margolisi* Moravec & McDonald, 1981. A. anterior end; B. male, posterior end, lateral view; C. male, tail, ventral view; D. vulvar region; E. mature egg. (Redrawn from Moravec 2001)

Females: Gravid worms 18.58–21.76 long, maximum width 0.093–0.112. Muscular oesophagus 0.359–0.382 long, stichosome 8.73–9.92, 44 to 51 stichocytes. Nerve ring 0.115–0.129 from anterior end. Vulva near level of oesophago-intestinal junction (Fig. 18D). Uterus with many eggs in one row near vulva, two or more rows distally. Mature eggs 0.062–0.069 x 0.025–0.028 (Fig. 18E). Ovary reaching posteriad to about mid-region of rectum. Rectum 0.081–0.110 long. Anus subterminal, tail 0.012–0.021 long.

Site: pyloric caeca

Hosts: *Hippoglossus stenolepis* (2, 3, 4); *Scorpaenichthys marmoratus* (1)

Distribution: Pacific
Records: 1. Moravec & McDonald 1981; 2. Blaycock 1996; 3. Blaycock *et al.* 1998a; 4. Blaycock *et al.* 1998b

***Capillaria* (*Procapillaria*) *gracilis* (Bellingham, 1840) Travassos, 1915**

Synonym: *Capillaria kabatai* Inglis & Coles, 1963

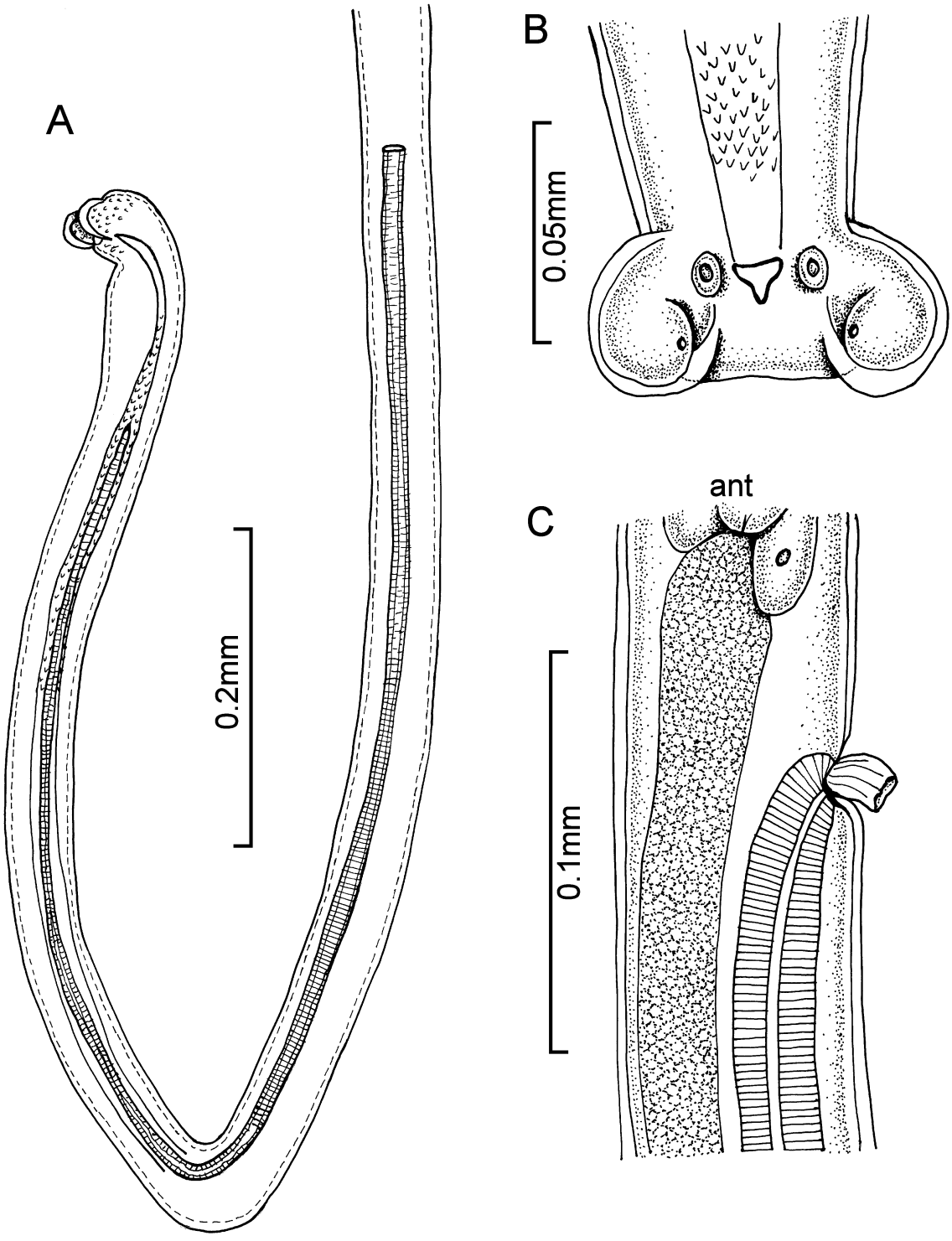

FIGURE 19. *Capillaria* (*Procapillaria*) *gracilis* (Bellingham, 1840) Travassos, 1915. A. male, posterior end; B. male, tail, ventral view; C. female, vulvar region with appendage. (Redrawn from Moravec 2001)

Description (after Moravec 2001). With characteristics of the genus.

Males: Body length 7.14–8.42 long, maximum width 0.041–0.054. Muscular oesophagus 0.180–0.396 long, stichosome 4.04–6.85, 47 stichocytes. Nerve ring 0.111 from anterior end. Spicule slender, 0.975–1.375 long, posterior half with rough transverse grooves (Fig. 19A). Cloaca opening subterminal. Tail rounded, 0.009–0.018 long, with ventro-lateral lobe, 0.018–0.027 long, on either side, each probably with a papilla (Fig. 19B). Pair of large sessile adcloacal papillae at lobe bases.

Females: Gravid worms 13.20–35.16 long, maximum width 0.068–0.095. Muscular oesophagus 0.225–0.450 long, stichosome 5.04–8.73, 38–51 stichocytes. Nerve ring 0.081–0.114 from anterior end. Vulva with appendage 0.027–0.123 behind oesophago-intestinal junction (Fig. 19C); rarely gravid females lack the appendage . Uterus with many eggs in one row near vulva. Mature eggs 0.072–0.090 x 0.027–0.036.

Site: intestine

Hosts: *Anarhichas lupus* (2); *Hippoglossoides platessoides* (2); *Hippoglossus hippoglossus* (2); *Macrourus berglax* (3); *Merluccius albidus* (4); *Merluccius bilinearis* (1); *Myoxocephalus octodecemspinosus* (5); *Nezumia bairdii* (3); *Urophycis chuss* (4); *Urophycis tenuis* (4)

Distribution: Atlantic

Records: 1. Gaevskaya & Umnova 1977; 2. Zubchenko 1980; 3. Zubchenko 1981a; 4. Scott 1987; 5. Moravec 1987

Capillaria (*Capillaroides*) *catenata* Van Cleave & Mueller, 1932

Synonym: *Capillaria* (*Thominx*) *catenata* Van Cleave & Mueller, 1932

Description (after Moravec 2001). With characteristics of the genus.

Males: 7.70–9.04 long, 0.068 maximum width. Entire oesophagus 5.90–6.48 long, 40 stichocytes. Spicule apparently weakly sclerotized, 0.399–0.465 long, covered with transverse grooves except at extremities (Fig. 20A). Posterior end rounded, somewhat inflated both sides, with two large ventro-lateral papillae. Cloacal opening subterminal, tail 0.018 long.

Females: Gravid worms 10.98–12.27 long, maximum width 0.068–0.095. Muscular oesophagus 0.210–0.300 long, stichosome 5.60–6.29 long, 40–44 stichocytes. Nerve ring 0.063–0.096 from anterior end. Vulva 0.009–0.090 behind oesophago-intestinal junction, its lips not elevated. Vulvar appendage absent (Fig. 20B). Relatively few eggs (*ca* 10) in uterus, in one row. Eggs 0.057–0.060 x 0.030–0.039 (possibly expanded by coverslip pressure).

Site: intestine

Hosts: *Ambloplites rupestris* (2); *Catostomus commersoni* (1); *Oncorhynchus nerka* (3, 4); *Osmerus mordax* (3, 4)

Distribution: Ontario, Quebec

Records: 1. Fantham & Porter 1948 (QC); 2. Dechtiar 1972a (ON); 3. Collins & Dechtiar 1974 (ON); 4. Dechtiar *et al.* 1988 (ON)

Capillaria sp.

Sites: intestine, stomach

Hosts: *Ameiurus nebulosus* (1); *Anoplopoma fimbria* (11); *Apodichthys flavidus* (5); *Artedius harringtoni* (4); *Chitonotus pugetensis* (5); *Cryptacanthodes giganteus* (3); *Gadus morhua* (7, 10); *Hemilepidotus hemilepidotus* (4); *Hexagrammos lagocephalus* (4); *Lycodes brevipes* (5); *Malacocottus kincaidi* (5); *Melanogrammus aeglefinus* (8, 9); *Micropterus dolomieu* (1); *Myoxocephalus polyacanthocephalus* (4); *Oncorhynchus kisutch* (4, 5); *Oncorhynchus tshawytscha* (5); *Paraplagusia bilineata* (2, 4, 5); *Parophrys vetulus* (2, 3); *Sebastes alutus* (6); *Sebastes babcocki* (6); *Sebastes borealis* (6); *Sebastes caurinus* (6); *Sebastes flavidus* (6); *Sebastes maliger* (6); *Sebastes nigrocinctus* (6); *Sebastes paucispinis* (6); *Sebastes ruberrimus* (2, 6)

Distribution: Atlantic, Ontario, Pacific

Records: 1. Bangham 1941 (ON); 2. Margolis 1952a (PA); 3. Margolis 1952b (PA); 4. Arai 1967a (PA); 5. Arai 1969 (PA); 6. Sekerak & Arai 1977 (PA); 7. Appy 1981 (AT); 8. Scott 1981 (AT); 9. Scott 1982 (AT); 10. Appy & Burt 1982 (AT); 11. Kabata & Whitaker 1984 (PA)

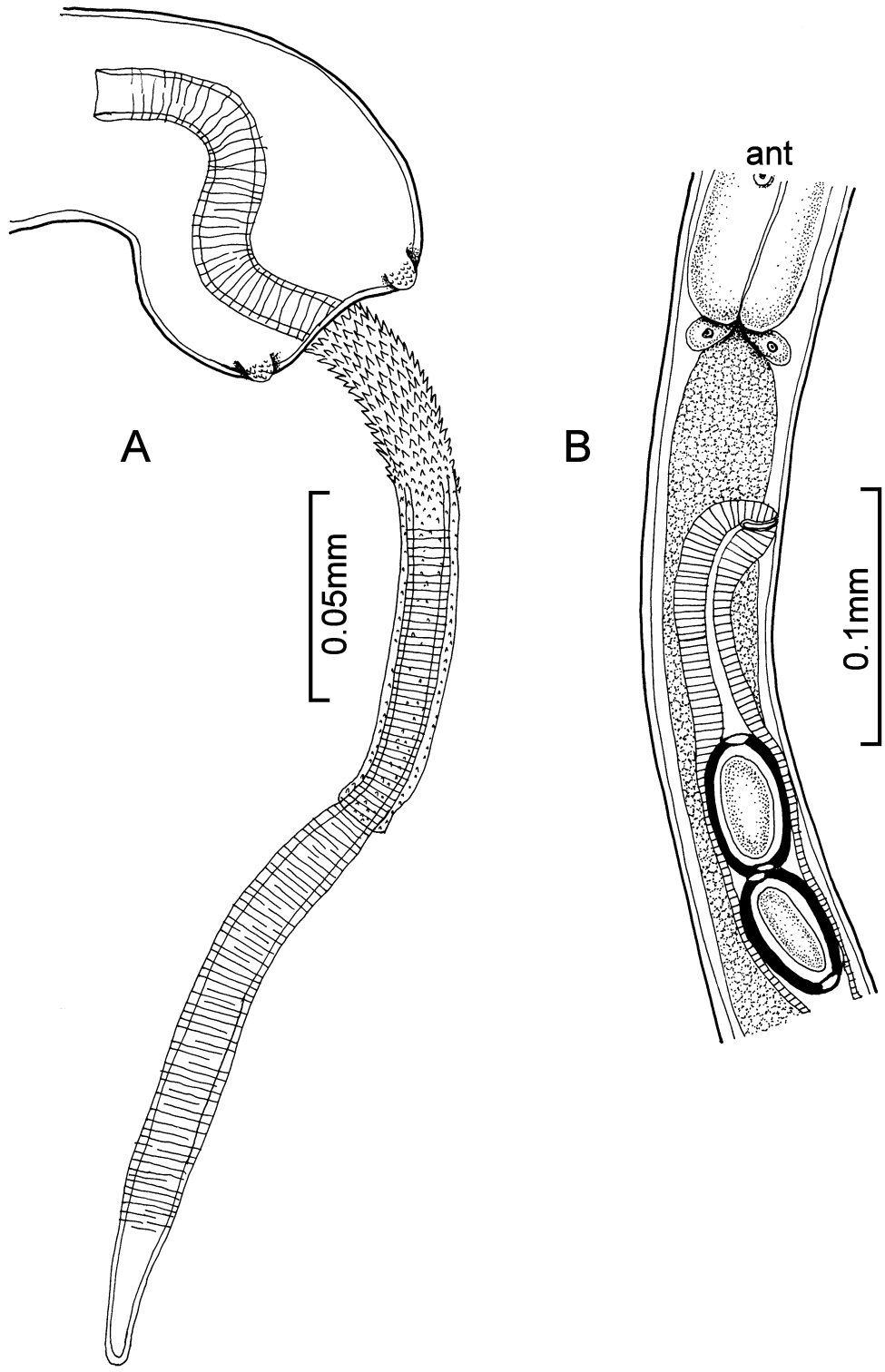

FIGURE 20. *Capillaria* (*Capillaroides*) *catenata* Van Cleave & Mueller, 1932. A. male, posterior end with evaginated spicular sheath and protruding spicules; B. female, vulvar region. (Redrawn from Moravec 2001)

Capillariidae gen. sp.

Site: alimentary tract
Hosts: *Mylocheilus caurinus* ; *Oncorhynchus mykiss*; *Ptychocheilus oregonensis*

Distribution: British Columbia
Record: 1. Anon. 1984

Piscicapillaria Moravec 1982

Generic diagnosis (after Moravec 2001). Capillariidae. Stichosome comprises one row of stichocytes. Males lack lateral caudal alae. Spicular sheath spiny. Small membranous bursa supported by pair of dorso-lateral digital projections (rays), curved along margin of bursa to dorsal side, and an unpaired dorsal caudal projection. One pair large caudal papillae present. Vulvar appendage absent.

One species, *Piscicapillaria* (*Piscicapillaria*) *freemani*, known from Canadian Pacific fishes.

Piscicapillaria (*Piscicapillaria*) *freemani* (Moravec, Margolis & McDonald, 1981) Moravec, 1982

Synonym: *Capillaria freemani* Moravec, Margolis & McDonald, 1981

Description (after Moravec 2001). With characteristics of the genus.

Males: Body length 13.35–25.76 long, maximum width 0.047–0.074. Muscular oesophagus 0.338–0.414 long, stichosome 6.09–11.35, 46–50 stichocytes. Nerve ring 0.081–0.092 from anterior end. Spicule 0.653–0.984 long, irregular transverse grooves on the third quarter of its length (Fig. 21A). Tail rounded. Wide membranous bursa supported by dorsal caudal projection and by a wide ray on each side, at the base of which is a large spherical papilla. Bursa 0.012–0.028 long (Fig. 21B).

Females: Vulva 0.041–0.108 below oesophago-intestinal junction, lips either not elevated or anterior one only slightly so (Fig. 21C). Mature eggs 0.078–0.090 x 0.028–0.035, polar plugs slightly protruding (Fig. 21D). Posterior end of ovary not reaching rectum, which is 0.083–0.150 long. Anus terminal.
Site: spiral valve
Hosts: *Bathyraja interrupta*; *Raja rhina*; *Raja stellulata*
Distribution: Pacific
Record: Moravec *et al.* 1981

Paracapillaria Mendonça, 1963

Generic diagnosis (after Moravec 2001). Capillariidae. Stichosome comprises one row of stichocytes. Males lack lateral caudal alae. Membranous bursa supported by two lateral digital processes (rays) bent along posterior border of bursa to dorsal side (Fig. 22A). Dorsal caudal projection absent. Pair of large sessile ad-cloacal or post-cloacal papillae present. Spicule without rough transverse grooves on surface. Spicular sheath non-spiny. Vulvar appendage absent.

One species, *Paracapillaria* (*Paracapillaria*) *parophrysi*, known from Canadian Pacific fishes.

Paracapillaria (*Paracapillaria*) *parophrysi* (Moravec, Margolis & McDonald, 1981) Moravec, 1982

Synonym: *Capillaria parophrysi* Moravec, Margolis & McDonald, 1981

Description (after Moravec 2001). With characteristics of the genus.

Males: Body length 3.98–5.74, maximum width 0.051–0.069. Muscular oesophagus 0.147–0.255 long, stichosome 1.86–2.22, 30–35 stichocytes. Nerve ring 0.060–0.078 from anterior end. Spicule well sclerotized, smooth, 0.281–0.373 long (Fig. 22B). Tail rounded, 0.009–0.014 long.

Females: Gravid worms 6.58–10.42 long, maximum width 0.056–0.093. Muscular oesophagus 0.138–0.235 long, stichosome 1.96–3.07, 33–35 stichocytes. Nerve ring 0.058–0.081 from anterior end. Vulva at level of oesophago-intestinal junction. Uterus with eggs in one row near vulva (Fig. 22C), distally in two rows. Mature

eggs 0.064–0.071 x 0.025–0.030, polar plugs distinctly protruding (Fig. 22D). Ovary posteriorly reaching anterior end of rectum. Rectum 0.081–0.113 long. Anus subterminal, tail 0.007–0.009 long.

Site: intestine

Hosts: *Hippoglossus stenolepis* (3, 4, 5); *Parophrys vetulus* (1, 2)

Distribution: Pacific

Records: 1. Margolis 1952; 2. Moravec *et al.* 1981; 3. Blaycock 1996; 4. Blaycock *et al.* 1998a; 5. Blaycock *et al.* 1998b

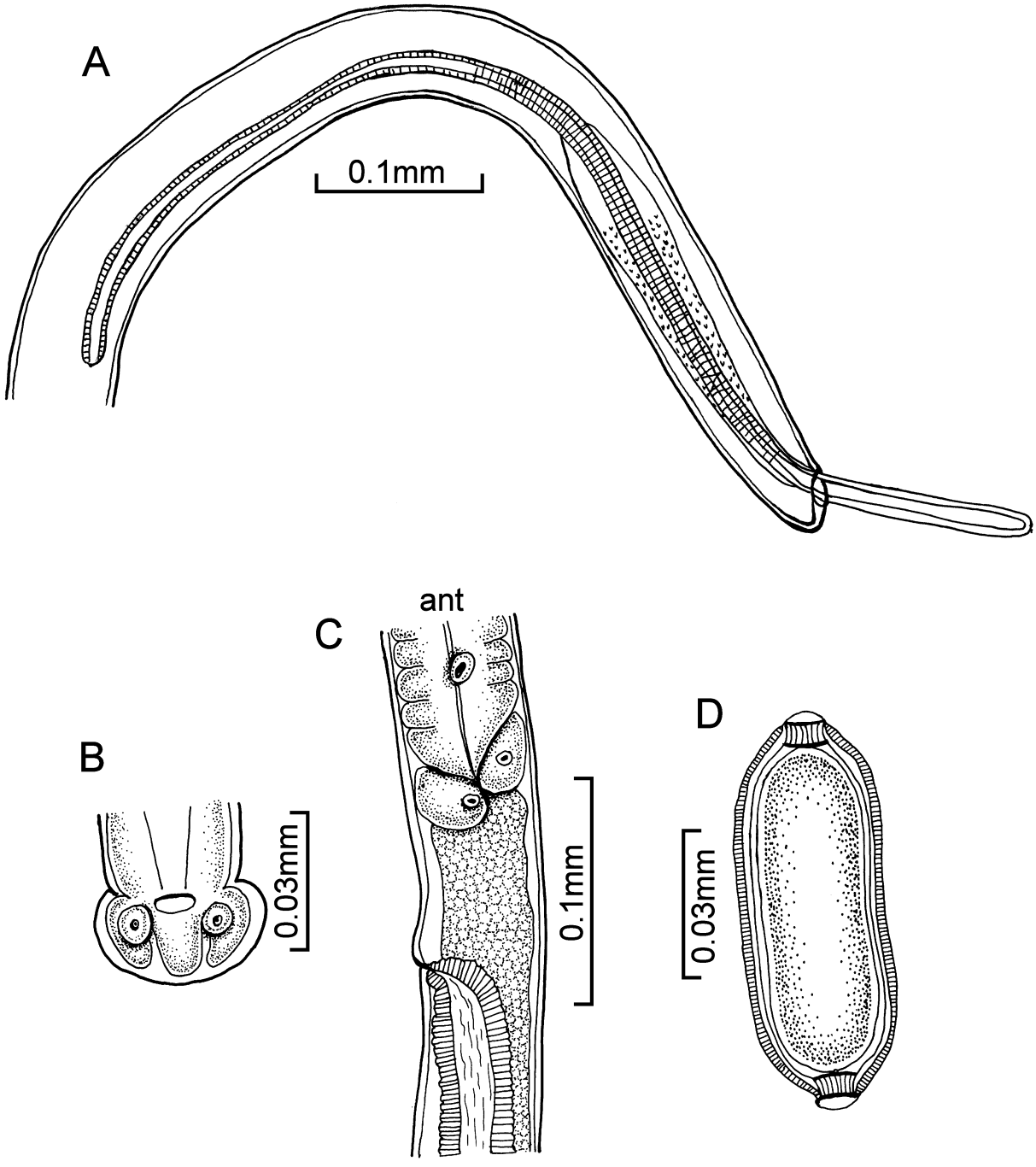

FIGURE 21. *Piscicapillaria* (*Piscicapillaria*) *freemani* (Moravec, Margolis & McDonald, 1981) Moravec, 1982. A. male, posterior end; B. male, tail, ventral view; C. female, vulvar region; D. egg. (Redrawn from Moravec 2001)

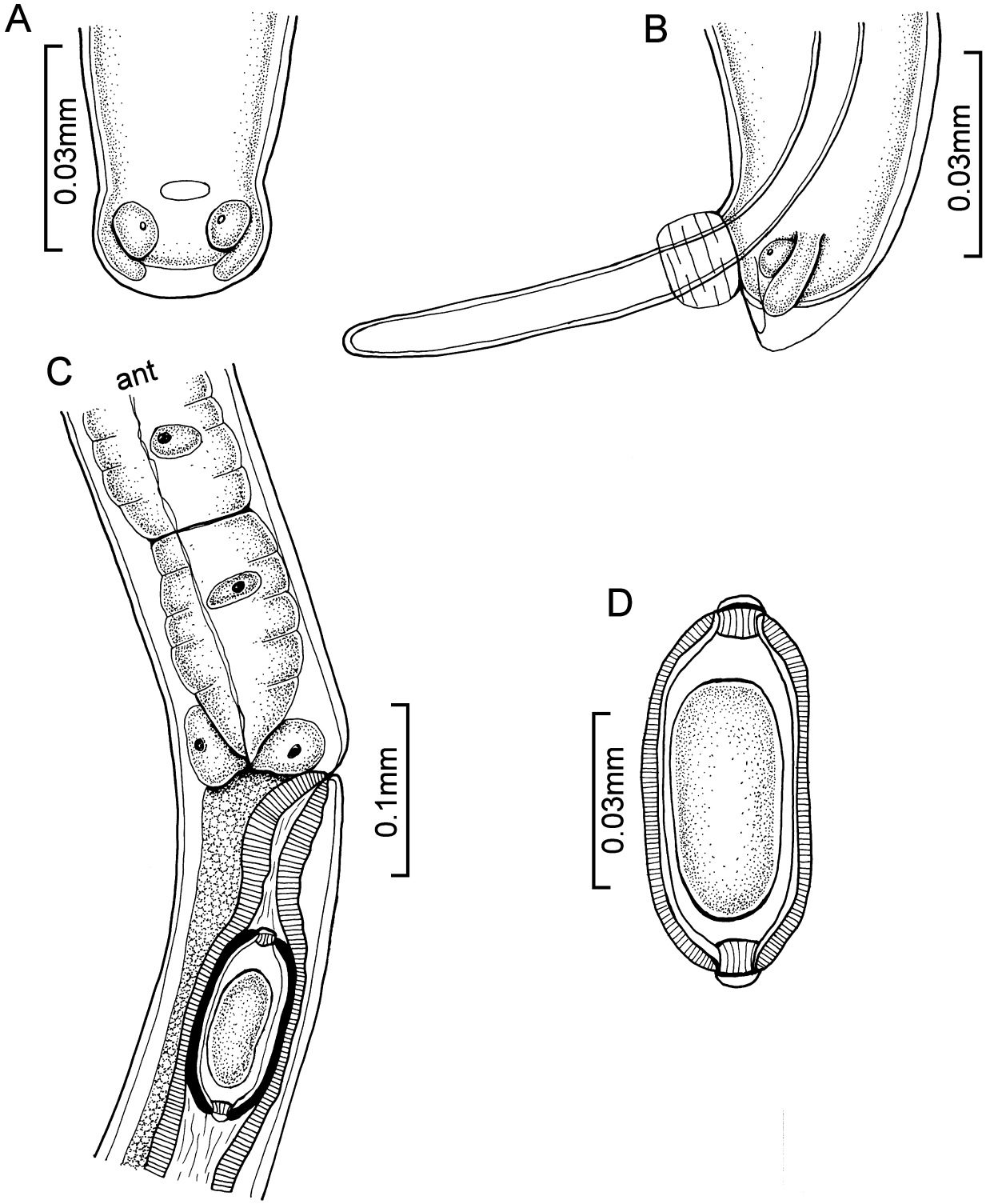

FIGURE 22. *Paracapillaria* (*Paracapillaria*) *parophrysi* (Moravec, Margolis & McDonald, 1981) Moravec, 1982. A. male, tail, ventral view; B. male, tail, lateral view; C. female, vulvar region; D. egg. (Redrawn from Moravec 2001)

Pseudocapillaria Freitas, 1959

Generic diagnosis (after Moravec 2001). Capillariidae. Two lateral bacillary bands extending most of body length (Fig. 23A). Stichosome comprises one row of stichocytes. Males lack lateral caudal alae. Male tail rounded with two large spherical subventral lobes behind cloacal opening. Dorsal cuticular membrane (bursa) reduced or absent. Spicular surface lacks rough transverse grooves. Spicular sheath non-spiny. Vulvar appendage present or absent.

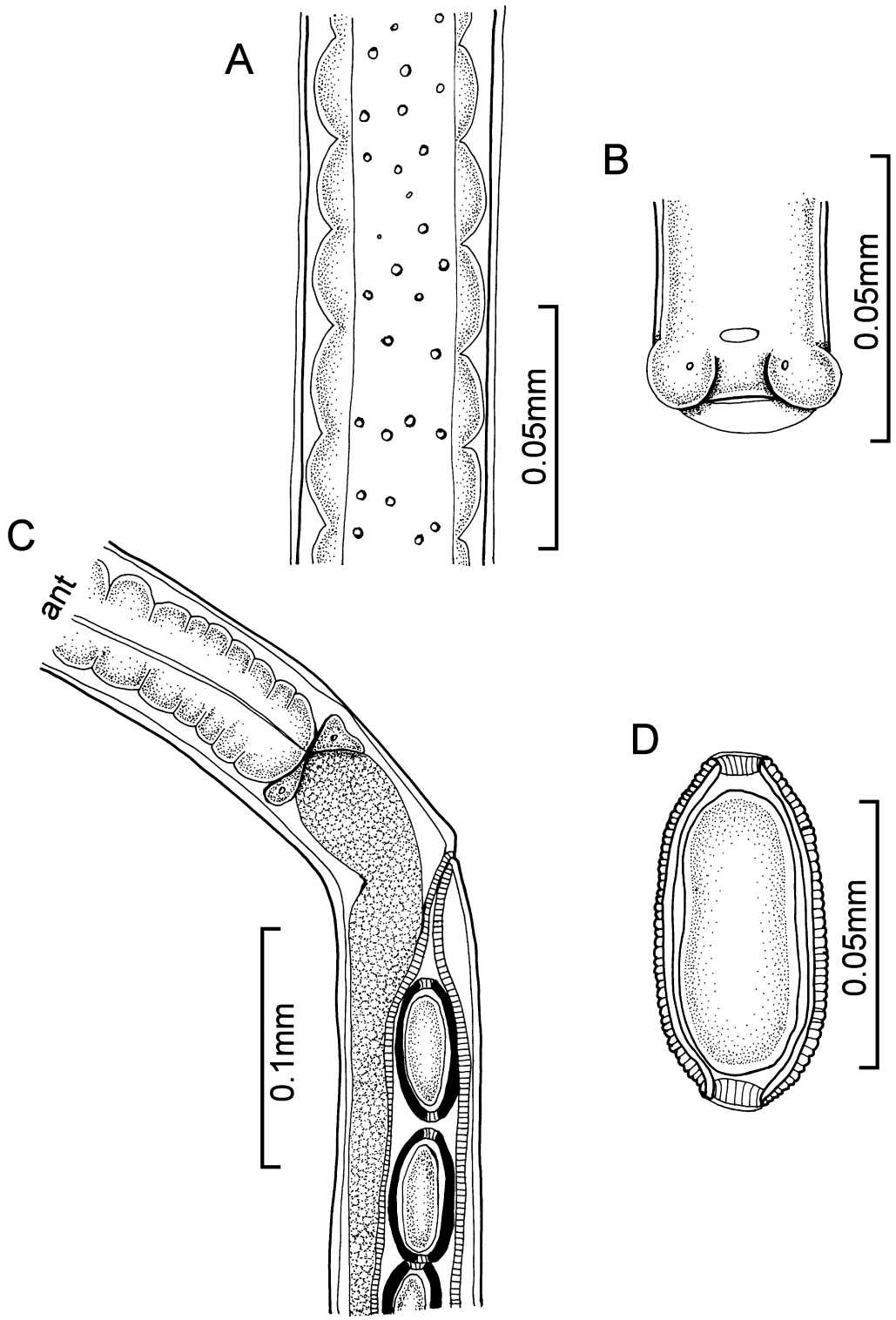

FIGURE 23. *Pseudocapillaria* (*Ichthyocapillaria*) *salvelini* (Polyanski, 1952) Moravec, 1982. A. stichosome region with marked bacillary band; B. male, tail, ventral view; C. female, vulvar region; D. egg. (Redrawn from Moravec 2001)

Key to the species of *Pseudocapillaria* from Canadian fresh-water fishes

1 Male tail with short dorsal caudal bursa connecting subventral lobes . . . . . *P.* (*Ichthyocapillaria*) *salvelini*
- Male tail lacking caudal bursa connecting subventral lobes. . . . . *P.* (*Pseudocapillaria*) *tomentosa*

Pseudocapillaria (*Ichthyocapillaria*) *salvelini* (Polyanski, 1952) Moravec, 1982

Synonym: *Capillaria salvelini* Polyanski, 1952

Description (after Moravec 2001). With characteristics of the genus.

Males: Body length 6.17–9.11, maximum width 0.060–0.84. Muscular oesophagus 0.285–0.330, 26–35 stichocytes. Nerve ring 0.087–0.099 from anterior end. Spicule smooth, well sclerotized, 0.405–0.636 long, 0.009–0.012 wide. Tail 0.018–0.027 long, rounded, with caudal bursa (Fig. 23B).

Females: Gravid worms 7.15–13.46 long, maximum width 0.054–0.095. Muscular oesophagus 0.300–0.393 long. Nerve ring 0.095–0.102 from anterior extremity. Vulva 0.030–0.081 behind oesophago-intestinal junction. Eggs in one row near vulva (Fig. 23C), several rows distally. Mature eggs 0.060–0.075 x 0.027–0.030, polar plugs non–protruding (Fig. 23D). Anus subterminal. Tail 0.009–0.015 long.

Site: alimentary tract

Hosts: *Coregonus clupeaformis* (5, 12, 22); *Cottus asper* (14); *Oncorhynchus kisutch* (11, 14, 16, 17, 18, 21); *Oncorhynchus mykiss* (22); *Osmerus mordax* (6, 14); *Prosopium cylindraceum* (5, 11, 22); *Salmo salar* (2, 6, 7, 8, 9 10, 14, 15, 17, 24, 25); *Salvelinus alpinus* (5, 23); *Salvelinus fontinalis* (3, 4, 5, 6, 12, 19, 20, 24); *Salvelinus fontinalis* x *Salvelinus namaycush* (13); *Salvelinus malma* (18); *Salvelinus namaycush* (5, 11, 12, 14, 17); *Thymallus arcticus* (11)

Distribution: British Columbia, Labrador, New Brunswick, Newfoundland, Northwest Territories, Nova Scotia, Ontario, Quebec, Yukon Territory

Records: 1. Pippy 1967 (NB, NL); 2. Pippy 1969 (NL, NB, NS); 3. Threlfall & Hanek 1969 (NF); 4. Threlfall & Hanek 1970c (NF); 5. Hicks & Threlfall 1973 (LB); 6. Hanek & Molnar 1974 (QC); 7. Hare & Burt 1975a (NB); 8. Hare & Burt 1975b (NB); 9. Hare 1975 (NB); 10. Hare & Burt 1976 (NB); 11. Arthur *et al*. 1976 (YT); 12. Chinniah & Threlfall 1978 (LB); 13. Dechtiar & Berst 1978 (ON); 14. Moravec 1980 (BC, NF, ON, YT); 15. Pippy 1980 (NB, NL, NT); 16. Anon. 1981 (BC); 17. Bell & Beverley-Burton 1981 (BC, NB, NT); 18. Anon. 1984 (BC); 19. Frimeth 1987a (NB); 20. Frimeth 1987b (NB); 21. Dechtiar & Christie 1988 (ON); 22. Dechtiar & Lawrie 1988 (ON); 23. Bouillon & Dempson 1989 (LB); 24. Marcogliese & Cone 1991a (LB, NB, NL, QC); 25. Marcogliese & Cone 1991b (NF)

Pseudocapillaria (*Pseudocapillaria*) *tomentosa* (Dujardin, 1843) Moravec, 1987

Synonyms: *Capillaria catostomi* Pearse 1934; *Hepaticola bakeri* Mueller & Van Cleave, 1932 (*partim*); *Capillaria bakeri* (Mueller & Van Cleave, 1932) Freitas & Lent, 1935; *Skrjabinocapillaria bakeri* (Mueller & Van Cleave, 1932) Skryabin & Schikhobalova, 1954

Description (after Moravec 2001). With characteristics of the genus.

Males: Body length 3.95–7.18, maximum width 0.054–0.068. Muscular oesophagus 0.183–0.330 long. Nerve ring 0.084–0.099 from anterior end. Spicule smooth, well sclerotized, 0.240–0.330 long (Fig. 24A). Tail 0.015–0.018 long, rounded. Caudal bursa absent (Fig. 24B).

Females: Gravid worms 7.30–12.04 long, maximum width 0.068–0.108. Muscular oesophagus 0.258–0.321 long, nerve ring 0.090–0.096 from anterior end. Vulva usually a short distance, 0.030–0.066, behind oesophago–intestinal junction (Fig. 24C). Eggs in one row near vulva, several rows distally. Mature eggs 0.063–0.078 x 0.030–0.039. Anus subterminal, tail 0.009–0.015 long.

Site: intestine

Hosts: *Catostomus catostomus* (1, 3); *Catostomus commersonii* (1, 4, 6, 7, 8); *Catostomus macrocheilus* (3); *Coregonus clupeaformis* (8); *Cottus asper* (3); *Couesius plumbeus* (3); *Cyprinus carpio* (8); *Cyprinus carpio* x *Carassius auratus* (8); *Lota lota* (1, 2, 5); *Mylocheilus caurinus* (3); *Oncorhynchus clarkii* (3); *Oncorhynchus kisutch* (3); *Oncorhynchus mykiss* (3); *Prosopium williamsoni* (3); *Ptychocheilus oregonensis* (3); *Richardsonius balteatus* (3); *Salvelinus fontinalis* (2, 3); *Salvelinus malma* (3)

Distribution: British Columbia, Ontario

Records: 1. Bangham 1941 (ON); 2. Bangham & Venard 1946 (ON); 3. Bangham & Adams 1954 (BC); 4. Bangham 1955 (ON); 5. Dechtiar 1972a (ON); 6. Bell & Beverley-Burton 1980 (ON); 7. Moravec 1980 (ON); 8. Bell & Beverley-Burton 1981 (ON)

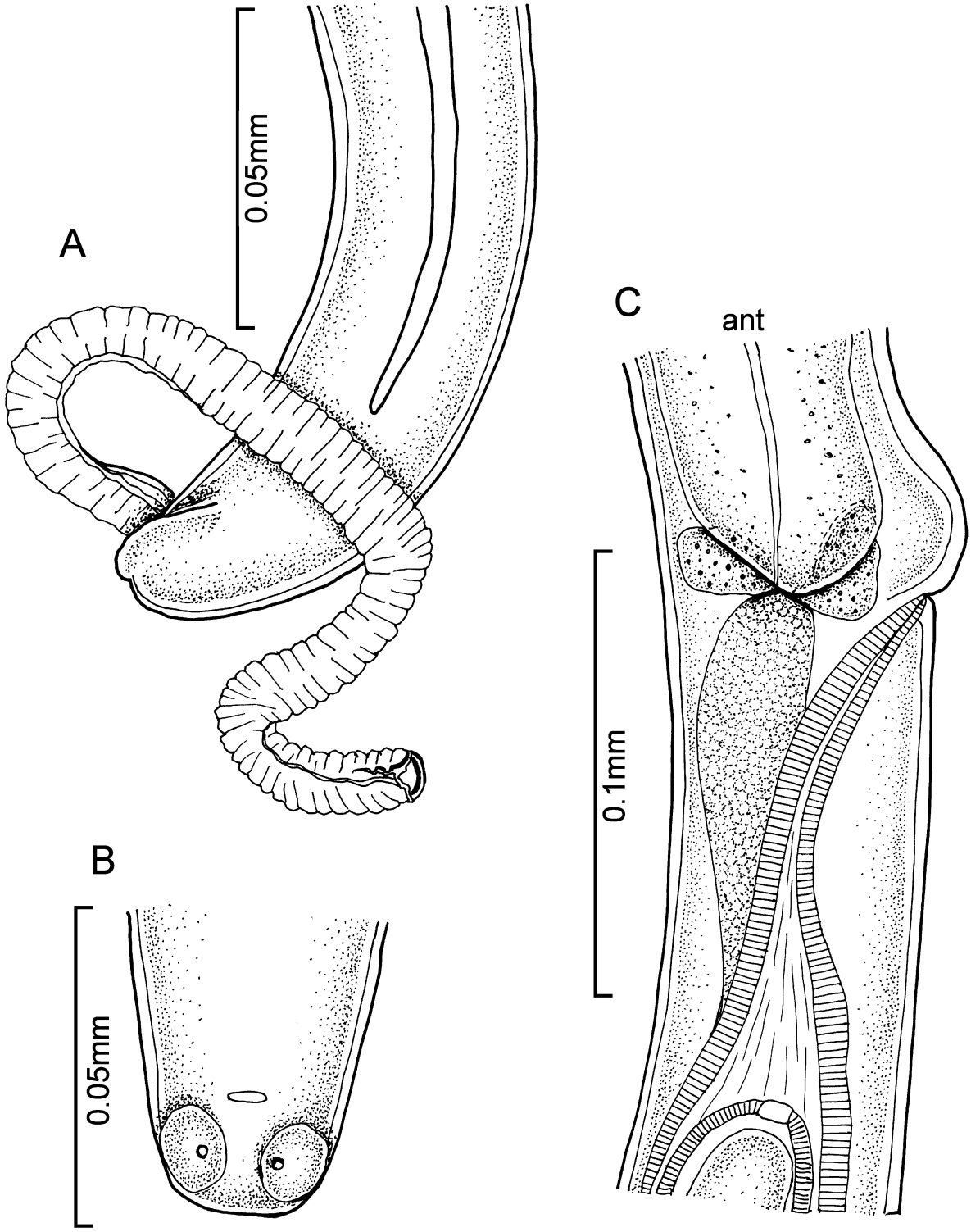

FIGURE 24. *Pseudocapillaria* (*Pseudocapillaria*) *tomentosa* (Dujardin, 1843) Moravec, 1987. A. male, posterior end, lateral view; B. male, tail, ventral view; C. female, vulvar region. (Redrawn from Moravec 2001)

Family TRICHOSOMOIDIDAE Hall, 1916

Preamble: Conboy & Speare (2002) speculated that *Huffmanela*-type eggs found in the skin of various species of *Sebastes* from coastal British Columbia might represent a new species. Indeed, Moravec, Conboy & Speare (2005) subsequently re-examined histologically the same rockfish material and recovered two complete males, three

complete females and worm fragments representing a new species, namely, *H. canadensis*. The nematode has commercial significance because infected rockfish with so-called "black mould" in the skin are downgraded in the market.

Huffmanela Moravec, 1987

Generic diagnosis (after Moravec 2001, and Gibbons 2010). Trichosomoididae. Small thread-like nematodes. Stichosome comprises single row of stichocytes. Males: cloaca long, spicule and spicular sheath absent. Posterior end dorso-ventrally depressed, membranous pseudobursa absent. Tail with one pair of ad-cloacal papillae. Female: vulva opens near posterior end of oesophagus. Eggs in uterus, non-embryonated; eggs in host tissue contain larva, strongly pigmented, dark, not translucent, wall often distinctly thick, walls including polar plugs completely covered with clear membrane covered in minute spines or ornamentation. Anus terminal. Parasites in skin, mucosa of gill arches, muscles, swim bladder, serosal cover of elasmobranch and teleost intestine.

Huffmanela canadensis Moravec, Conboy & Speare, 2005

Description (after Moravec *et al.* 2005). With characteristics of the genus.

Males (holotype measurements in parentheses): 3.441–3.862 (3.441) long, 0.045–0.063 (0.045) maximum width. Entire oesophagus 1.333–1.346 (1.333), muscular oesophagus 0.147–0.153 (0.153), and stichosome 1.180–1.199 (1.180) long; 40–42 (42) stichocytes (Fig. 25A). Nerve ring 0.048–0.069 (0.069) from anterior end. Single testis reaches anteriorly to near oesophago-intestinal junction (Fig. 25B). Cloaca long (0.093 in holotype). Tail slightly narrowed, rounded, bearing pair of large pre-anal papillae. Cloacal aperture slightly depressed (Fig. 25C).

Females (allotype measurements in parentheses): gravid worms 7.711–8.160 (17.711) long, 0.090–0.105 (0.090) maximum width. Entire oesophagus 1.768–2.054 (1.768), muscular oesophagus 0.180–0.216 (0.210), and stichosome 1.558–1.838 (1.558) long; 32–37 (35) stichocytes. Nerve ring 0.075–0.078 (0.078) from anterior end. Vulva slightly posterior to oesophago-intestinal junction, anterior vulvar lip elevated (Fig. 25D). Vagina short. Ovary single, posteriorly extending to end of intestine. Colourless rectum 0.111 (0.099) long, anus terminal (Fig. 25E). *In utero* eggs with polar plugs, oval, light coloured, non-embryonated, shell appears two-layered (Fig. 25F). Eggs 0.032–0.039 x 0.024–0.027 (0.036–0.039 x 0.024–0.027). Eggs in anterior uterus arranged in one row, two to three rows posteriorly.

Advanced eggs in host skin are dark brown, oval, with two-layered wall, surface with many transverse, somewhat oblique, complete or incomplete ridges. Polar plugs light coloured, height 0.006–0.009. Eggs including the polar plugs 0.048–0.063 (mean 0.054) x 0.024–0.027 (mean 0.026) containing a fully formed larva (Fig. 25G,H).

Sites: skin of fins and adjacent skin
Hosts: *Sebastes* spp.
Distribution: Pacific
Records: Conboy & Speare 2002; Moravec *et al*. 2005

Key to higher taxonomic ranks of the Class CHROMADOREA

1 Males with reduced number of caudal papillae; usually only one spicule; body short and stout; oesophagus with bulb; pre-cloacal sucker absent; large embryonated eggs often flattened on one side . . . . . Infraorder Oxyuridomorpha
- Nematodes lacking most of the above characteristics 2
2 Anterior end triradiate (except in some Seuratoidea); lateral external labial papillae, and two to three pairs of dorso-lateral caudal papillae present; oesophagus variable but not comprising short muscular and long glandular portions; male pre-cloacal sucker present or absent . . . . . Infraorder Ascaridomorpha
- Anterior end bilaterally symmetrical; lateral external labial papillae absent; caudal papillae ventral or ventro-lateral in position; oesophagus divided, anterior muscular portion shorter than posterior glandular portion; pre-cloacal sucker absent . . . . . Rhabditida

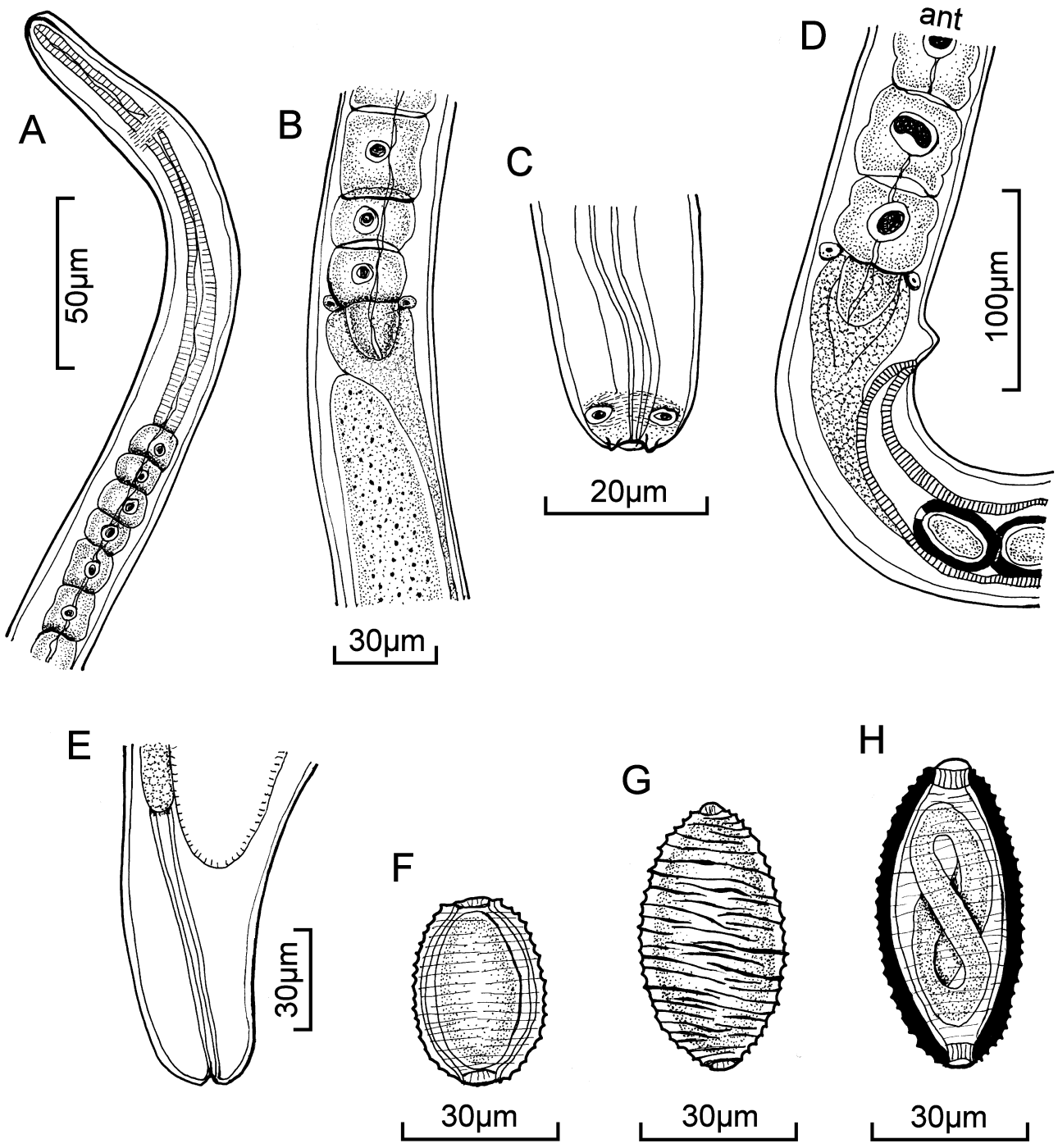

FIGURE 25. *Huffmanela canadensis* Moravec, Conboy & Speare, 2005. A. male, anterior end; B. male, oesophago-intestinal junction; C. male tail, ventral view; D. female, vulvar region; E. female tail, lateral view; F. most developed egg *ex* uterus; G. egg, dark, fully developed *ex* host tissue, showing surface ridges; H. egg, dark, fully developed, contains larva. (Redrawn from Moravec *et al*. 2005)

Order RHABDITIDA Chitwood, 1933

Key to Superfamilies of RHABDITIDA

1 Pseudolabia always absent; buccal capsule well developed, reduced or absent; oesophagus divided into muscular and glandular portions or muscular throughout; oesophageal glands uninucleate (except in *Philonema* and some species of *Philometroides*); larvae without cephalic hooks, tail generally long and pointed, usually with conspicuous phasmids containing broad cavities

and prominent pores; parasitic in gut of cold-blooded vertebrates or other organs of all classes of vertebrates; intermediate hosts mostly copepods. . . . . (Suborder Camallanina)…2

- Head with small pseudolabia, sometimes rudimentary; buccal capsule usually an elongate, moderately sclerotized tube; muscular and glandular portions of oesophagus well differentiated; oesophageal glands multinucleate; larvae usually with cephalic hooks or spines and inconspicuous pore-like phasmids; parasitic in gut or tissues of all classes of vertebrates; intermediate hosts invertebrates other than copepods (except Gnathostomatoidea) . . . . . (Suborder Spirurina) ... 3

2 Buccal capsule well developed, orange-brown in colour; buccal cavity well developed; internal labial papillae tiny; parasitic in gut . . . . . Camallanoidea

- Buccal capsule reduced or absent (except for Anguillicoloidea); if buccal cavity present then simple, rounded, not separated into two valves; internal labial papillae prominent; not usually parasitic in gut 3

3 Oviparous. Buccal capsule well developed. Oesophagus short, undivided. Sclerotized copulatory organs absent. Vulva functional. Parasites of swim bladder of eels. . . . . .Anguillicoloidea

- Viviparous. Buccal capsule usually reduced or absent. Oesophagus divided into muscular and glandular portions or muscular throughout. Spicules, copulatory plate or sclerotized genital cone present. Anus and vulva in gravid worms sometimes atrophied. Parasites of tissues, body cavity or closed cavities and organs of vertebrates . . . . . Dracunculoidea

4 Buccal capsule well cuticularized, elongate or short. Pseudolabia present or absent 5

- Buccal capsule little cuticularized; two massive lateral trilobed pseudolabia present; inner face of each pseudolabium thick, generally folded into rounded tooth-like formations that fit into corresponding folds on adjacent pseudolabium; anterior extremity sometimes swollen into bulb; adults parasitic in fishes, reptiles and mammals, larvae in fishes Gnathostomatoidea

5 Pseudolabia practically absent; caudal alae absent 6

- Pseudolabia present; caudal alae present or absent 7

6 Buccal capsule variable, sometimes long and cylindrical; mouth opening hexagonal or oval; caudal papillae not arranged as in typical spirurid; vulva markedly anterior or posterior in position; adults parasitic in intestine of fishes . . . . . .Thelazioidea

- Buccal capsule well cuticularized, never long and cylindrical; caudal alae present; caudal papillae arranged as in typical spirurid; vulva rarely markedly anterior or posterior in position; larvae parasitic in fishes, adults in higher vertebrates . Spiruroidea

7 Pseudolabia not covering entire cephalic surface, median lips still visible; four outer labial papillae often visible on lips; buccal cavity rarely long and cylindrical; cephalic cuticular ornamentation present or absent; adults parasitic in various organs of fishes . . . . . Habronematoidea

- Pseudolabia large, involving entire cephalic surface; outer labial papillae fused with cephalic papillae; buccal cavity generally elongated and cylindrical; cuticular cephalic ornamentation present; larvae parasitic in arthropods and fishes, adults in birds . . . . . Acuarioidea

8 Buccal cavity weakly developed; leaf crowns absent; bursa and often dorsal ray reduced; vulva at mid-body or posterior end; didelphic or monodelphic; viviparous or ovoviviparous; parasitic in the respiratory, cardiovascular and nervous systems of mammals . . . . . .Metastrongyloidea

Superfamily ANGUILLICOLOIDEA Yamaguti, 1935

Family ANGUILLICOLIDAE Yamaguti, 1935

Preamble: Five species of the eel swim bladder nematode *Anguillicola* are recognised currently: *A. globiceps* Yamaguti, 1935 (type species); *A. australiensis* Johnston & Mawson, 1940; *A. crassus* Kuwahara, Niimi & Itagaki, 1974; *A. novaezelandiae* Moravec & Taraschewski, 1988; and *A. papernai* Moravec & Taraschewski, 1988. Reports of *A. crassus* as an invasive species in American eels (*Anguilla rostrata*) in Canadian and other North American waters are of concern because the nematode causes morbidity and mortality in Japanese and European eels, *A. japonica* and *A. anguilla* (Laetsch *et al.* 2012). Molecular analyses by Laetsch *et al.* (*op. cit*.) do not support Moravec's (2006) division of the Family Anguillicolidae Yamaguti, 1935, into the genera *Anguillicola* Yamaguti, 1935, and *Anguillicoloides* Moravec & Taraschewski, 1988. Further analyses might not support Moravec & Taraschewski's (1988) erection of the subgenera *Anguillicola* and *Anguillicoloides* within *Anguillicola*. Indeed, in an exploration of spirurine evolutionary relationships Wijová, Moravec, Horák & Lukeš (2006) referred, without comment, to the binomen *Anguillicola crassus*; they also stated that "the genus *Anguillicola* should be evaluated within an independent Superfamily Anguillicoloidea, whose position within a higher taxonomic unit remains uncertain at best". Future molecular analyses might shed light on such problems.

Evidence that forage fish species in North America serve as paratenic hosts of *Anguillicola crassus* was provided by Li *et al*. (2015). Of Canadian interest was the finding of two *A. crassus* L3 in one of nine Atlantic tomcod (*Microgadus tomcod*) from the Mira River, Cape Breton, Nova Scotia; one of these L3 was 846µm long and 33µm wide.

Family diagnosis (after Moravec 2013). Buccal capsule well developed, with numerous peribuccal teeth. Cuticle smooth, spinose or with papilla-like excrescences. Four submedian cephalic papillae present. Oesophagus

short, undivided. Males with common cloacal duct opening on prominent process. Preanal and postanal papillae present. Vulva well developed, situated in posterior half of body. Parasites of swim bladder of eels.

Anguillicola Yamaguti, 1935

Generic diagnosis (after Moravec & Taraschewski 1988, and Moravec 2013). Anguillicolidae. Cuticle aspinose, sometimes with irregularly scattered excrescences of fibrous material on anterior and posterior ends of the body. Head end with four submedian papillae and two lateral amphids. Buccal capsule small or medium sized with row of small circumoral teeth. Oesophagus short, undivided; anterior end lacks inflation, posterior end expanded, valvular apparatus well developed. Intestine dark, distended posteriorly. Rectal glands large. Spicules absent. Testis begins near tail end; seminal vesicle well developed. *Ductus ejaculatorius* opens on prominent caudal process. Preanal and postanal papillae present. Vulva opens on tip of prominent cone in posterior part of body. Uterus amphidelphic. Eggs contain ensheathed 2nd-stage larvae. Parasites of swim bladder of eels.

Anguillicola crassus Kuwahara, Niimi & Itagaki, 1974

Synonyms: *Anguillicola* (*Anguillicoloides*) *crassus* (Kuwahara, Niimi & Itagaki, 1974) Moravec & Taraschewski, 1988; *Anguillicoloides crassus* (Kuwahara, Niimi & Itagaki, 1974) Moravec, 2006

Description (after Moravec 2013). With characteristics of the genus. Body darkly coloured, fusiform, rather plump, both ends tapering. Epicuticle almost smooth. Head end rounded. Mouth aperture circular, surrounded by four large dorso-lateral and ventro-lateral cephalic papillae and two small lateral amphids. Buccal capsule heavily sclerotized, its anterior rim bearing a row of 21 to 28 large circumoral teeth (Fig. 26A). Oesophagus strongly muscular, expanded posteriorly, with a well developed valvular apparatus. Nerve ring at about one-third oesophagus length from anterior end, and excretory pore near oesophageal-intestinal junction. Intestine dark, distended posteriorly (Fig. 26B). Three large and one small rectal glands, tail conical, very short (Fig. 26C,D).

Males: 5.77–23.12 long, 0.34–1.77 maximum width. Buccal capsule 0.021–0.027 long, 0.048–0.063 wide. Oesophagus 0.571–0.843 long, 0.135–0.258 maximum width. Oesophageal valves 0.054–0.095 long. Nerve ring and excretory pore respectively 0.210–0.286 and 0.694–0.924 from anterior end. Seminal vesicle well developed. Common cloacal duct opens on prominent process 0.048–0.090 long. Usually six pairs of caudal papillae: two to three preanal, one adanal, two to three postanal (Fig. 26D). Tail conical, 0.109–0.286 long.

Females: gravid worms 13.08–44.74 long, 1.22–5.00 maximum width. Buccal capsule 0.024–0.027 long, 0.054–0.063 wide. Oesophagus 0.775–1.090 long, 0.204–0.381 maximum width. Nerve ring and excretory pore respectively 0.258–0.299 and 0.857–1.142 from anterior end. Vulva prominent, cone shaped, 3.40–7.01 from posterior end (Fig. 26E). Uterus occupies most of the body space, containing numerous eggs with developing embryos or ensheathed 2nd-stage larvae 0.244–0.258 long and 0.015 wide (Fig. 26F). Rectum usually opens into a well-developed papilla-like process. Tail conical, 0.136–0.448 long (26C).

Sites: swim bladder (eels); mesenteries, intestinal wall (paratenic hosts)

Hosts: *Anguilla rostrata* (1, 2, 3, 4); *Microgadus tomcod* (5)

Distribution: New Brunswick, Nova Scotia

Records: 1. Aieta & Oliveira 2009 (NB, NS); 2. Rockwell *et al.* 2009 (NS); 3. Campbell *et al.* 2013 (NB, NS); 4. Denny *et al.* 2013 (NS); 5. Li *et al.* 2015 (NS)

Superfamily DRACUNCULOIDEA Stiles, 1907

Key to Families of DRACUNCULOIDEA

1	Vulva anterior or pre-equatorial, well developed in mature female; monodelphic or didelphic.	2
-	Vulva posterior or equatorial, more or less completely atrophied in mature female; two ovaries present	Philometridae
2	Spicules present; caudal alae in male absent or reduced	Guyanemidae
-	Spicules absent; caudal alae in male absent	Daniconematidae

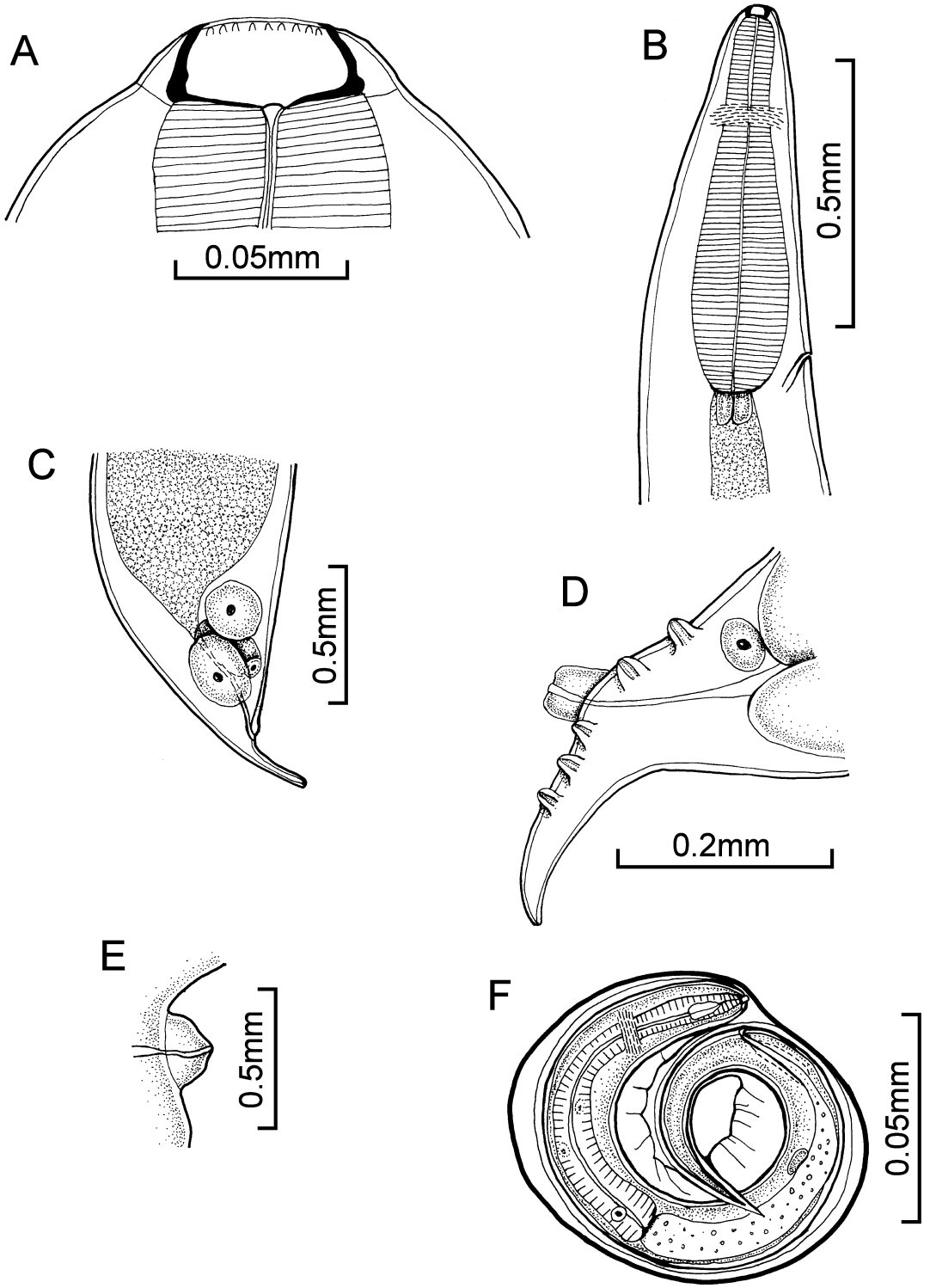

FIGURE 26. *Anguillicola crassus* Kuwahara, Niimi & Itagaki, 1974. A. female, buccal capsule; B. male, anterior end; C. female, tail; D. male, tail with five rather than the usual six caudal papillae; E. vulva; F. egg containing 2nd-stage larva. (Redrawn from Moravec 2013)

Family DANICONEMATIDAE Moravec & Køie, 1987

Family diagnosis (after Moravec 2013). Body thread-like. Head end with pair of prominent labial papillae and eight external paired papillae. Buccal capsule absent. Oesophagus muscular, with long, posteriorly extending,

oesophageal gland. Tail of male long, without caudal alae, provided with several pre-cloacal and post-cloacal papillae. Spicules or sclerotized copulatory plate absent. Cloacal opening on special genital projection. Vulva in anterior part of body. Monodelphic. Viviparous. Parasites of eels.

This Family appears to be represented by only one genus, *Daniconema*.

Daniconema Moravec & Køie, 1987

Generic diagnosis (after Moravec 2013). Daniconematidae. Body thread-like, head bluntly rounded, with pair of large dome-shaped forwardly directed papillae (cephalic elevations); there are also eight external paired papillae (two ventro-ventral, two latero-ventral, two dorso-lateral, two dorso-dorsal) and pair of lateral amphids (Fig. 27A). Buccal capsule absent. Oesophagus muscular. Oesophageal gland highly developed, very long, extending posteriorly along intestine. Nerve ring encircling oesophagus in its anterior half, with excretory pore slightly below nerve ring level. Male tail long, lacking caudal alae; four pairs pre-cloacal and five pairs post-cloacal papillae. Spicules, gubernaculum or sclerotized copulatory plate absent; common cloacal duct opening on lobular genital projection. Female with functional anus. Female tail conical with rounded tip. Most of female body filled with uterus containing larvae. Vulva in anterior part of body. Monodelphic. Viviparous. Parasites of eels.

Type and apparently only species *D. anguillae* Moravec & Køie, 1987.

Daniconema anguillae Moravec & Køie 1987

Description (after Moravec 2013). With characteristics of the genus. Fine, thread-like worms with slightly striated cuticle. Head papillae and absence of buccal capsule as described above for the genus. Junction of muscular oesophagus and intestine somewhat submerged into oesophageal gland (Fig. 27B). Position of nerve ring and excretory pore as described above for genus. Deirids not observed. Intestine a fine narrow tube. Gravid females two to three times longer than males.

Males: 7.48–8.81 long; maximum width 0.041–0.051. Cephalic elevations 0.006 high. Muscular oesophagus 0.501–0.540, and oesophageal gland 2.04–2.96 long. Nerve ring and excretory pore 0.210–0.219 and 0.233–0.243 respectively from anterior end. Anterior end of testis near end of oesophageal gland. Caudal end spirally coiled; caudal alae absent. Four pairs pre-cloacal papillae, all subventral; five pairs post-cloacal papillae, four subventral and one lateral (Fig. 27C). Spicules, gubernaculum and sclerotized plate absent. Common cloacal duct opening on peculiar large, lobular genital projection. Tail conical, sharply pointed, 0.114–0.141 long (Fig. 27C).

Females: Gravid worms 16.82–31.17 long; maximum width 0.081–0.095. Muscular oesophagus 0.666–0.680, and oesophageal gland 2.68–2.70 long. Nerve ring and excretory pore 0.270–0.381 and 0.299–0.408 respectively from anterior end. Anus functional. Tail conical, rounded tip, 0.144–0.162 long. Monodelphic. Posterior end of ovary reaches tail. Uterus very long, occupies much of body, contains eggs, developing embryos and fully formed larvae about 0.5 long. Vulva well developed, 0.830–0.966 from anterior end. Narrow, thin-walled vagina extending anteriorly from uterus along most of length of oesophageal gland; ovijector oval in shape.

Site: swim bladder

Host: *Anguilla rostrata*

Distribution: Atlantic, Nova Scotia

Records: Marcogliese & Cone 1996 (NS); Marcogliese & Cone 1998 (AT)

Family GUYANEMIDAE Petter, 1975

Family diagnosis (after Petter 1975, and Adamson & Roth 1990). Head with four cephalic papillae, and four internal and four external labial papillae. Buccal capsule reduced or absent; peribuccal ring present. Oesophagus comprises short muscular portion and longer, cylindrical glandular portion. Female tail long. Functional anus present in mature worms. Functional vulva situated anteriorly. Monodelphic or didelphic. Male tail long, with pre- and post-cloacal papillae; caudal alae present or absent. Two equal spicules. Viviparous. Parasites of fishes.

As presently defined Guyanemidae consists of two genera, namely, *Guyanema* Petter, 1975, and *Pseudodelphis* Adamson & Roth, 1990. Only *Pseudodelphis* has been recorded from Canadian fishes.

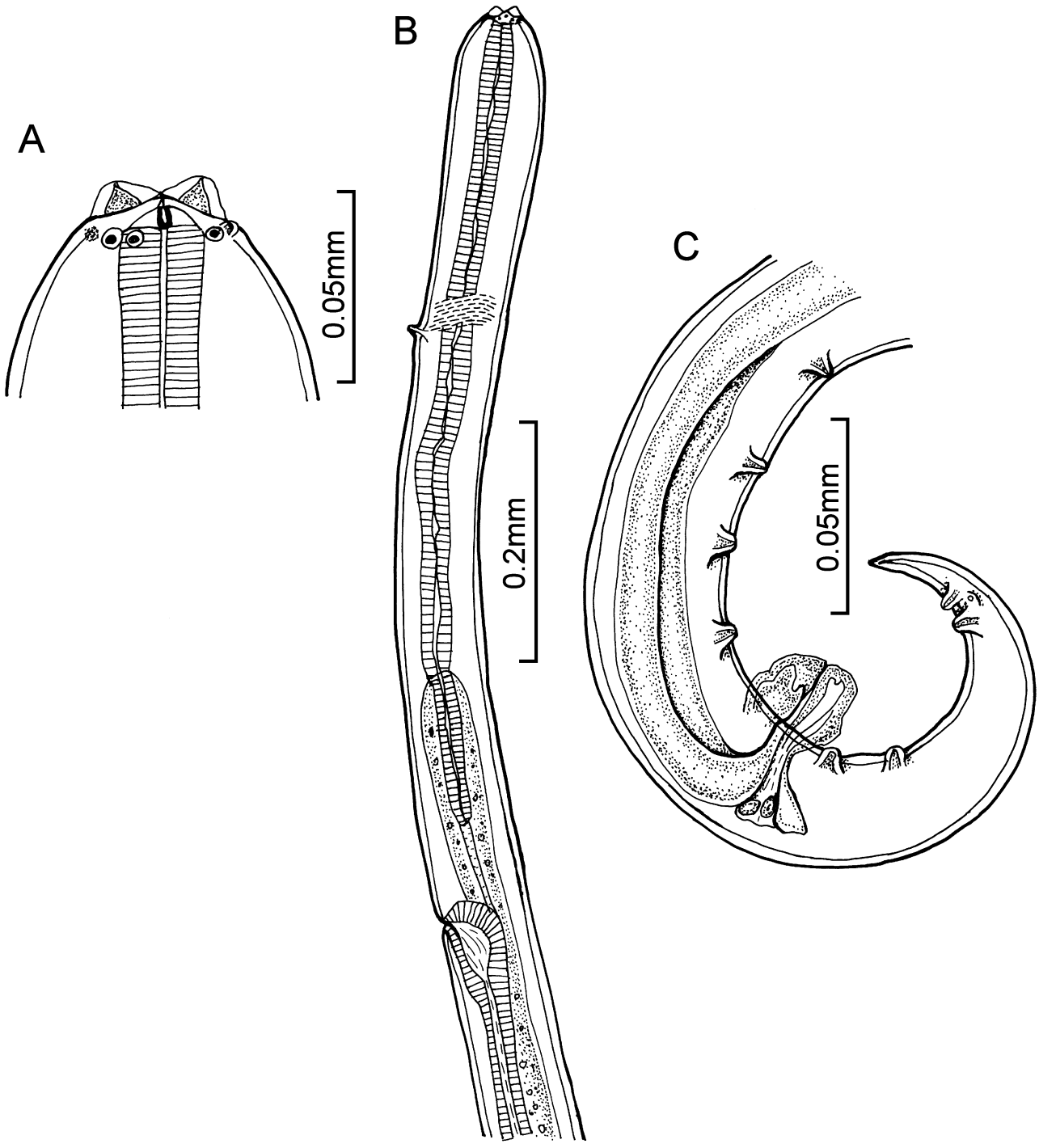

FIGURE 27. *Daniconema anguillae* Moravec & Køie, 1987. A. female, head, lateral view; B. female, anterior end, lateral view; C. male, posterior end, lateral view. (Redrawn from Moravec 2013)

Pseudodelphis Adamson & Roth, 1990

Generic diagnosis (after Adamson & Roth 1990). Guyanemidae. Buccal capsule reduced to peribuccal ring. Oesophagus long with distinct muscular and glandular portions. Males lack caudal alae; caudal extremity subconical, simple. Females didelphic, anterior uterus ending blindly without associated oviduct and ovary. This genus appears to be monotypic, being represented only by *P. oligocotti* Adamson & Roth, 1990.

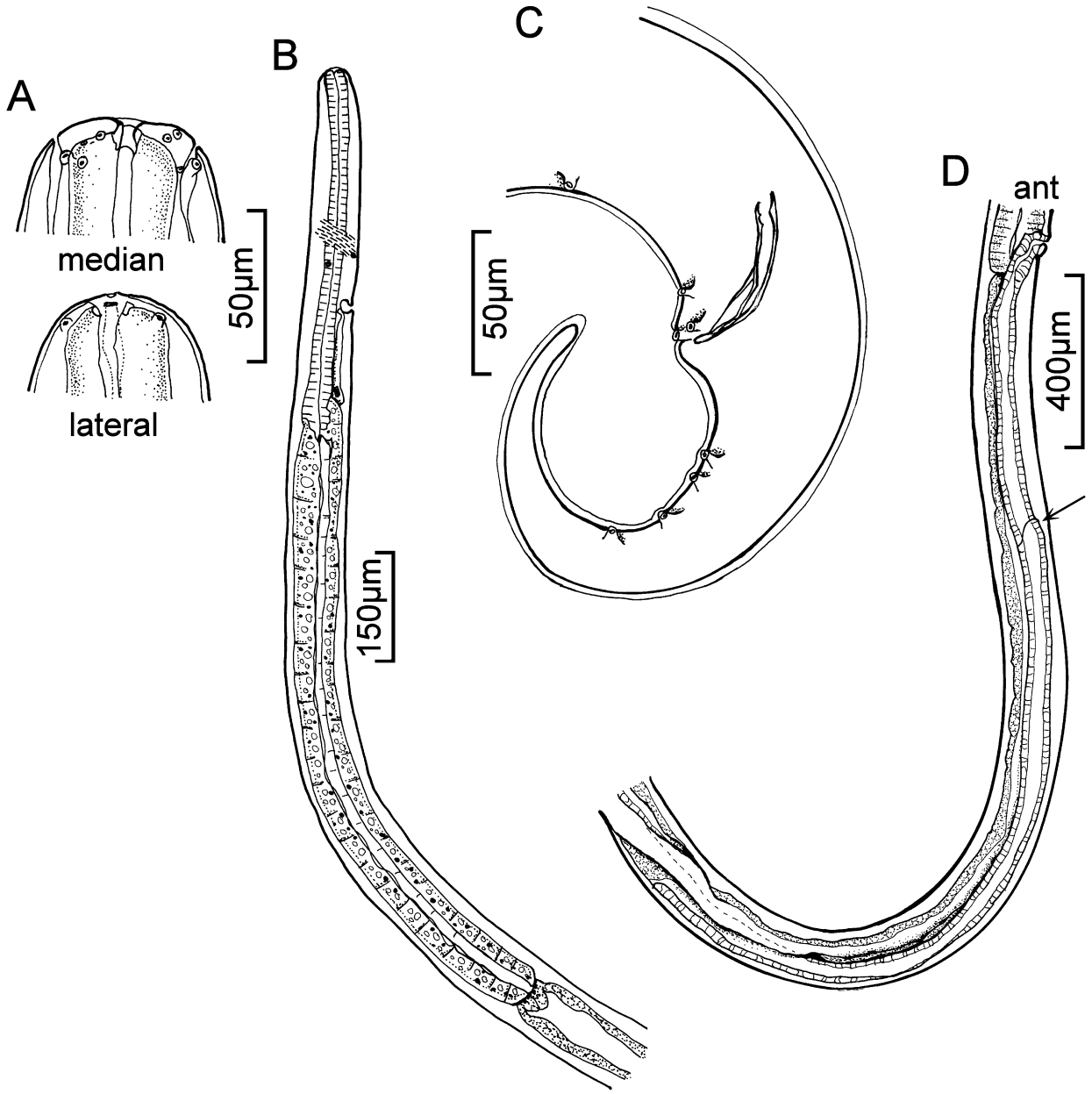

FIGURE 28. *Pseudodelphis oligocotti* Adamson & Roth, 1990. A. male, head, median and lateral views; B. male, anterior end, oesophageal region, lateral view; C. male, posterior end, lateral view; D. female, vaginal region, lateral view—arrow indicates anterior extremity of uterine diverticulum. (Redrawn from Adamson & Roth 1990)

Pseudodelphis oligotti, Adamson & Roth 1990

Description of *P. oligocotti* (after Adamson & Roth 1990). With characteristics of the genus. Long, slender worms. Head end rounded, slightly wider in median than lateral view (Fig. 28A). Mouth opening subtriangular, dorso-ventrally elongate, surrounded by inner ring of six and outer ring of eight papillae. Papillae of inner ring similar; those of outer ring arranged in four pairs of which the more median element of each pair is smaller. Buccal capsule a simple cuticularized ring surrounded by oesophageal tissue. Oesophagus slightly swollen at anterior end, and comprising anterior muscular and posterior glandular portion. Nerve ring and hemizonid prominent. Excretory pore inconspicuous, leading by slender tubular duct to ventral excretory cell just anterior to glandular oesophagus. Deirids in form of small digitiform projections between level of nerve ring and excretory pore.

The following measurements are means for nine male and eight female *P. oligocotti*, with measurements of types in parentheses.

Males: 16.28 (18.0) long; maximum width 0.128 (0.125). Muscular oesophagus 0.561 (0.457) and glandular oesophagus 1.054 (0.898) long. Nerve ring 0.294 (0.279), excretory pore 0.416 (0.417), and anterior extremity of testis 2.793 (1.97) from anterior end (Fig. 28B). Spicule 0.064 (0.070) and tail 0.205 (0.218) long. Testis unflexed, extending posteriorly as broad tube filled with developing sperm. Tail subconical with anus elevated on slightly developed genital cone. Two pairs pre-cloacal, two pairs ad-cloacal, and four pairs post-cloacal caudal papillae (occasionally ad-cloacal pairs number three on one side, and post-cloacal five on one side). Cuticular prominence on anterior anal lip with 1 median pre-cloacal papilla. Phasmids between 1st and 2nd post-cloacal papilla pair. Tail conical with rounded end, coiled in a dextral spiral in more mature worms (Fig. 28C).

Gravid females: 26.87 (32.1) long [none contained eggs with 1st-stage larvae]; maximum width 0.169 (0.140). Muscular oesophagus 0.618 (0.704) and glandular oesophagus 1.490 (1.677) long. Nerve ring 0.274 (0.311), excretory pore 0.362 (0.416), and vulva 2.149 (2.661) from anterior end. Vagina 5.576 (3.465) long. Blind end of ovary 1.297 (1.464) from anus. Tail subconical with rounded end, 0.253 (0.279) long. Didelphic. Vagina in region of base of oesophagus, extends posteriorly to join with anterior and posterior uteri (Fig. 28D). Anterior uterus ends blindly about 0.500 posterior to base of oesophagus. Posterior uterus extends posteriorly to join oviduct and ovary.

Sites: body cavity, mesenteries

Hosts: *Apodichthys flavidus* (3); *Artedius lateralis* (3); *Gasterosteus aculeatus* (3); *Gobiesox maeandricus* (2, 3); *Leptocottus armatus* (2, 3); *Oligocottus maculosus* (1, 2, 3); *Pholis laeta* (2, 3); *Pholis ornata* (2, 3); *Syngnathus leptorhynchus* (2, 3)

Distribution: Pacific

Records: 1. Adamson & Roth 1990; 2. Bennett & Adamson 1994; 3. Bennett & Adamson 2004

Family PHILOMETRIDAE Baylis & Daubney, 1926

Family diagnosis (after Moravec 2013). Female body long. Head end rounded, peribuccal ring absent. Mouth simple, buccal capsule absent. Mouth opening usually surrounded by four to eight cephalic papillae. Males much smaller than females. Two equal or slightly unequal spicules; gubernaculum present or absent. Vulva and vagina more or less completely atrophied in gravid worms. Uterus amphidelphic. Viviparous. Parasitic in subcutaneous tissues, body cavity, serosa or blood vessels of fishes.

Key to genera of PHILOMETRIDAE

1	Body elongate, claviform; oesophageal gland limited to middle of oesophagus	*Clavinema*
-	Body cylindrical, long; oesophageal gland more or less extensive	2
2	Dorsal oesophageal gland developed along greater posterior portion of oesophagus; anterior muscular portion more or less swollen anteriorly, without free posterior glandular appendix; anterior ovary not rudimentary	3
-	Anterior muscular portion of oesophagus elongate, with two swellings separated by nerve ring, with free posterior glandular appendix; anterior ovary rudimentary	*Ichthyofilaria*
3	Body of female covered with prominent cuticular bosses	*Philometroides*
-	Body of female smooth, without cuticular bosses	4
4	Posterior end of both sexes rounded; anus of male terminal; gubernaculum present	*Philometra*
-	Posterior end of both sexes tapering to a sharp point; tail of male coiled, anus remote from tail tip; gubernaculum absent	*Philonema*

Clavinema Yamaguti, 1935

Generic diagnosis (after Yamaguti 1935). Philometridae. Body elongate, claviform, with thick muscular wall. Head and tail papillae absent. Anterior end of oesophagus bulbous, strongly muscular; posterior portion longer and cylindrical, with small oesophageal gland at about its middle. Intestine voluminous anteriorly. Ovaries amphidelphic. Uterus extends most of body length, distended with eggs, anteriorly especially. Vulva and vagina atrophied or absent. Viviparous. Males unknown. Parasites of fishes.

One species, *C. mariae*, is known from several fish species in Canada.

***Clavinema mariae* (Layman, 1930) Yamaguti, 1935**

Synonyms: *Philometra mariae* Layman, 1930; *Philometra americana* Kuitunen-Ekbaum, 1933; *Philometra* sp. of Arai (1967 *partim*)

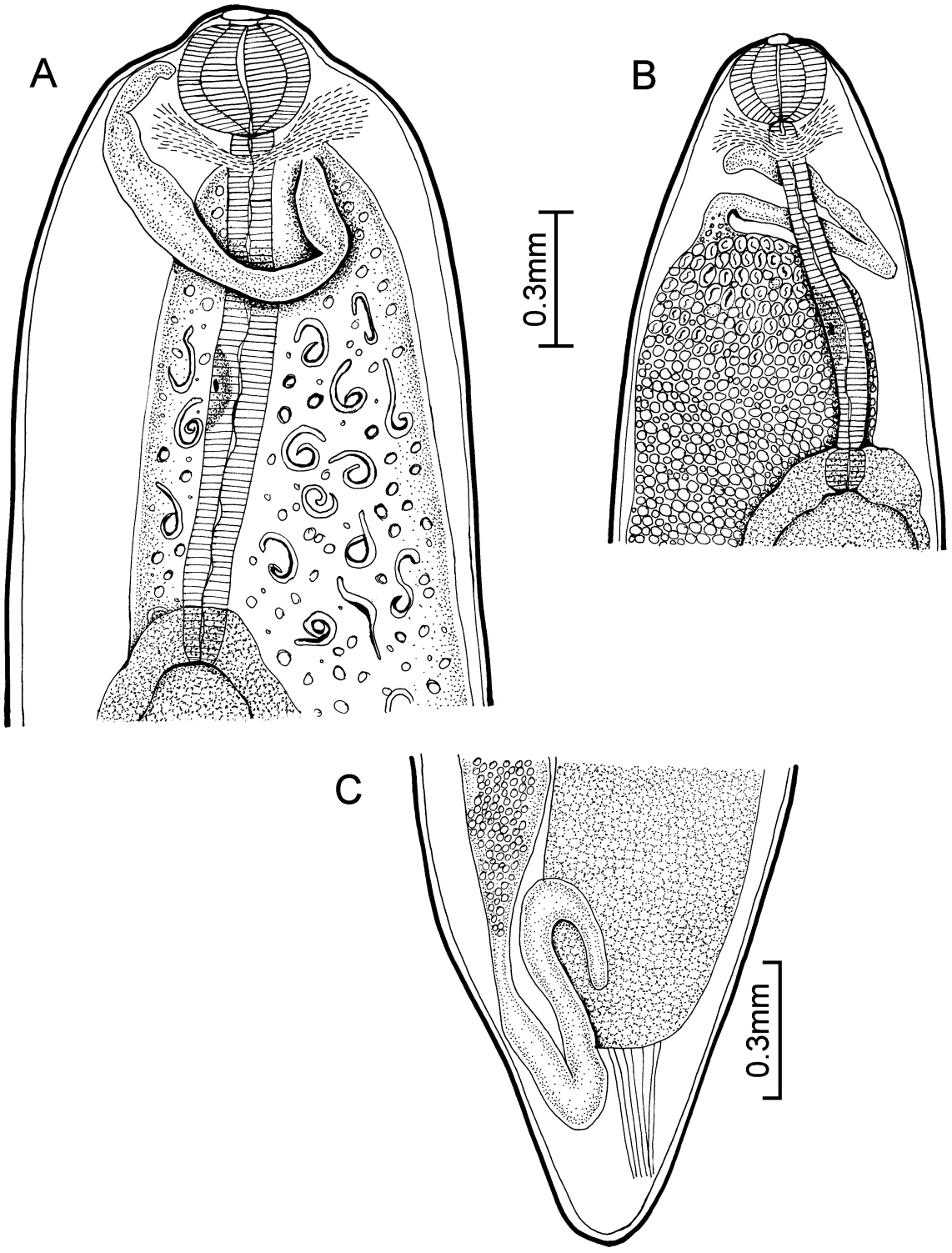

FIGURE 29. *Clavinema mariae* (Layman, 1930) Yamaguti, 1935. A. gravid female, anterior end; B. subgravid female, anterior end; C. gravid female, posterior end. (Redrawn from Margolis & Moravec 1987)

Description (after Margolis & Moravec 1987). With characteristics of the genus.

Males unknown.

Females: body of gravid and subgravid worms distinctly narrower in posterior half. Cuticle smooth. 23.6–48.5 long; maximum width 0.74–1.90. Gravid worms with larvae in uteri 33.7–48.5 long; maximum width 0.74–1.49. Head end rounded, with elevated oesophageal bulb region (0.115 long and 0.322 wide) in larger worms. Mouth papillae not observed. Mouth slightly depressed. Anterior end of oesophagus forming a conspicuous, strongly muscular bulb, well separated from posterior cylindrical portion of oesophagus; bulb 0.202–0.326–0.235–0.398. Small, not well demarcated oesophageal gland situated about middle of posterior portion of oesophagus. Entire oesophagus including bulb 0.958–1.442 long (Fig. 29A). Oesophagus opens into intestine through distinct valves. Nerve ring encircles anterior end of cylindrical portion of oesophagus, 0.281–0.446 from anterior end (Fig. 29A). Intestine dark and broad throughout, attached by short ligament to ventral body wall near posterior end (Fig. 29C). Uterus containing eggs, developing embryos, and larvae. Larvae 0.300–0.426 long and 0.009–0.018 maximum width. Vulva absent. Uterus reaches anteriorly to posterior end of oesophageal bulb in gravid worms (Fig. 29A) or near it in subgravid worms (Fig. 29B). Anterior ovary tubular, well developed. Posterior ovary directed anteriorly, its distal end pointing backwards. Uterus reaching posteriorly almost to posterior end of intestine. Posterior end of body rounded, lacking projections or papillae (Fig. 29C).

Sites: body cavity, fins, musculature, subcutaneous

Hosts: *Anoplarchus purpurescens* (2); *Cottus asper* (9); *Gobiesox maeandricus* (1, 2); *Parophrys vetulus* (3, 4, 7); *Pholis laeta* (5, 6); *Pholis ornata* (1, 2); *Platichthys stellatus* (1, 2, 4, 8); *Paraplagusia bilineata* (1, 2); *Xiphister atropurpureus* (1, 2)

Distribution: British Columbia, Pacific

Records: 1. Kuitunen-Ekbaum 1933c (PA); 2. Kuitunen-Ekbaum 1938 (PA); 3. Margolis 1952a (PA); 4. Margolis 1952b (PA); 5. Arai 1967a (PA); 6. Arai 1969 (PA); 7. Margolis 1970 (PA); 8. Lewis 1978 (PA); 9. Margolis & Moravec 1987 (BC, PA)

Ichthyofilaria Yamaguti, 1935

Generic diagnosis (after Yamaguti 1961). Philometridae. Body cylindrical, with tapered extremities. Mouth simple. Oesophagus comprises anterior muscular portion with two swellings separated by nerve ring, and a shorter posterior portion. Vermiform glandular appendix arises from posterior end of muscular portion of oesophagus, and extends backwards dorsal to the posterior portion of oesophagus and terminating on anterior end of intestine. Anterior ovary poorly developed, posterior ovary long, cylindrical, reaching to near tail end. Uterus continuous. Viviparous. Males unknown. Parasites of fishes.

One species, namely *I. canadensis*, is known from two species of *Lycodes* in Canadian waters .

Ichthyofilaria canadensis Appy, Anderson & Khan, 1985

Description (after Appy *et al*. 1985). With characteristics of the genus.

Males unknown.

Holotype (gravid female): 22 long; maximum width 0.275. Anterior part of body narrows abruptly at excretory pore level; anterior end bluntly rounded. Posterior part of body tapers to pointed tip. Mouth opening circular, surrounded by delicate cuticular ring. Four poorly defined median cephalic papillae present. Amphidial pores prominent. Muscular portion of oesophagus 0.275 long, swollen anterior and posterior to nerve ring. Glandular part of oesophagus about 0.100 long, extending slightly into intestine. Oesophageal gland with several nuclei and extending posterior to oesophago-intestinal junction as vermiform appendix. Nerve ring 0.180 and excretory pore 0.295 from anterior end (Fig. 30A). Intestine inflated anteriorly, contains fine granular material; posteriorly, intestine reduced to ligament attached to hypodermis 0.303 from posterior end. Anus apparently not patent (Fig. 30B). Vulva 14.5 from anterior end; vagina narrow, directed posteriorly before dividing into uteri (Fig. 30C). Uteri amphidelphic, didelphic, thin-walled and filled with 1st-stage larvae (microfilarioid in form and ensheathed) and developing embryos. Anterior ovary narrow, poorly developed, and extending to oesophageal region. Posterior ovary well developed, reflexed, and ending in narrow ligament attached to hypodermis adjacent to intestinal ligament (Fig. 30B).

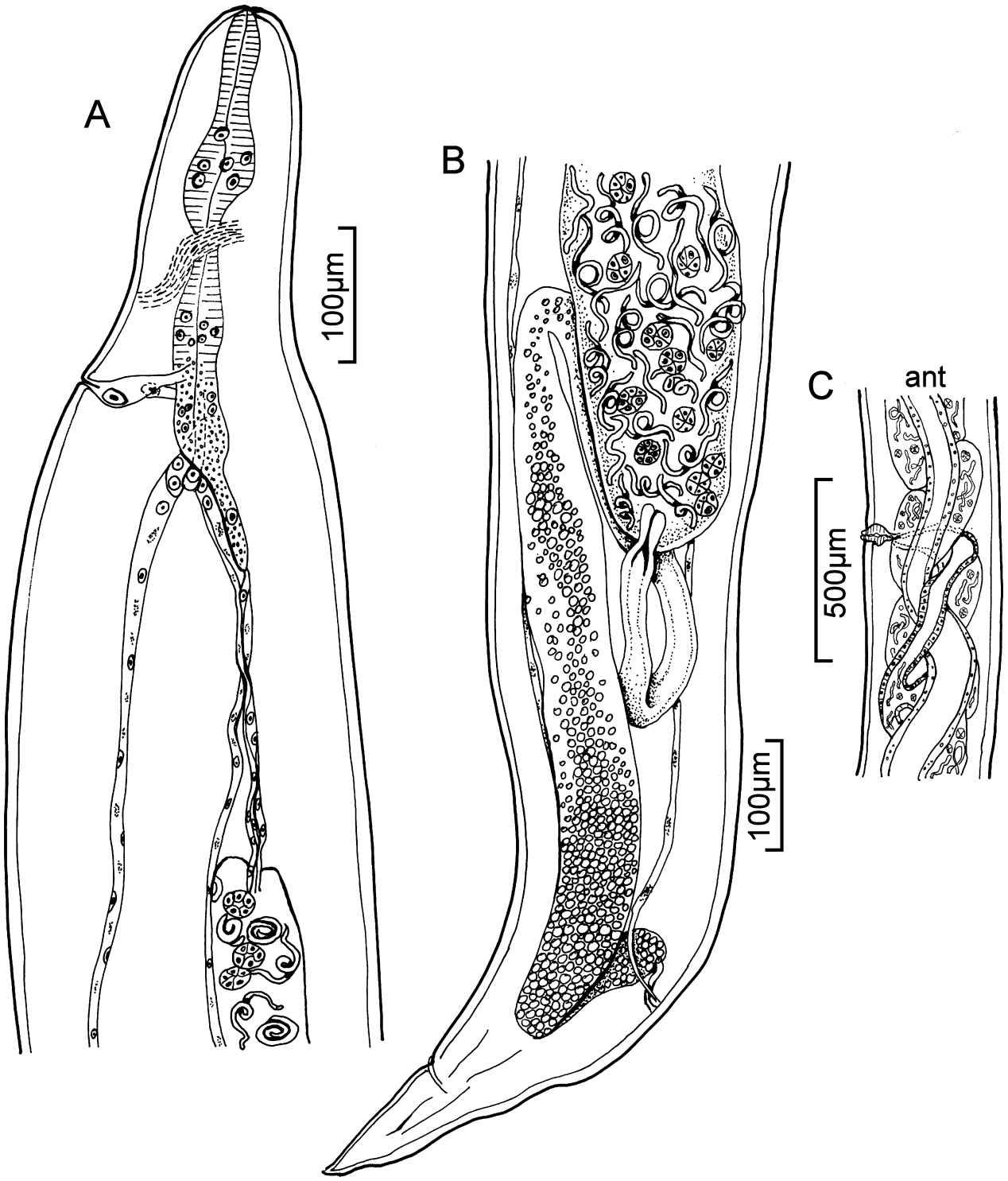

FIGURE 30. *Ichthyofilaria canadensis* Appy, Anderson & Khan, 1985. A. holotype, anterior end, lateral view; B. holotype, posterior end, lateral view; C. paratype, vulva and vagina, lateral view. (Redrawn from Appy *et al*. 1985)

Paratypes (15 gravid worms): 19 (8–28) long; maximum width 0.313 (0.127–0.469). Nerve ring 0.185 (0.155–0.229) and excretory pore 0.330 (0.242–0.447) from anterior end. Total length oesophagus 0.382 (0.263–0.375). Vulva 12.2 (4.6–18.7) from anterior end. Anus 0.320 (0.259–0.389) from posterior end.
Sites: body cavity, mesenteries
Hosts: *Lycodes lavalaei*; *Lycodes vahlii*
Distribution: Atlantic
Record: Appy *et al.* 1985

Philometra Costa, 1845

Generic diagnosis (after Yamaguti 1961). Philometridae. Males much smaller than females (males of some species unknown). Body filiform, anterior and posterior ends rounded. Mouth with or without lips. Head and tail papillae present or absent. Oesophagus cylindrical, short, bulbous at anterior end. Oesophageal gland confined to wall of oesophagus. Males with spicules equal, or almost so, slender; gubernaculum present. Vulva of gravid worms atrophied. Uteri occupy most of body. Ovaries amphidelphic. Parasites of body cavity and tissues of fishes.

Key to species of *Philometra*

1	Female mouth opening oval; 14 cephalic papillae arranged in two circles; subgravid worms < 60 mm long; oesophagus relatively long (> 3 mm)	*P. rubra*
-	Female mouth opening round; four cephalic papillae; gravid worms > 90 mm long; oesophagus relatively short (< 3 mm)	2
2	Female tail rounded, bearing two small lateral papillae	*P. cylindracea*
-	Female tail tapers, bearing small dorsally directed papilla	*P. kobuleji*

Philometra cylindracea (Ward & Magath, 1917) Van Cleave & Mueller, 1934

Synonym: *Ichthyonema cylindracea* Ward & Magath, 1917

Description (after Molnar & Fernando 1975a). With characteristics of the genus.

Males: transparent, minute, 2.7 (2.5–2.8) long. Greatest width close to posterior end, 0.035 (0.031–0.041); at nerve ring level, 0.025 (0.021–0.031). Cuticle smooth and thin. Head rounded; papillae not observed. Mouth three-lobed. Oesophagus a muscular tube 0.615 (0.572–0.680) long, with a well-developed oesophageal gland alongside. Intestine narrow. Tail end blunt, with two lateral papillae connected by a narrow inconspicuous membrane. Spicules relatively short, subequal, right one 0.060 (0.049–0.071), left one 0.061 (0.049–0.075). Gubernaculum 0.038 (0.034–0.043) long, in the form of a bent chitinous plate with a spear-like posterior end (Fig. 31A).

Females: Fully developed worms are coloured red and 97 (91–102) long. Body cylindrical, tapering slightly at both extremities; greatest width 0.9 (0.8–1.0). Cuticle thin and smooth. Body cavity filled by uterus full of larvae. Head rounded, with three lips and four inconspicuous papillae (Fig. 31B). Caudal end also rounded, showing two small lateral papillae (Fig. 31C). Oesophagus 2.3 (2.0–2.9) long, muscular and forming a bulb near mouth. Oesophageal gland very prominent with clearly visible nucleus at its centre (Fig. 31B). Intestine greater in width than posterior portion of oesophagus. Vulva atrophied. Two long, thin ovaries run in opposite directions connected by common uterine duct. Anterior ovary bent backwards near nerve ring region, the posterior one bent forwards at terminal end of intestine. Uterus packed with vigorously moving larvae; larvae are 0.36 (0.31–0.39) long and have rounded anterior ends and sharply attenuated tails (Fig. 31B,C).

Site: body cavity

Hosts: *Aplodinotus grunniens* (1); *Perca flavescens* (1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12); *Salvelinus fontinalis* (2, 13); *Sander vitreus* (1)

Distribution: Ontario, Quebec

Records: 1. Bangham & Hunter 1939 (ON); 2. Fantham & Porter 1948 (QC); 3. Bangham 1955 (ON); Tedla 1969 (ON); 4. Tedla & Fernando 1969a (ON); 5. Tedla & Fernando 1972 (ON); 7. Dechtiar 1972a (ON); 8. Molnar *et al.* 1974 (ON); 9. Molnar & Fernando 1975a (ON); 10. Dechtiar & Christie 1988 (ON); 11. Dechtiar & Nepszy 1988 (ON); 12. Dechtiar *et al.* 1988 (ON); 13. Marcogliese & Cone 1991a (QC)

Philometra kobuleji Molnar & Fernando, 1975

Description (after Molnar & Fernando 1975b). With characteristics of the genus.

Males: minute, transparent, 2.1–3.0 (2.5) long. Cylindrical body tapers slightly at anterior end. Greatest width, 0.056–0.061 (0.059) near tail end. Cuticle smooth and thin. Head rounded, papillae not observed. Mouth simple,

with three lips. Oesophagus muscular, slightly swollen near mouth, 0.375– 0.440 (0.418) long (Fig. 32A). Tail end blunt, with two prominent lateral papillae connected by inconspicuous membrane. Two spicules, almost equal; right one 0.109–0.134 (0.120), left one 0.106–0.126 (0.115) long. Gubernaculum a bent chitinous plate with spear-like end, 0.065–0.074 (0.072) long (Fig. 32B). Anus opens ventrally near posterior end.

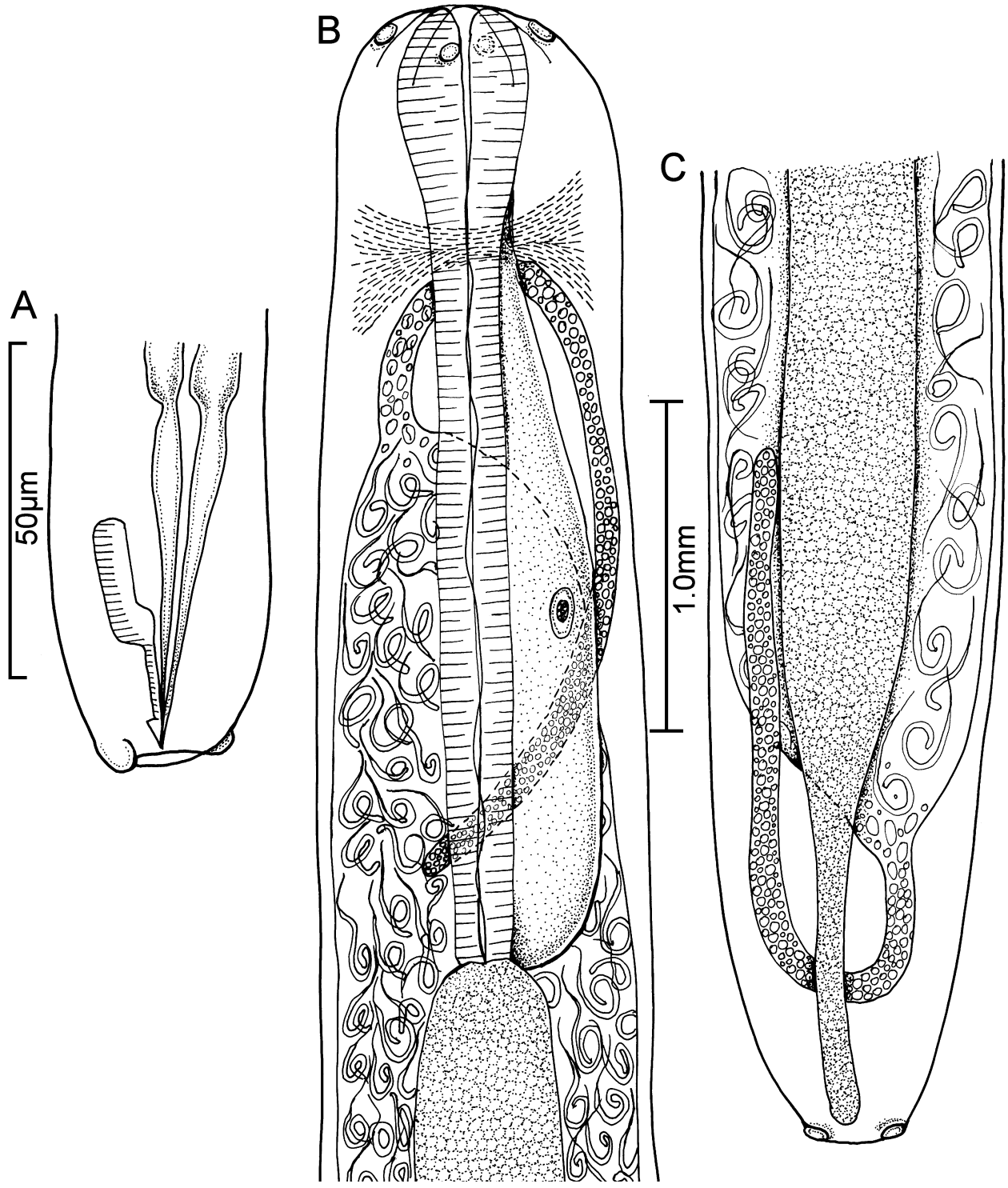

FIGURE 31. *Philometra cylindracea* (Ward & Magath, 1917) Van Cleave & Mueller, 1934. A. male, posterior end; B. female, anterior end; C. female, posterior end. (Redrawn from Molnar & Fernando 1975a)

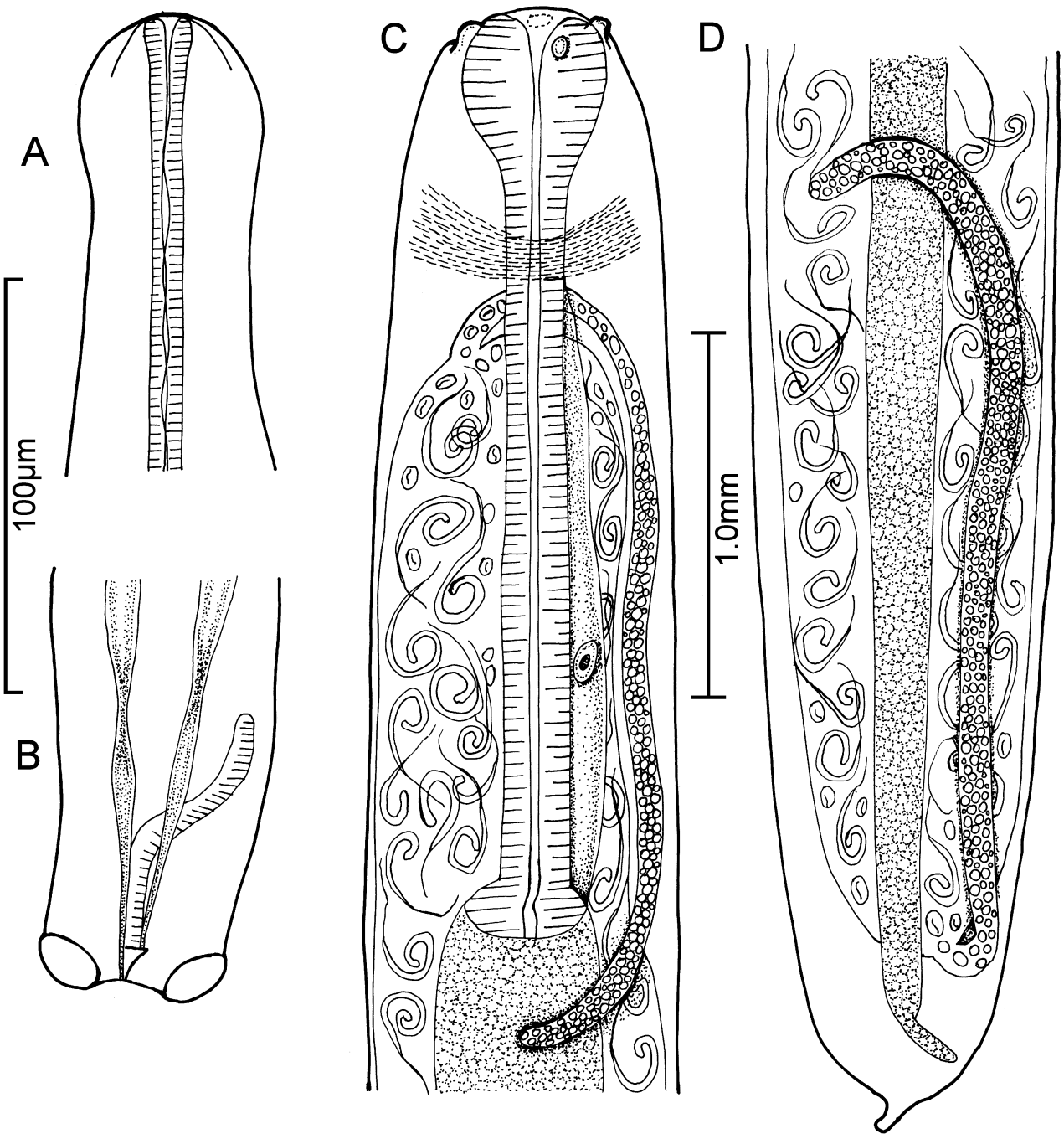

FIGURE 32. *Philometra kobuleji* Molnar & Fernando, 1975. A. male, anterior end; B. male, posterior end; C. female, anterior end; D. female, posterior end. (Redrawn from Molnar & Fernando 1975b)

Females: mature specimens red in colour, 86–97 (91) long. Body cylindrical, tapering at anterior and posterior ends. Cuticle smooth and thin. Body cavity dominated by uterus packed with larvae, 0.320–0.370 (0.350) long; larvae have rounded anterior end and sharply pointed tail (Fig. 32C,D). Head rounded, bearing pair of lateral amphids, and four fleshy papillae in submedian line. Rim of mouth with three lips. Tail tapers at tip, bearing small dorsally directed papilla (Fig. 32D). Oesophagus 1.1–1.4 (1.2) long, with bulb near mouth. Oesophageal gland moderately well developed. Nerve ring 0.3 from anterior end (Fig. 32C). Intestine ends blindly near tail tip (Fig. 32D). Vulva atrophied. Two ovaries joined by common uterine duct. Uteri end near nerve ring and anus (Fig. 32C,D).

Sites: body cavity, mesenteries, swim bladder

Host: *Catostomus commersonii*

Distribution: Ontario
Records: Molnar & Fernando 1975b; Chan 1980; Molnar *et al.* 1982

***Philometra rubra* (Leidy, 1856)**

Synonym: *Filaria rubra* Leidy, 1856

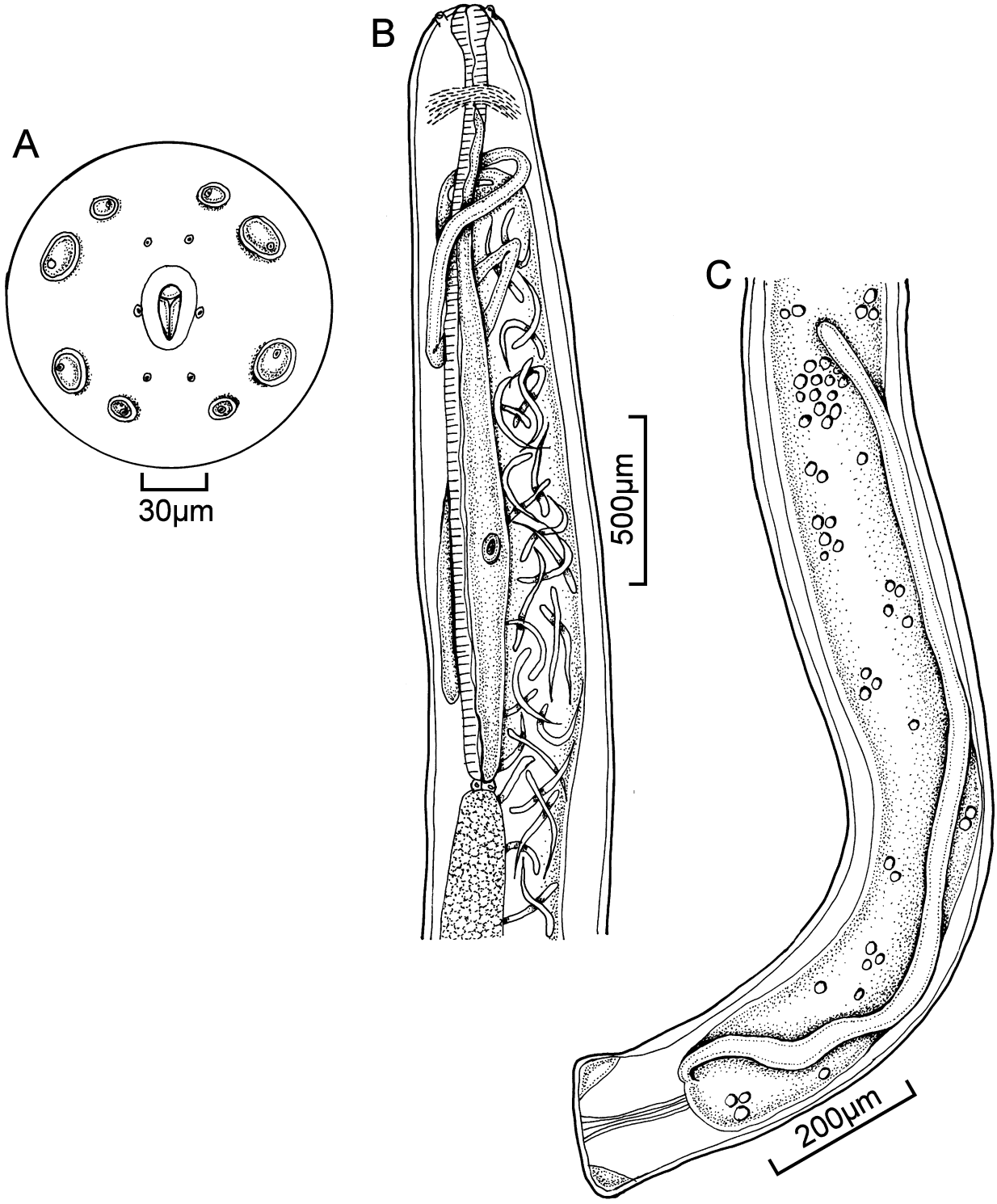

FIGURE 33. *Philometra rubra* (Leidy, 1856): gravid females. A. *en face* view; B. anterior end, lateral view; C. posterior end, dorso-ventral view. (Redrawn from Moravec *et al.* 2013)

Description (after Moravec *et al.* 2009a, and Moravec *et al*. 2013). With characteristics of the genus.

Males unknown.

Females: two gravid worms (measurements of four subgravid worms in parentheses) (after Moravec *et al.* 2013): body 108–184 (100–148) long. Maximum width 0.64–0.79 (0.64–0.68). Head end round, mouth opening small, dorso-ventrally elongate, surrounded by 14 cephalic papillae arranged in two circles, with lateral amphids. Four dorso-lateral and ventro-lateral papillae of outer circle large, dome shaped; four dorso-dorsal and ventro-ventral external papillae small; internal circle comprises one pair of minute lateral papillae and two pairs of minute sub-median papillae (Fig. 33A). Oesophagus 2.6–3.4 long (2.3–4.6). Well developed anterior muscular bulb, and oesophageal gland with large cell nucleus. Nerve ring 0.33–0.39 (0.27–0.53) from anterior end, small ventriculus, oesophagus opens into intestine through distinct valve (Fig. 33B). Intestine brown, ends blindly, attached by ligament to body wall near tail end (Fig. 33C). Vulva and anus absent. Ovaries long, narrow, amphidelphic, situated near anterior end (Fig. 33A) and posterior end (Fig. 33C). Uterus occupies most of body space, filled with 1st-stage larvae, 0.46–0.53 long (Fig. 33B), and eggs (Fig. 33C). Tail end of adults round in lateral view (Fig. 33D) and rectangular in dorso-ventral view (Fig. 33C), bearing two large papilla-like projections (Fig 33C).

Two subgravid worms (after Moravec *et al*. 2009a): body filiform, 40 and 59 long. Maximum width 0.48 and 0.50. Arrangement of head papillae and alimentary tract anatomy similar to that of gravid worms. Ovaries narrow, long, amphidelphic. Uterus filled with clusters of small spherical eggs.

Comment: the species identified by Séguin *et al*. (2011) as *Philometra* sp. from wild-hatched captive-raised *Morone saxatilis* in Canada probably represents *P. rubra*.

Sites: body cavity, mesenteries

Host: *Morone saxatilis*

Distribution: New Brunswick, Quebec

Records: 1. Hogans 1984 (NB); 2. Moravec *et al.* 2013 (NB, QC)

****_Philometra_ sp.**

Sites: body cavity, circulatory system, eye, gills, intestine

Hosts: *Aplodinotus grunniens* (7, 13); *Aulorhynchus flavidus* (5); *Catostomus catostomus* (9); *Catostomus commersonii* (10, 11, 14); *Coregonus artedi* (3, 4); *Coregonus clupeaformis* (3, 4); *Esox niger* (2); *Hypentelium nigricans* (11); *Lepomis gibbosus* (1); *Micropterus dolomieu* (8); *Micropterus salmoides* (12); *Morone saxatilis* (15); *Osmerus mordax* (4); *Perca flavescens* (2, 7, 8); *Pholis laeta* (5); *Platichthys stellatus* (5, 6); *Prosopium cylindraceum* (3, 4, 14); *Salvelinus fontinalis* (2)

Distribution: Ontario, New Brunswick, Pacific, Quebec

Records: 1. Bangham 1941 (ON); 2. Fantham & Porter 1948 (QC); 3. Bangham 1951 (ON); 4. Bangham 1955 (ON); 5. Arai 1967a (PA); 6. Arai 1969 (PA); 7. Dechtiar 1972a (ON); 8. Dechtiar 1972b (ON); 9. Hanek & Molnar 1974 (QC); 10. Molnar *et al.* 1974 (ON); 11. Mackie *et al.* 1983 (ON); 12. Dechtiar & Christie 1988 (ON); 13. Dechtiar & Nepszy 1988 (ON); 14. Dechtiar *et al.* 1989 (ON); 15. Séguin *et al.* 2011 (NB, QC)

Philometroides Yamaguti, 1935

Generic diagnosis (after Moravec 2013). Philometridae. Females much larger than males. Body cylindrical, long. Cuticle of females and males of some species covered with numerous bosses. Cephalic papillae present. Oesophagus short, cylindrical, expanded at anterior end; oesophageal gland usually well developed, mono- or multinucleate; small ventriculus present or absent. Vulva and anus atrophied in gravid worms. Ovaries amphidelphic. Viviparous. Male tail blunt or rounded with or without lobes. Two spicules and gubernaculum present. Parasitic in body cavity and tissues of fresh-water and marine fishes.

Key to species of _Philometroides_

1 Caudal, ventro-lateral, hypodermal extensions present; cuticle of both males and females covered with bosses; worms occur mainly in pectoral fins and occasionally in pelvic, dorsal and anal fins. . . . . *P. huronensis*

- Caudal hypodermal extensions absent; bosses absent from cuticle of males; worms occur mainly in subcutaneous tissues of head . . . . . *P. nodulosus*

Philometroides huronensis Uhazy, 1976

Description (after Uhazy 1976). With characteristics of the genus. Body cylindrical with bluntly narrowing

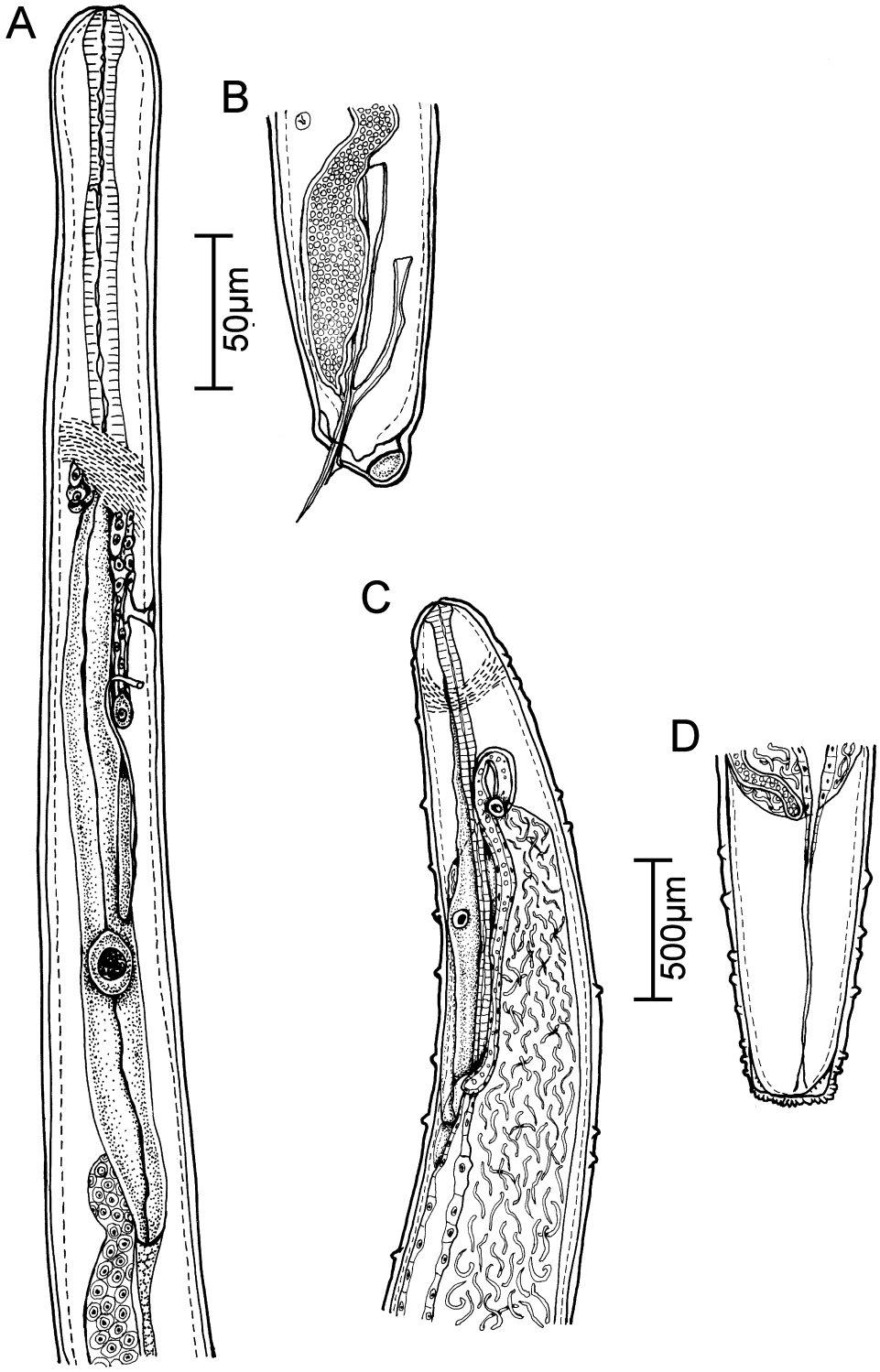

FIGURE 34. *Philometroides huronensis* Uhazy, 1976. A. male, anterior region, ventro-lateral view; B. male, posterior region, lateral view; C. gravid female, anterior region, lateral view; D. gravid female, posterior region, ventral view. (Redrawn from Uhazy 1976)

extremities. Cuticle longitudinally striated with numerous irregularly distributed bosses. Mouth opening surrounded by three lips. Cephalic papillae comprise six inner and four pairs outer papillae. Amphids distinct. Oesophagus inflated anteriorly with a short anterior muscular portion and longer posterior glandular portion. Dorsal oesophageal gland prominent. Nerve ring at posterior end of muscular oesophagus (Fig. 34A).

Mature males: 2.8–3.6 long, and 0.041–0.05 wide. Muscular oesophagus 0.159–0.245 and glandular oesophagus 0.214–0.398 long. Dorsal oesophageal gland large with distinct nucleus (Fig. 34A). Nerve ring 0.128–0.191, hemizonid 0.150–0.309, excretory pore 0.167–0.301, right anterior deirid 0.180–0.355, and left anterior deirid 0.197–0.356 from anterior end. Right posterior deirid 0.139–0.272, and left posterior deirid 0.310–0.513 from posterior end. Intestine ligament-like throughout its length. Monorchic testis at level of oesophago-intestinal junction. *Vas deferens* and ejaculatory duct packed with spermatozoa. Spicules slender, unequal: right one 0.122–0.140, left one 0.110–0.134, and gubernaculum 0.070–0.082 long. Anus subterminal. Caudal extremity distinctly lobed, with one pair pre-cloacal and two pairs post-cloacal papillae (Fig. 34B). Phasmids terminal. Cuticle longitudinally striated and covered with minute bosses.

Gravid females: 35.4–101.0 long, and 0.600–0.850 wide. Muscular oesophagus 0.29–0.48 and glandular oesophagus 1.0–1.9 long. Dorsal oesophageal gland large with distinct nucleus (Fig. 34C). Nerve ring 0.270–0.440 from anterior end. Uterus 34.0–98.8 long. Intestine ligamentous posteriorly; anus not patent. Caudal papillae absent. Prominent hypodermis giving rise to caudal, ventro-lateral extensions (Fig. 34D). Cuticular bosses distributed generally on body but clustered in regions of caudal hypodermal extensions (Fig. 34D). Amphidelphic, didelphic, uterus thin walled and packed with 1st-stage larvae 0.362–0.406 long. 97% of body length occupied by uterus (Fig. 34C,D). Ovaries often reflexed and close to anterior and posterior ends of body. Vulva and vagina absent (Fig. 34C,D).

Comments: Uhazy (1976) also provided measurements of subgravid and mature females.

Sites: fins, mesenteries, swim bladder, subcutaneous

Hosts: *Catostomus catostomus* (4, 5, 7, 10); *Catostomus commersonii* (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12); *Catostomus macrocheilus* (7, 10); *Moxostoma macrolepidotum* (4, 5)

Distribution: British Columbia, Manitoba, Ontario, Quebec

Records: 1. Uhazy 1976 (ON); 2. Uhazy & Anderson 1976 (ON); 3. Uhazy 1977a (ON); 4. Uhazy 1977b (ON); 5. Uhazy 1977c (ON); 6. Uhazy 1978 (ON); 7. Anon. 1978 (BC); 8. Chan 1980 (ON); 9. Molnar *et al.* 1982 (ON); 10. Arai & Mudry 1983 (BC); 11. Mackie *et al.* 1983 (ON); 12. Dubois *et al.* 1996 (QC)

Philometroides nodulosus **(Thomas, 1929) Dailey, 1967**

Synonym: *Philometra nodulosa* Thomas, 1929

Description (after Dailey 1966). With characteristics of the genus.

Males (five studied): cuticle smooth, lacking bosses. Body uniform in width except for anterior tapering, 2.39–2.68 long, and 0.031–0.048 wide. Mouth small with three unelevated lips; inner ring of four papillae and outer ring of four pairs of papillae, and pair of amphids (Fig.35A). Oesophagus 0.623–0.688 long. Oesophageal gland 0.414 long with large nucleus. Nerve ring just behind anterior oesophageal swelling. Posterior end truncated with two ventral and two dorsal rounded swellings. Anus median. Spicules subequal, left one 0.137–0.164 and right one 0.130–0.161 long. Gubernaculum 0.048–0.059 long with terminal barb (Fig. 35B). Seminal vesicle begins just behind oesophageal gland, extending posteriorly 1.46, and ending in slender *vas deferens* that leads to posterior end.

Females (five gravid and 20 subgravid worms studied): cuticle covered with numerous irregularly spaced, rounded bosses confined to the cortical layer. Body of uniform width except at anterior and posterior ends where it tapers slightly, 30.0–44.5 long and 0.370–0.602 wide. Mouth with three elevated fleshy lips, an inner ring of four and an outer ring of eight evenly spaced papillae, and a pair of amphids (Fig. 35C). Oesophagus 1.91–3.1 long. Small ventriculus with four appendices projecting into intestine. Oesophageal gland with large nucleus (Fig. 35D). Anus absent, intestine ending blindly near bluntly rounded posterior end. Anterior ovary loops over oesophagus and extends caudad; posterior ovary doubles back on itself to project anteriad (Fig. 35E). Ovaries lead into uterus (Fig. 35D,E). Uterus a single, blind tubule packed with ova containing developing 1st-stage larvae that occupy most of body-cavity.

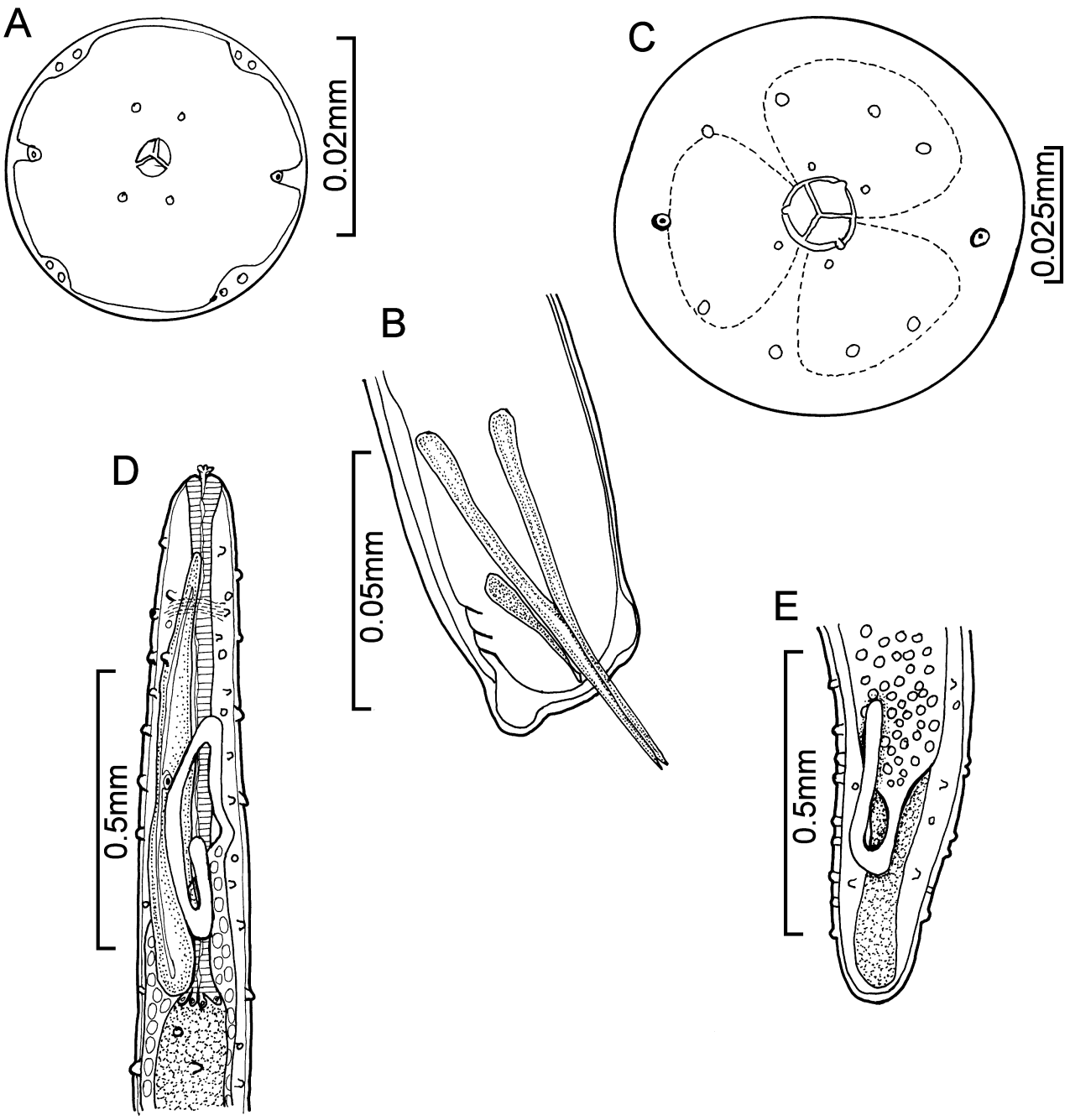

FIGURE 35. *Philometroides nodulosus* (Thomas, 1929) Dailey, 1967. A. adult male, *en face* view; B. adult male, posterior end, lateral view; C. adult female, *en face* view; D. adult female, anterior end, lateral view; E. adult female, posterior end, lateral view. (Redrawn from Dailey 1966)

Comments: Dailey (1966) is an unpublished PhD thesis in which it is claimed that males of *Philometroides nodulosus* were described for the first time. Dailey (1967) presumably refers to an abstract of that thesis in which the n. comb. was first widely publicised. Dailey (1967) has not been traced, and does not appear in the reference list of this part of the Guide therefore. Adding to the confusion, there appear to be discrepancies in the measurements provided in the foregoing description of *P. nodulosus* and the illustrations (see Figure 35). A redescription of *P. nodulosus* is justified.

Sites: cheek galleries, eye, gills, subcutaneous

Hosts: *Carpiodes cyprinus* (2, 6); *Catostomus catostomus* (7); *Catostomus commersonii* (1, 3, 4, 5, 6, 7, 8, 9, 10, 11)

Distribution: Manitoba, Ontario, Quebec

Records: 1. Fantham & Porter 1948 (QC); 2. Dechtiar 1972b (ON); 3. Chan 1980 (ON); 4. Molnar *et al.* 1982 (ON); 5. Dechtiar & Christie 1988 (ON); 6. Dechtiar & Nepszy 1988 (ON); 7. Dechtiar *et al.* 1988 (ON); 8. Dechtiar *et al.* 1989 (ON); 9. Szalai 1989 (MB); 10. Szalai *et al.* 1992 (MB); 11. Dubois *et al.* 1996 (QC)

**Philometroides* sp.

Site: eye
Host: *Catostomus commersonii*
Distribution: Ontario
Record: Chan 1980

Philonema Kuitunen-Ekbaum, 1933

Generic diagnosis (after Moravec 2013). Philometridae. Body thread-like, anterior end rounded, posterior end conical. Cuticle smooth. Cephalic papillae present or absent. Oesophagus short, posterior half expanded and containing multinucleate oesophageal gland. Females very much larger than males. Male tail coiled; cloaca remote from tail tip. Spicules simple, equal. Gubernaculum absent. Vulva and anus of gravid worms atrophied. Ovaries amphidelphic. Viviparous. Parasitic in body cavity and tissues of fishes.

Comments: Adamson *et al.* (1992) distinguished *Philonema agubernaculum* from *Oncorhynchus mykiss* and *P. oncorhynchi* from *O. nerka* on the basis of DNA restriction fragment length differences but did not provide morphological details. According to Moravec & Nagasawa (1999) the three recognized species of *Philonema* from salmonids (*P. agubernaculum*, *P. oncorhynchi* and *P. sibirica*) are inadequately described, especially regarding male caudal morphology, and cannot be distinguished one from another on the basis of the morphological features given in existing descriptions. For these reasons a key to distinguish *P. agubernaculum* from *P. oncorhynchi* has not been attempted here.

***Philonema agubernaculum* Simon & Simon, 1936

Synonym: ***Philonema salvelini* Richardson, 1936

Description (after Simon & Simon 1936). With characteristics of the genus.

Males: mean 16.5 (range 12–23) long; mean maximum width 0.296. Mean lengths of the muscular and glandular portions of the oesophagus are 0.404 and 1.122 respectively. Anus to tail tip averages 0.276. Spicules equal, sharply curved, lightly chitinized, mean length 0.284 (Fig. 36A).

Females: 86.1 (49–140) long; mean maximum width 0.771. Mean lengths of muscular and glandular oesophagus 0.553 and 1.172 respectively (Fig. 36B). Anus to tail tip averages 0.446 (Fig. 36C). Anus sometimes atrophied in gravid worms. Vulva and vagina atrophied in gravid worms. Small ovary present at each end of body. Uterus of gravid worms filled with embryos and occupying nearly all of the body cavity. Uteri of young specimens contains eggs in various stages of development. Eggs measure 0.032 x 0.046. Embryos 0.343 long.

Comments: ***P. agubernaculum* requires both redescription and much improved illustrations. A nerve ring is not mentioned in the original description so in Figure 36B one has been added in a position based on the anatomy of ***P. oncorhynchi* (see Fig. 37B,D).

Sites: body cavity, kidneys, liver, swim bladder

Hosts: *Coregonus artedi* (11, 15); *Coregonus clupeaformis* (6, 21); *Gasterosteus aculeatus* (8); *Oncorhynchus kisutch* (9, 11, 15, 33); *Oncorhynchus mykiss* (4, 7, 12, 14, 19, 21, 33); *Oncorhynchus nerka* (14, 21, 24, 26, 27, 29, 32, 36); *Osmerus mordax* (8); *Prosopium cylindraceum* (6); *Prosopium williamsoni* (12, 14, 19, 21, 35); *Salmo salar* (31); *Salvelinus alpinus* (5, 6, 10, 13, 16, 17, 18, 20, 22, 23, 25, 28, 34, 37); *Salvelinus fontinalis* (1, 2, 3, 6, 8, 30, 31); *Salvelinus malma (*14, 21); *Salvelinus namaycush* (6, 20, 21)

Distribution: Alberta, British Columbia, Labrador, Newfoundland, Northwest Territories, Pacific, Quebec

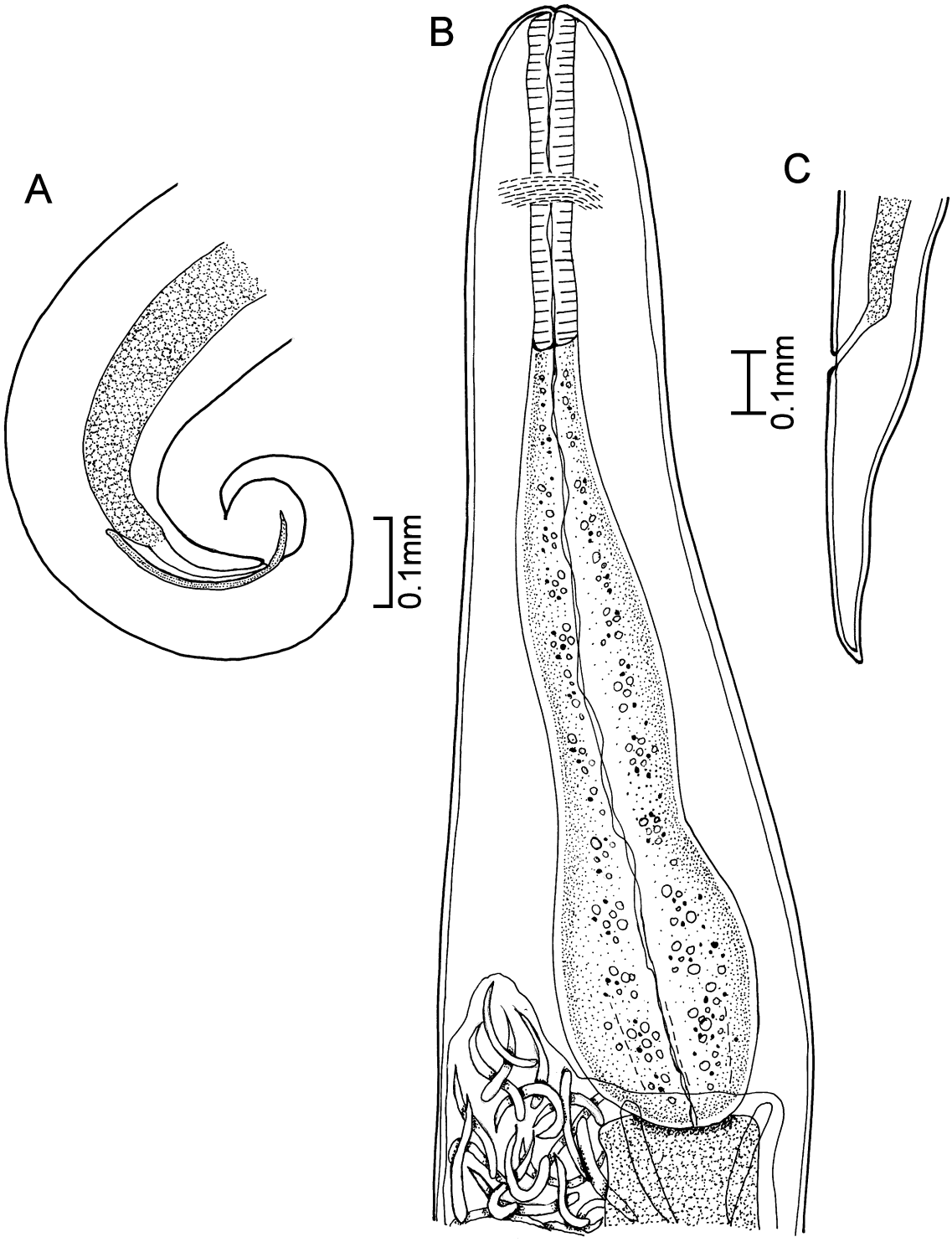

FIGURE 36. *Philonema agubernaculum* Simon & Simon, 1936. A. male, posterior end; B. female, anterior end; C. female, posterior end. (Redrawn from Simon & Simon 1936 but with the addition in B. of a nerve ring)

Records: 1. Richardson 1936a (QC); 2. Richardson 1936b (QC); 3. Sandeman & Pippy 1967 (NF); 4. Ko & Adams 1969 (BC); 5. Pippy 1970 (NF); 6. Hicks & Threlfall 1973 (LB); 7. Adams 1974 (EX, BC); 8. Hanek & Molnar 1974 (QC); 9. Leong & Holmes 1974 (AB); 10. Jamieson & Freeman 1975 (NT); 11. Leong 1975 (AB); 12. Anon. 1978 (BC); 13. Curtis 1979 (NU); 14. Anon. 1981 (BC); 15. Leong & Holmes 1981 (AB); 16. Dick & Belosevic 1981 (NT); 17. Curtis 1982 (NT); 18. Stewart & Bernier 1982 (NU); 19. Arai & Mudry 1983 (BC); 20. Stewart & Bernier 1983 (NT); 21. Anon. 1984 (BC); 22. Curtis 1984 (NT, QC); 23. Dick 1984 (NT);

24. Groot *et al.* 1984 (BC); 25. Stewart & Bernier 1984 (NT); 26. Bailey & Margolis 1987 (BC); 27. Bailey *et al.* 1988 (BC); 28. Bouillon & Dempson 1989 (LB); 29. Groot *et al.* 1989 (BC); 30. Marcogliese & Cone 1991a (LB, NL); 31. Marcogliese & Cone 1991b (NF); 32. Adamson *et al.* 1992 (BC); 33. Despres *et al.* 1995 (BC); 34. Kolasa & Curtis 1995 (QC); 35. Nener *et al.* 1995 (BC); 36. Bennett *et al.* 1998 (BC); 37. Desdevises *et al.* 1998 (QC)

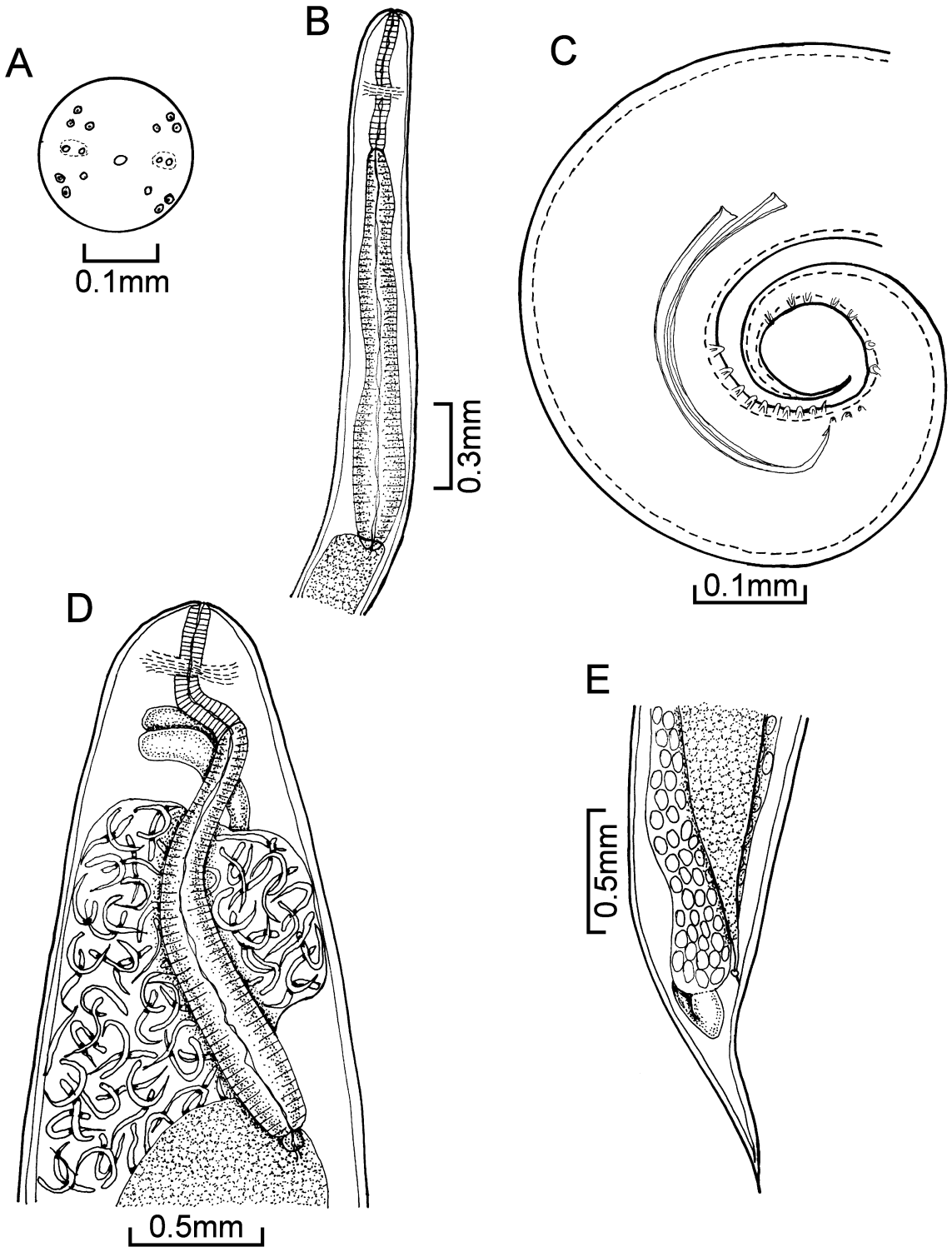

FIGURE 37. *Philonema oncorhynchi* Kuitunen-Ekbaum, 1933. A. female, *en face* view; B. male, anterior end, lateral view; C. male, posterior end, lateral view; D. gravid female, anterior end, with larvae in uterus; E. subgravid female, posterior end, with eggs in uterus. (Redrawn from Moravec & Nagasawa 1999a)

****_Philonema oncorhynchi_ Kuitunen-Ekbaum, 1933**

Description (after Moravec & Nagasawa 1999a). With characteristics of the genus. Body filiform, whitish in colour, cuticle smooth. Head end rounded, bearing two rings of small papillae: outer ring of four pairs of papillae, inner ring with four single papillae. Small lateral bifid amphids present (Fig. 37A). Mouth opening circular. Oesophagus comprises short and narrow anterior muscular portion, and longer and wider posterior glandular portion. Oesophagus enters intestine through valve. Intestine light coloured, relatively wide anterior end. Tail conical ending in sharp point.

Males: body 13.91–30.16 long, and 0.206–0.412 wide. Muscular oesophagus 0.444–0.762, and glandular portion 1.218–2.162 long. Nerve ring 0.261–0.391 from anterior end (Fig. 37B). Excretory pore not seen. Caudal end ventrally curved. Tail 0.331–0.566 long. Spicules equal, simple, needle-like, well sclerotized, 0.188–0.396 long. Pre-cloacal papillae: nine pairs small sessile subventral papillae, plus two subventral horn-like outgrowths or papillae separated by one unpaired median papilla on anterior cloacal lip. Post-cloacal papillae: nine pairs of small subventral papillae, distance between 2nd and 3rd greater than that between 3rd and 4th pairs (Fig. 37C).

Females (gravid worms with larvae): body 102.8–185.0 long, and 0.948–1.483 wide. Head end rounded, cephalic papillae indistinct in lateral view. Muscular oesophagus 0.433–1.092, and glandular portion 1.277–2.019 long. Nerve ring 0.252–0.453 from anterior end (Fig. 37D). Excretory pore not seen. Anal opening absent. Vulva and vagina atrophied. Uterus amphidelphic, occupying most of body space, containing many 1st-stage larvae; it extends anteriorly to oesophagus level (Fig. 37D), and posteriorly a little behind end of intestine (Fig. 37E). Anterior and posterior ovaries reflexed, relatively short (Fig. 37D,E).

Larvae from uterus variable in shape and size, 0.392–0.580 long, 0.020–0.028 wide. Head end with small dorsal tooth. Tail sharply pointed (Fig. 37E).

Sites: body cavity, mesenteries, swim bladder

Hosts: *Carassius auratus* (25); *Oncorhynchus clarkii* (6); *Oncorhynchus gorbuscha* (9, 31); *Oncorhynchus kisutch* (6); *Oncorhynchus mykiss* (6, 16, 25); *Oncorhynchus nerka* (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 25, 26, 27, 28, 29, 30, 32, 33, 34, 35); *Oncorhynchus tshawytscha* (5, 23, 24); *Salvelinus malma* (6)

Distribution: British Columbia, Ontario, Pacific

Records: 1. Kuitunen-Ekbaum 1933a (PA); 2. Kuitunen-Ekbaum 1933b (PA); 3. Smedley 1933 (BC); 4. Kuitunen-Ekbaum 1937a (BC); 5. Margolis 1952b (PA); 6. Bangham & Adams 1954 (BC); 7. Dombrowski 1955 (BC); 8. Margolis 1956 (BC, PA); 9. Margolis 1957 (BC, PA); 10. Margolis 1963 (BC, PA); 11. Bashirullah & Adams 1966 (BC); 12. Platzer 1966 (BC); 13. Platzer & Adams 1967 (BC); 14. Ko & Adams 1969 (BC); 15. Adams 1969 (EX, BC); 16. Bell & Hoskins 1971 (BC); 17. Lewis 1973 (BC); 18. H. D. Smith 1973 (BC); 19. Adams 1974 (BC); 20. Lewis *et al.* 1974 (BC); 21. Bell & Margolis 1976 (BC); 22. Boyce & Yamada 1977 (BC); 23. Anon. 1978 (BC); 24. Arai & Mudry 1983 (BC); 25. Bashirullah 1983 (EX, BC); 26. Bashirullah & Adams 1983 (BC); 27. Groot *et al.* 1984 (BC); 28. Bailey & Margolis 1987 ((BC); 29. Wood *et al.* 1987 (BC); 30. Bailey *et al.* 1988 (BC); 31. Dechtiar & Lawrie 1988 (ON); 32. Groot *et al.* 1989 (BC); 33. Garnick & Margolis 1990 (BC); 34. Adamson *et al.* 1992 (BC); 35. Després *et al.* 1995 (BC)

****_Philonema_ sp.**

Sites: body cavity, peritoneum, stomach, testes

Hosts: *Acrocheilus alutaceus* (6); *Catostomus commersonii* (17); *Coregonus artedi* (2, 19); *Coregonus clupeaformis* (15, 16); *Coregonus* sp. (5); *Esox lucius* (5); *Oncorhynchus clarkii* (14); *Oncorhynchus kisutch* (12, 13); *Oncorhynchus mykiss* (15, 16, 18); *Oncorhynchus nerka* (10, 11, 15, 16, 20); *Oncorhynchus tshawytscha* (12, 13); *Prosopium cylindraceum* (6); *Prosopium williamsoni* (6, 11, 15, 16); *Salvelinus alpinus* (7, 8); *Salvelinus fontinalis* (4, 9); *Salvelinus malma* (15, 16); *Salvelinus namaycush* (1, 2, 3, 5); *Thymallus arcticus* (15, 16)

Distribution: Alberta, Labrador, Manitoba, Northwest Territories, Ontario, Pacific, Quebec

Records: 1. MacLulich 1943 (ON); 2. Miller 1945 (AB, NT); 3. Miller & Kennedy 1948 (NT); 4. Munroe 1949 (LB, QC); 5. Rawson 1951 (NT); 6. Bangham & Adams 1954 (BC); 7. Andrews & Lear 1956 (LB); 8.

Thomson 1957 (NT); 9. Pippy 1965 (NF); 10. Wood 1965 (BC); 11. Meredith 1966 (BC); 12. Arai 1967a (PA); 13, Arai 1969 (PA); 14. Hoskins *et al.* 1976 (BC); 15. Anon. 1978 (BC); 16. Arai & Mudry 1983 (BC); 17. Poole 1983 (MB); 18. Margolis 1984 (PA); 19. Nelson & Paetz 1992 (AB); 20 Després *et al.* 1995 (BC)

Philometridae gen. sp.

Sites: musculature, subcutaneous
Hosts: *Gobiesox maeandricus*; *Platichthys stellatus*; *Paraplagusia bilineata*; *Rhodymenichthys dolichogaster*
Distribution: Pacific
Record: Kuitunen-Ekbaum 1933a
Comment: Kuitunen-Ekbaum (1933a) reported "*Philometra sanguinea*" from the four species listed above, the fishes having been caught in Departure Bay, BC. The identification cannot be confirmed in the absence of a description or illustration. In any event, Rasheed (1963) referred this philometrid species to the genus *Philometroides*. Moravec (2013), for example, described and illustrated *Philometroides sanguineus* from *Carassius* spp., these hosts being fresh-water cyprinids, rather than species of marine fishes. For these reasons it is best to list the record merely as a philometrid.

Superfamily GNATHOSTOMATOIDEA Railliet, 1895

Family GNATHOSTOMATIDAE Railliet, 1895

***Spiroxys contortus* (Rudolphi, 1819) Schneider, 1866**

Preamble: Because an account of L3 from fishes does not appear to be available, Bartlett & Anderson's (1985) description of specimens from snails *Lymnaea stagnalis* is given here.

L3 variable in length: short ones 1.8 (1.6–2.0); longer ones—on which the remainder of the description is based—2.7 (2.5–2.9) long. Maximum width 0.064 (0.058–0.070). Anterior end with two pseudolabia, eight cephalic papillae, and two lateral amphids. Cuticle thick, with fine transverse striations. Nerve ring 0.155 (0.140–0.160) and excretory pore 0.200 (0.190–0.220) from anterior end. Deirids 0.080 (0.065–0.095) behind excretory pore. Buccal cavity 0.019 (0.016–0.020) long. Oesophagus 0.90 (0.78–1.09) long, and divided near nerve ring into anterior muscular and posterior glandular portions (Fig. 38A). Genital primordium oval, 1.8 (1.6–2.1) from anterior end. One post-deirid present near genital promordium. Anus 0.078 (0.070–0.090) from posterior extremity. Phasmids large, protuberant. Tail tapers to point (Fig. 38B).
Site: mesenteries
Hosts: *Ameiurus nebulosus*; *Perca flavescens*
Distribution: Ontario
Record: Molnar *et al.* 1974

***Spiroxys* sp.**

Sites: alimentary tract, mesenteries, viscera
Hosts: *Ambloplites rupestris* (9); *Ameiurus nebulosus* (9); *Catostomus commersonii* (5); *Catostomus macrocheilus* (3); *Culaea inconstans* (13); *Etheostoma nigrum* (2, 4); *Fundulus diaphanus* (6); *Lepisosteus osseus* (9); *Lepomis gibbosus* (3, 7); *Luxilus cornutus* (13); *Micropterus dolomieu* (11); *Morone chrysops* (11); *Notropis heterolepis* (2, 12); *Notropis hudsonius* (4); *Perca flavescens* (2, 4, 8); *Phoxinus neogaeus* (13); *Pimephales notatus* (2); *Ptychocheilus oregonensis* (3); *Rhinichthys cataractae* (10); *Richardsonius balteatus* (3); *Semotilus atromaculatus* (13); *Umbra limi* (1, 9, 12)
Distribution: British Columbia, Nova Scotia, Ontario
Records: 1. Bangham & Hunter 1939 (ON); 2. Bangham 1951 (ON); 3. Bangham & Adams 1954 (BC); 4.

Bangham 1955 (ON); 5. Dechtiar 1972a; 6. Wiles 1975 (NS); 7. Cone & Anderson 1977 (ON); 8. Baker 1984b (ON); 9. Dechtiar & Christie 1988 (ON); 10. Dechtiar & Lawrie 1988 (ON); 11. Dechtiar & Nepszy 1988 (ON); 12. Dechtiar *et al.* 1988 (ON); 13. Dechtiar *et al.* 1989 (ON)

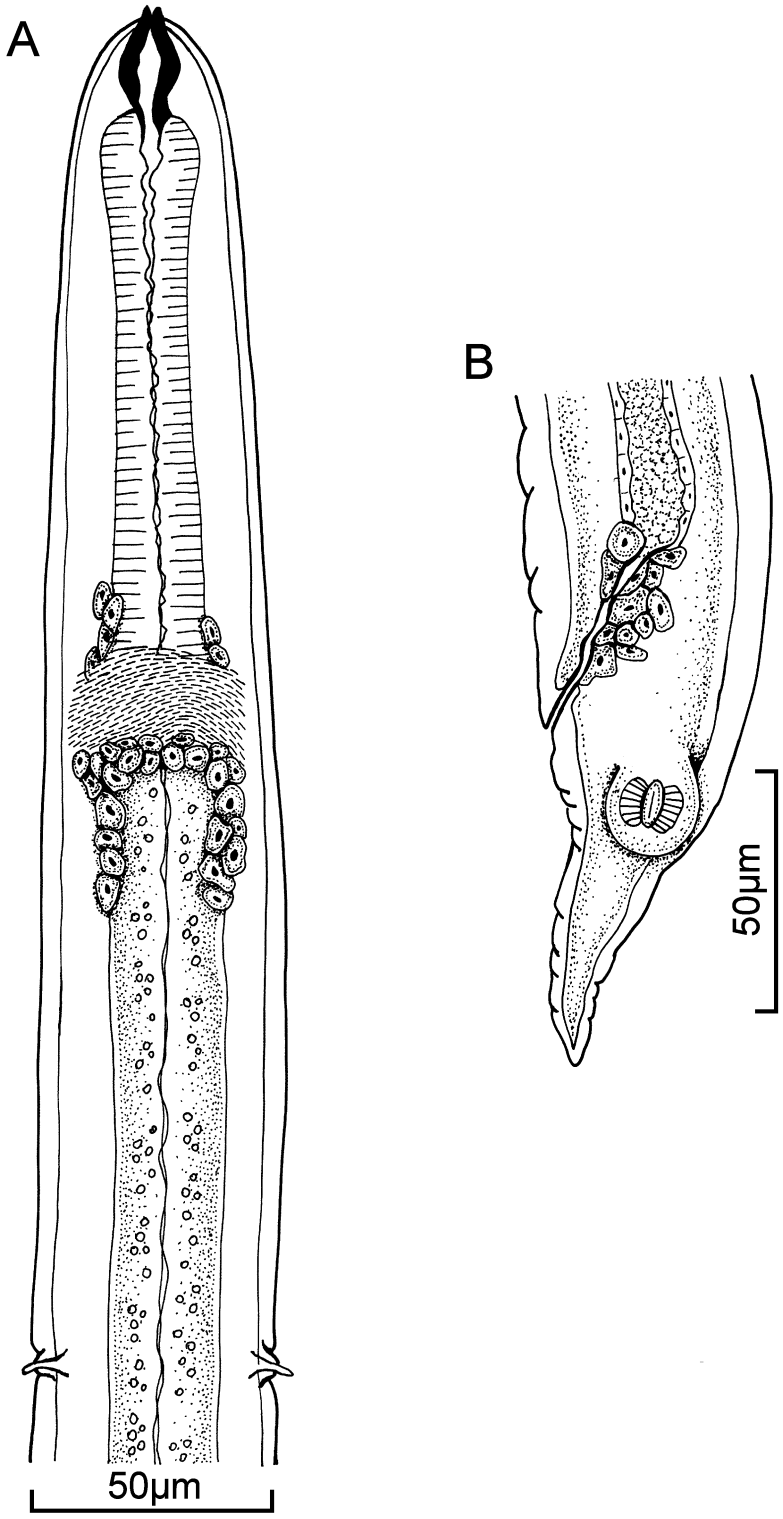

FIGURE 38. **Spiroxys contortus* (Rudolphi, 1819) Schneider, 1866. A. anterior end, dorso-ventral view; B. posterior end, lateral view. (Redrawn from Bartlett & Anderson 1985)

Infraorder OXYURIDOMORPHA

Superfamily OXYUROIDEA

There appears to be only one record of a member of this Superfamily in a Canadian species of fish, namely that of Arthur (1978) [repeated by Arthur & Arai 1980a]. No morphological details were provided.

Oxyuroidea gen. sp. larva type 1

Site: gill washings
Host: *Clupea pallasi*
Distribution: Pacific
Records: Arthur 1978; Arthur & Arai 1980a

Superfamily CAMALLANOIDEA Travassos, 1920

Family CAMALLANIDAE Railliet & Henry, 1915

Family diagnosis (after Moravec 2013). Outer circle of cephalic papillae comprising four large and four rudimentary papillae; inner circle formed by six very small papillae. Buccal cavity strongly sclerotized, laterally compressed and forming two sclerotized lateral valves, or rounded. Mouth opening slit-like or rounded. Lips absent or rudimentary. Pseudolabia absent. Oesophagus divided into anterior muscular and posterior glandular sections. Spicules unequal. Gubernaculum present or absent. Vulva near mid-body. Viviparous. Parasites of cold-blooded vertebrates.

Key to genera of CAMALLANIDAE

1 Longitudinal bands sustaining the two lateral valves of the divided buccal capsule continuous . . . . . *Camallanus*
- Longitudinal bands sustaining the two lateral valves transformed posteriorly into rows of spines or a few combs . . . . . *Oncophora*

Camallanus Railliet & Henry, 1915

Generic diagnosis (after Moravec 2013). Camallanidae. Mouth opening slit-like. Buccal capsule divided into two lateral valves; buccal cavity behind valves reduced to basal ring; longitudinal thickenings (bands) sustaining buccal valves continuous, smooth or armed with denticles, not separated into ventral and dorsal groups; tridents present. Usually six to seven pairs of pre-cloacal papillae in males. Spicules unequal. Parasites of alimentary tract of fishes and amphibians.

Key to species of *Camallanus*

1 Head straight, not bent ventrally. Males < 9.0 long, with 11 pairs of pedunculate caudal papillae: six pairs pre-cloacal, five pairs post-cloacal. Female tail > 1.5 long . . . . . *C. oxycephalus*
- Head bent slightly ventrally. Males > 9.0 long, with 11 pairs of pedunculate and two pairs of sessile, caudal papillae: one sessile and seven pedunculate pairs pre-cloacal, one sessile and four pedunculate pairs post-cloacal. Female tail < 0.6 long . . . . . *C. ancylodirus*

****_Camallanus ancylodirus_ Ward & Magath, 1917**

Description (after Baker 1979). With characteristics of the genus. Slender worms with blunt anterior end, and

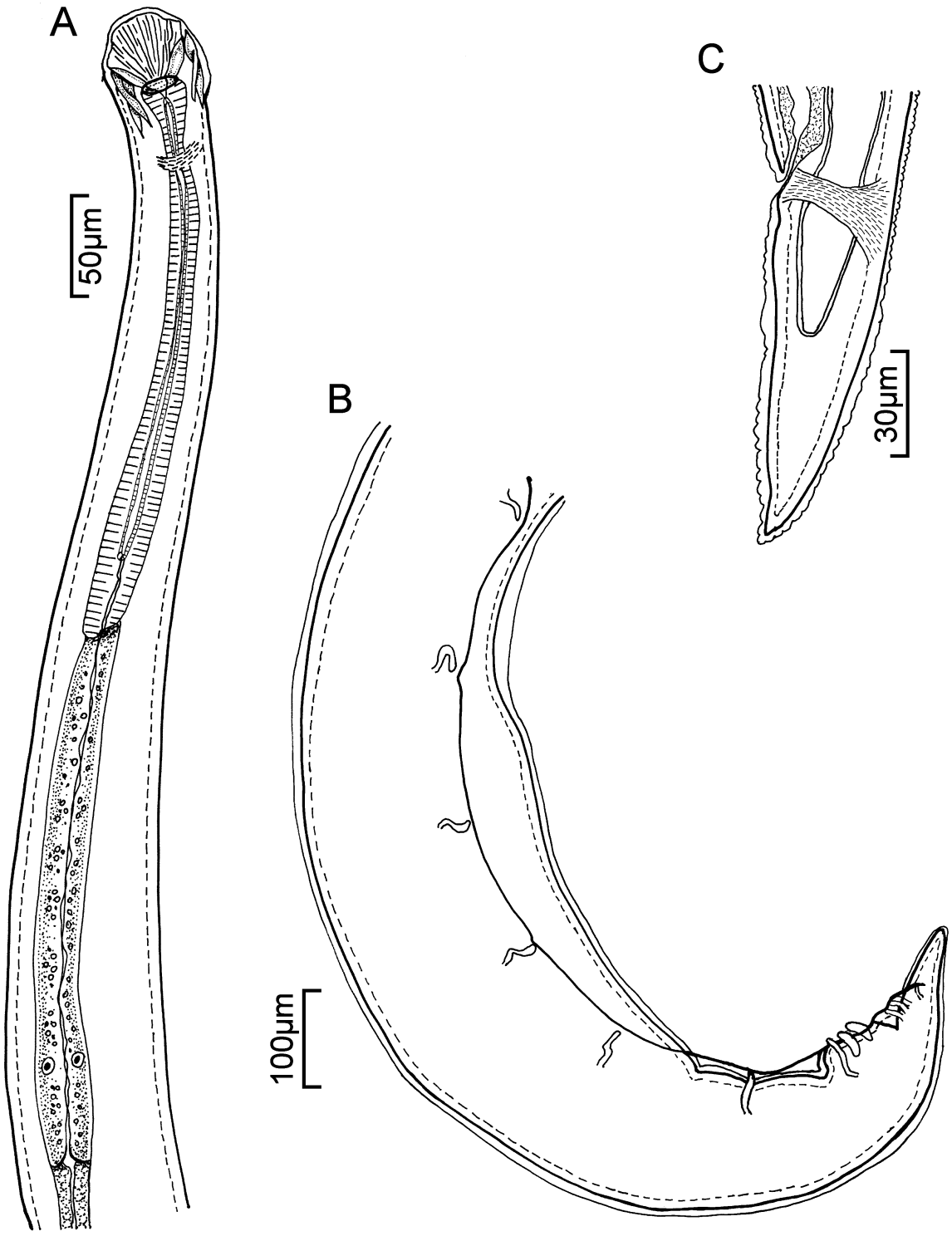

FIGURE 39. *Camallanus ancylodirus* Ward & Magath, 1917. A. female, anterior end, lateral view; B. male, posterior end, lateral view; C. female, posterior end, lateral view. (Redrawn from Baker 1979)

posterior end. Males about two-thirds size of gravid females. Head bent slightly ventrally in mature worms. Cuticle 0.007 thick with faint longitudinal and transverse striations. Mouth opening elongate. Four cephalic papillae observed. Amphids not observed. Buccal capsule with identical lateral valves, each with numerous irregular,

slender, longitudinal ridges. A pair of sclerotized plates near anterior margin of each buccal valve. Posterior end of buccal cavity surrounded by prominent sclerotized ring. Tridents prominent, with pair of elongate, equal, lateral processes and elongate medial process. Oesophagus divided into slender anterior muscular portion and slender posterior glandular portion (Fig. 39A).

Males (two specimens): 15.2 and 17.1 long. Buccal valves 0.137 and 0.39, tridents 0.173 and 0.186, muscular oesophagus 1.08 and 1.15, and glandular oesophagus 0.70 and 1.00 long. Nerve ring 0.318 and 0.346 from anterior end. Posterior end with prominent protuberance in anal region and ventral groove-like constriction in mid-region of tail. Tail 0.138 and 0.157 long, tapering to blunt terminal point. Caudal end with 11 pairs of subventral pedunculate papillae distributed as follows: seven pre–cloacal pairs arranged in two rows with papillae in each row evenly spaced, and four post-cloacal pairs with the three most anterior pairs arising closely together from hypodermis. All pedunculate caudal papillae contained within prominent caudal alae. Hypodermal protuberance in anal region with one pre-cloacal and one post-cloacal pair of sessile papillae. Sessile papillae with band of thick cuticle extending laterally to base of protuberance (Fig. 39B). Spicules prominent, unequal, curved in lateral view, with blunt capitulum and tubular shaft ending distally in sharp point. Right spicule with robust shaft, 0.277–0.290 long; left one relatively slender, 0.218–0.239 long.

Females (four specimens): 24.2–26.2 long. Buccal valves 0.170–0.186, tridents 0.178–0.215, muscular oesophagus 1.16–1.39, and glandular oesophagus 1.31–1.39 long. Nerve ring 0.337–0.361 from anterior end. Vulva small and round, opening into cup-shaped projection of the cuticle, 9.4–11.5 from posterior end. Cuticle beside vulva forming an elongate ridge about 0.250 long. Tail 0.451–0.480 long, tapering to blunt point. Anus inconspicuous. Posterior part of uterus extending behind anus to mid-region of tail (Fig. 39C). Uterus contains numerous larvae.

Site: intestine

Host: *Carpiodes cyprinus*

Distribution: Ontario

Record: Dechtiar & Nepszy 1988

*****Camallanus oxycephalus*** **Ward & Magath, 1917**

Description (after Stromberg *et al*. 1973). With characteristics of the genus.

Slender worms, widest in middle third of body and tapering slightly towards tail. Living worms red in colour. Cuticle with barely perceptible striae. Head straight, not bent ventrally. Mouth opening elongate. Buccal capsule divided into two sclerotized lateral valves with smooth longitudinal rib-like thickenings internally; inflation of valves forms sclerotized ring at junction of buccal cavity and oesophagus. Two trident-shaped processes at junction of valves, one dorsal, one ventral (Fig. 40A). Three pairs of simple circumoral papillae in outer circle; two pairs in inner circle at dorsal and ventral ends of mouth opening. Oesophagus with anterior club-shaped muscular portion, and posterior cylindrical glandular portion. Intestine straight. Anal lips slightly protruding.

Males: 4.57 (4.43–5.20) long; width 0.15 (0.12–0.18). Buccal capsule 0.103 (0.096–0.112) by 0.100 (0.096–0.107). Tridents 0.094 (0.086–0.104) long. Muscular oesophagus 0.390 (0.360–0.422), and glandular oesophagus 0.461 (0.428–0.530) long. Nerve ring 0.168–0.210 from anterior end. Single testis reaching almost to glandular oesophagus, then reflexed; reproductive tract with several swollen portions separated by constrictions. Tail 0.121 (0.109–0.136) long, rolled ventrally in mature worms, ending bluntly without a mucron. Thin caudal alae supported by papillae. Six pairs pre-cloacal, five pairs post-cloacal papillae. Spicules unequal but similar, left one weakly sclerotized, right one heavily so, 0.154 (0.146–0.166) long. Gubernaculum absent (Fig. 40B).

Females: 18.18 (15.93–25.05) long. Buccal capsule 0.137 (0.128–0.142) by 0.151 (0.136–0.165). Tridents 0.138 (0.134–0.144) long. Muscular oesophagus 0.569 (0.483–0.666), glandular oesophagus 0.652 (0.558–0.748) long. Nerve ring 0.262 (0.222–0.300) from anterior end. Vulva 2.24–3.11 from tail tip, lips slightly protruding. Vagina very muscular, directed posteriorly. Single ovary reaching level of muscular oesophagus, then reflexing; posterior branch of uterus reaching tail end, ending blindly in an highly muscular sac. Tail 1.87 (1.53–2.21) long, bluntly rounded without mucron (Fig. 40C). Ovoviviparous: larvae 0.635 (0.629–0.645) long.

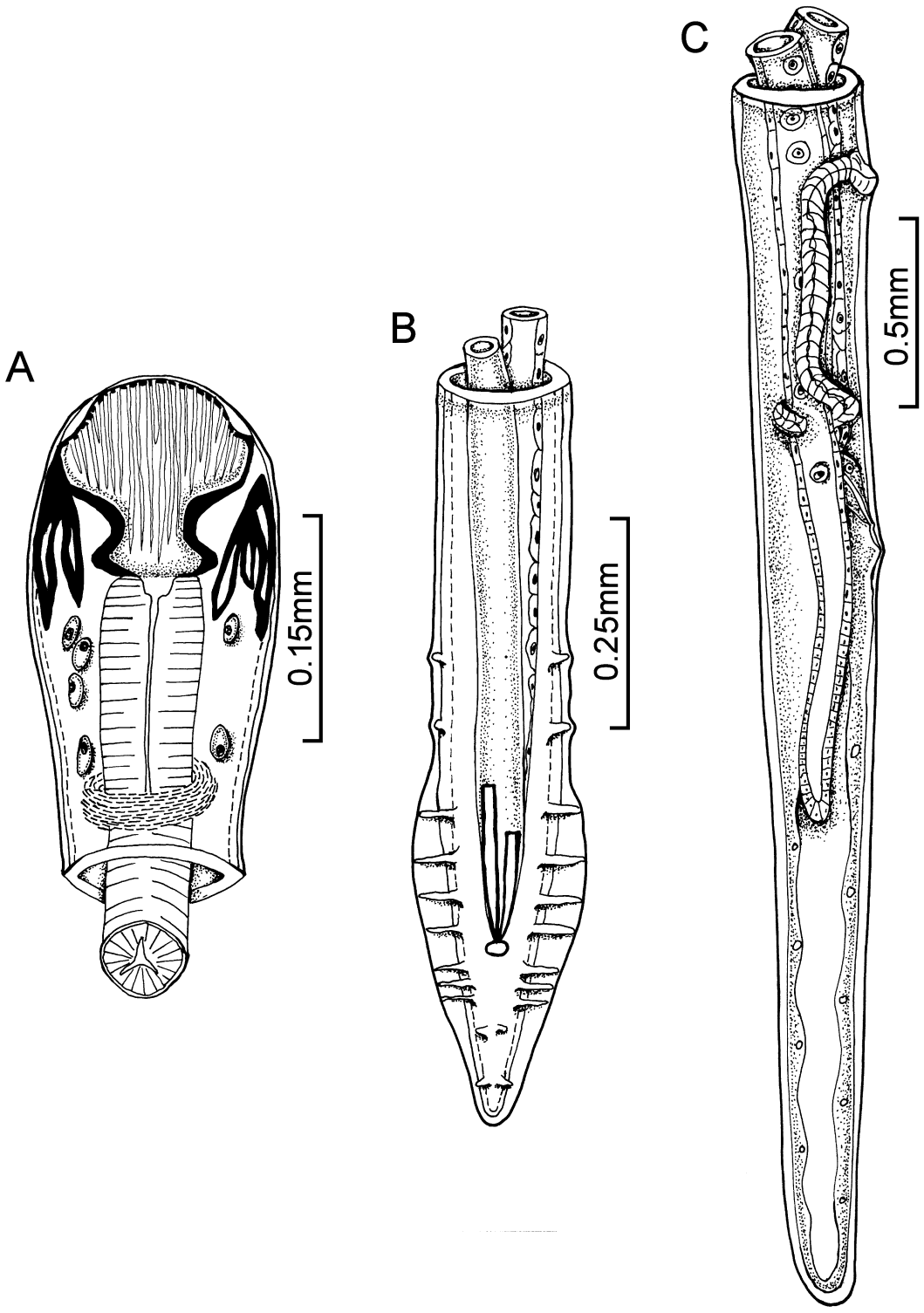

FIGURE 40. *Camallanus oxycephalus* Ward & Magath, 1917. A. adult, buccal capsule, lateral view; B. male, posterior end, ventral view; C. female, posterior end, lateral view. (A. redrawn from Stromberg & Crites 1974; B. and C. redrawn from Stromberg *et al*. 1973)

Site: intestine

Hosts: *Ambloplites rupestris* (1, 2, 7); *Ameiurus nebulosus* (4); *Ammocrypta pellucida* (1); *Aplodinotus grunniens* (1, 9); *Carpiodes cyprinus* (4, 9); *Catostomus commersonii* (3, 6); *Cottus bairdii* (3); *Culaea inconstans* (3); *Cyprinella spiloptera* (1); *Esox lucius* (7); *Etheostoma blennioides* (1); *Etheostoma exile* (3, 7); *Fundulus diaphanus* (7); *Hiodon tergisus* (1); *Ictalurus punctatus* (1); *Labidesthes sicculus* (1); *Lepomis gibbosus* (1, 7); *Lepomis macrochirus* (7); *Lota lota* (3); *Micropterus dolomieu* (1, 2, 3, 7, 8, 9, 10, 11); *Micropterus salmoides*

(1); *Morone chrysops* (1, 2, 9); *Notemigonus crysoleucas* (7, 12); *Notropis atherinoides* (1); *Notropis buccatus* (1); *Notropis heterodon* (1); *Notropis heterolepis* (1); *Notropis hudsonius* (1); *Notropis stramineus* (1); *Noturus flavus* (1); *Oncorhynchus kisutch* (7); *Perca flavescens* (1, 3, 9); *Percina caprodes* (1, 3, 7); *Percina copelandi* (1); *Percina maculata* (1); *Percopsis omiscomaycus* (1); *Pomoxis nigromaculatus* (1, 2, 7); *Rhinichthys cataractae* (1); *Salmo salar* (5); *Sander canadensis* (1, 3); *Sander vitreus* (1, 9)

Distribution: Nova Scotia, Ontario

Records: 1. Bangham & Hunter 1939 (ON); 2. Bangham 1955 (ON); 3. Dechtiar 1972a (ON); 4. Dechtiar 1972 b (ON); 5. Hare & Frantsi 1974 (NS); 6. Chan 1980 (ON); 7. Dechtiar & Christie 1988 (ON); 8. Dechtiar & Lawrie 1988 (ON); 9. Dechtiar & Nepszy 1988 (ON); 10. Dechtiar *et al.* 1988 (ON); 11. Dechtiar *et al.* 1989 (ON); 12. Forest & Cone 2011 (ON)

Camallanus sp.

Site: alimentary tract

Hosts: *Acipenser fulvescens* (4); *Esox lucius* (2); *Perca flavescens* (1, 3)

Distribution: Hudson Bay Drainage, Labrador, Manitoba, Ontario

Records: 1. Tedla 1969 (ON); 2. Threlfall & Hanek 1970b (LB); 3. Tedla & Fernando 1972 (ON); 4. Choudhury & Dick 1998 (HBD, MB)

Oncophora Diesing, 1851

Generic diagnosis (after Baudin-Laurencin 1971, Petter 1979, and Pinto *et al.* 1988). Camallanidae. Body elongated, tapering at each end. Buccal capsule with two valves, marked internally by numerous interrupted ridges in both sexes. Mouth opening slit-like. Pair of tridents associated with buccal capsule. Oesophagus comprises an anterior muscular portion, and a posterior glandular portion of about equal length. Cuticle thin, finely striated in both sexes.

One species, *O. melanocephala*, is known from one fish species in Canada.

Oncophora melanocephala (Rudolphi, 1819) Baudin-Laurencin, 1971

Description (after Moravec *et al*. 1999). With characteristics of the genus. Relatively large worms with elongate body, adult females much longer than males; body of both sexes broadest posteriorly. Cuticle thick with fine, dense transverse striations. Body white, only buccal capsule darkly coloured, almost black. Mouth opening slit-like, formed by two lateral valves, strengthened on inner face by about 20 thin longitudinal thickenings (ribs or ridges) extending posteriorly to its base; a few ridges usually incomplete. Each valve has one dorso-lateral and one ventro-lateral cephalic papilla, one small lateral amphid, and two large, longitudinally elongated, sclerotized plates (shields) in outer buccal wall. Dorsal and ventral sides of anterior part of buccal capsule provided with large tridents. Anterior portion of capsule formed by valves followed by shorter and narrower posterior portion of capsule in form of thick-walled ring surrounding spacious buccal cavity (Fig. 41A). Posterior margin of this connecting ring followed by small, colourless, oesophageal cup. Oesophagus leads to straight narrow intestine. Small deirids located just behind nerve ring level.

Males (four specimens): 12.9–20.8 long, maximum width 0.245–0.354. Buccal capsule 0.141–0.207, and connecting ring 0.036–0.042 long. Each valve bears about 22 longitudinal ridges, some incomplete. Whole tridents 0.210–0.255 long. Muscular oesophagus 1.1–1.7, glandular oesophagus 1.2–1.6 long. Nerve ring and excretory pore 0.340–0.435 and 0.462–0.465 from anterior end (deirids not located). Posterior end with broad caudal alae supported by pedunculate papillae. Seven pairs of pre-cloacal and five pairs post-cloacal pedunculate caudal papillae. Cloacal opening surrounded by two transverse mounds, forming laterally two pairs of additional papillae (Fig. 41B). Right spicule well sclerotized, 0.579–0.843 long; left spicule hardly visible, 0.249–0.294 long. Tail conical, 0.084–0.138 long, sometimes with three poorly developed minute papilla-like outgrowths.

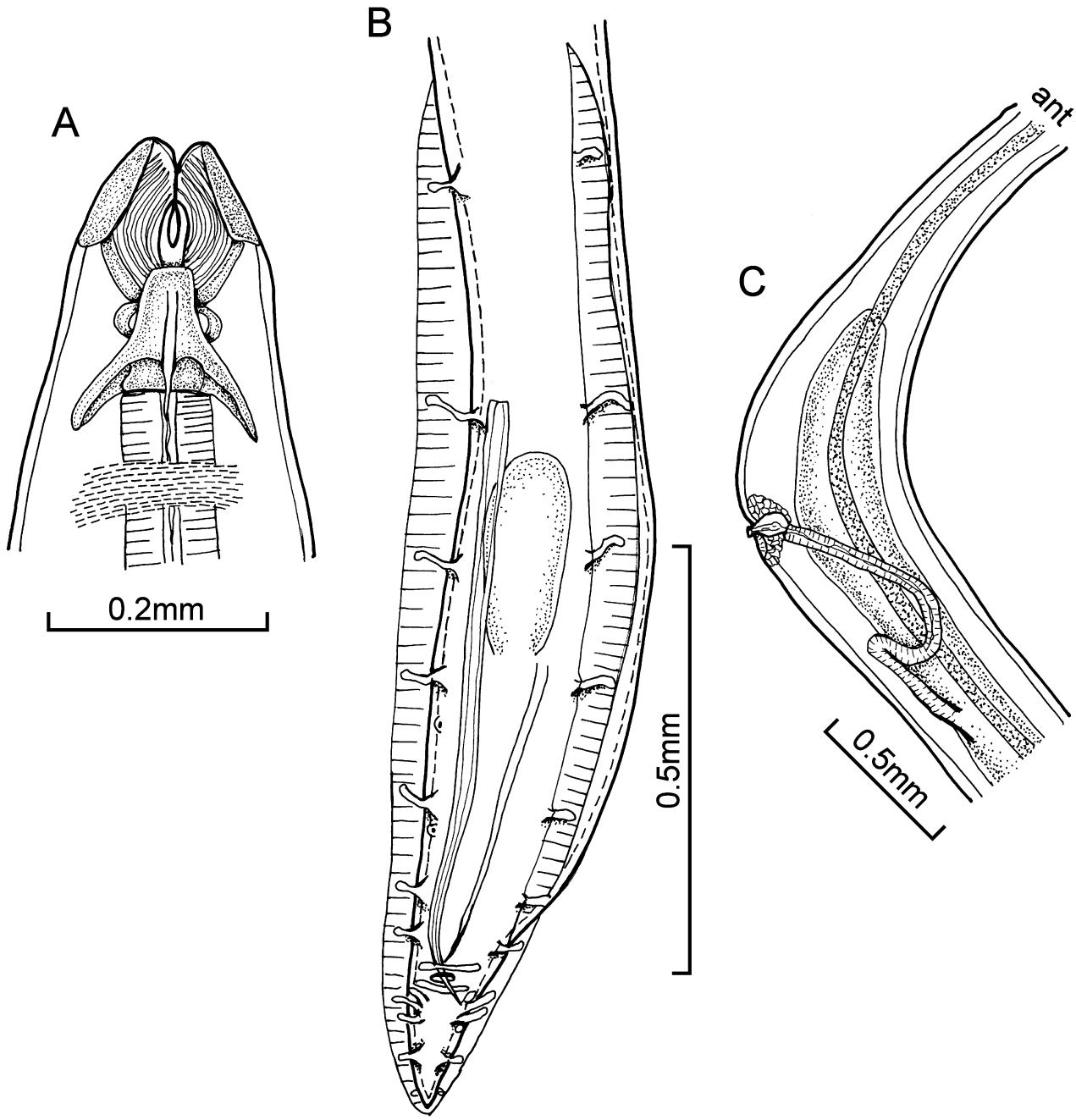

FIGURE 41. *Oncophora melanocephala* (Rudolphi, 1819) Baudin-Laurencin, 1971. A. young female, anterior end, dorso-ventral view; B. male, posterior end, ventral view; C. young female, vulvar region. (Redrawn from Moravec *et al*. 1999)

Females (one complete and two incomplete specimens with eggs; range of measurements of three juveniles in parentheses): Gravid worms markedly broad at approximately posterior third, and narrow filiform anteriorly. 53.8 (20.5–33.8) long. Width: anterior to vulva 0.204–0.367 (0.299–0.313), at vulva level 0.680–1.3 (0.258–0.394), at posterior part 0.544–0.898 (0.272–0.435). Buccal capsule 0.198 (0.198–0.204), and connecting ring 0.033 (0.030–0.033) long. Whole tridents 0.233 (0.219–0.240) long. Muscular oesophagus 1.9 (1.8–1.9), glandular oesophagus 1.8 (1.6–1.8) long. Nerve ring, excretory pore, and deirids 0.326 (0.340–0.394), (0.408–0.449) and 0.422 (0.400) from anterior end. Vulva not elevated, 12.1–18.5 (5.4–9.5) from posterior end of body. Ovijector with sclerotized walls, surrounded by mass of cells. Vagina muscular, narrow, directed posteriorly from vulva. Uterus extends a short distance anterior to vulva; uterus contains eggs (without eggs in juveniles) (Fig. 41C). Tail conical, 0.326–0.462 (0.286) long, with rounded tip bearing three minute, poorly developed papilla-like protrusions.
Site: stomach

Host: *Xiphias gladius*
Distribution: Atlantic
Record: Hogans *et al.* 1983

Superfamily THELAZIOIDEA Skryabin, 1915

Family RHABDOCHONIDAE Travassos, Artigas & Pereira, 1928

The Family Rhabdochonidae is represented in Canadian fishes by only one genus, namely, *Rhabdochona.* The phylogeny and biogeography of species of *Rhabdochona* from Canada and elsewhere in the Americas were investigated by Mejía-Madrid *et al*. (2007).

Rhabdochona Railliet, 1916

Generic diagnosis (after Moravec 2013). Rhabdochonidae. Medium sized nematodes. Pseudolabia rudimentary. Vestibule dilated to form well-defined funnel- or barrel-shaped prostom supported by longitudinal thickenings projecting anteriorly as teeth, variable in number. Deirids simple or bifurcate. Lateral alae present or absent. Oesophagus divided into anterior muscular portion and posterior glandular portion.

Males: many pre-cloacal and five to seven post-cloacal pairs of papillae; no caudal alae; spicules unequal and dissimilar; gubernaculum absent; tail conical, its tip rounded or with sharp point, rarely with several minute digital processes.

Females: amphidelphic; vulva about mid-body, tail tip rounded or with sharp point, sometimes with many spines, spikes or small mucronate points; eggs elliptical, embryonated, their shells smooth, filamented or with swellings ("formations"). Parasitic in intestine of fresh-water fishes.

Key to species of *Rhabdochona*

According to Moravec *et al.* (1981) the closest relative of *R. zacconis* Yamaguti, 1935 is probably *R. canadensis* Moravec & Arai, 1971; the two species "differ distinctly only in the position of the deirids (more anterior relative to length of the vestibule in *R. canadensis*) and the shape of the distal end and width of the left spicule". There is possible confusion here because Moravec & Arai (1971) stated that the left spicule of *R. canadensis* is "conspicuously slender" but, at a width of 0.06–0.09 (see Moravec *et al*., 1981), it is not as slender as that of *R. zacconis* at 0.012–0.015. For these reasons the following key does not attempt to distinguish the two species (although separate descriptions are given). It is relevant to point out that neither Anon. (1978) nor Arai & Mudry (1983) described or illustrated the worms from *Catostomus macrocheilus* in British Columbia that they claimed represented *R. zacconis*. This species has not been previously reported from North America so it is possible that the worms represented *R. canadensis* rather than *R. zacconis*.

1	Mature eggs smooth, without filaments or gelatinous "formations"	2
-	Mature eggs with gelatinous "formations", mostly in the shape of polar caps, or filaments	4
2	Left spicule longer than 0.8; length ratio of right to left spicule 1:10.2 to 1:11.9.	*R. decaturensis*
-	Left spicule shorter than 0.6; length ratio of right to left spicule 1:3.1 to 1:4.2	3
3	Right spicule with truncated proximal end; tail ends in rounded tip	*R. rotundicaudatum*
-	Right spicule with bulbous, convex proximal end; tail ends in sharp point	*R. cascadilla*
4	Prostom with 16 teeth; egg surfaces covered with fine protuberances and numerous short filaments.	*R. ovifilamenta*
-	Prostom with 10 or 14 teeth	5
5	Prostom with 10 teeth	6
-	Prostom with 14 teeth	7
6	Prostom lacks basal teeth; deirids small, bifurcate	*R. catostomi*
-	Prostom with basal teeth; deirids medium-sized, bifurcate; eggs with gelatinous "formations" covering most of poles and lateral surfaces	*R. kisutchi*
7	Tail tip rounded; eggs with two long single, rarely double, filaments; parasitic in Cottidae	*R. cotti*

-	Tail ends in sharp point	8
8	Both egg poles with numerous fine filaments	*R. milleri*
-	Both egg poles with at least one filament, sometimes two filaments on one or both poles	*R. canadensis*/*R. zacconis*

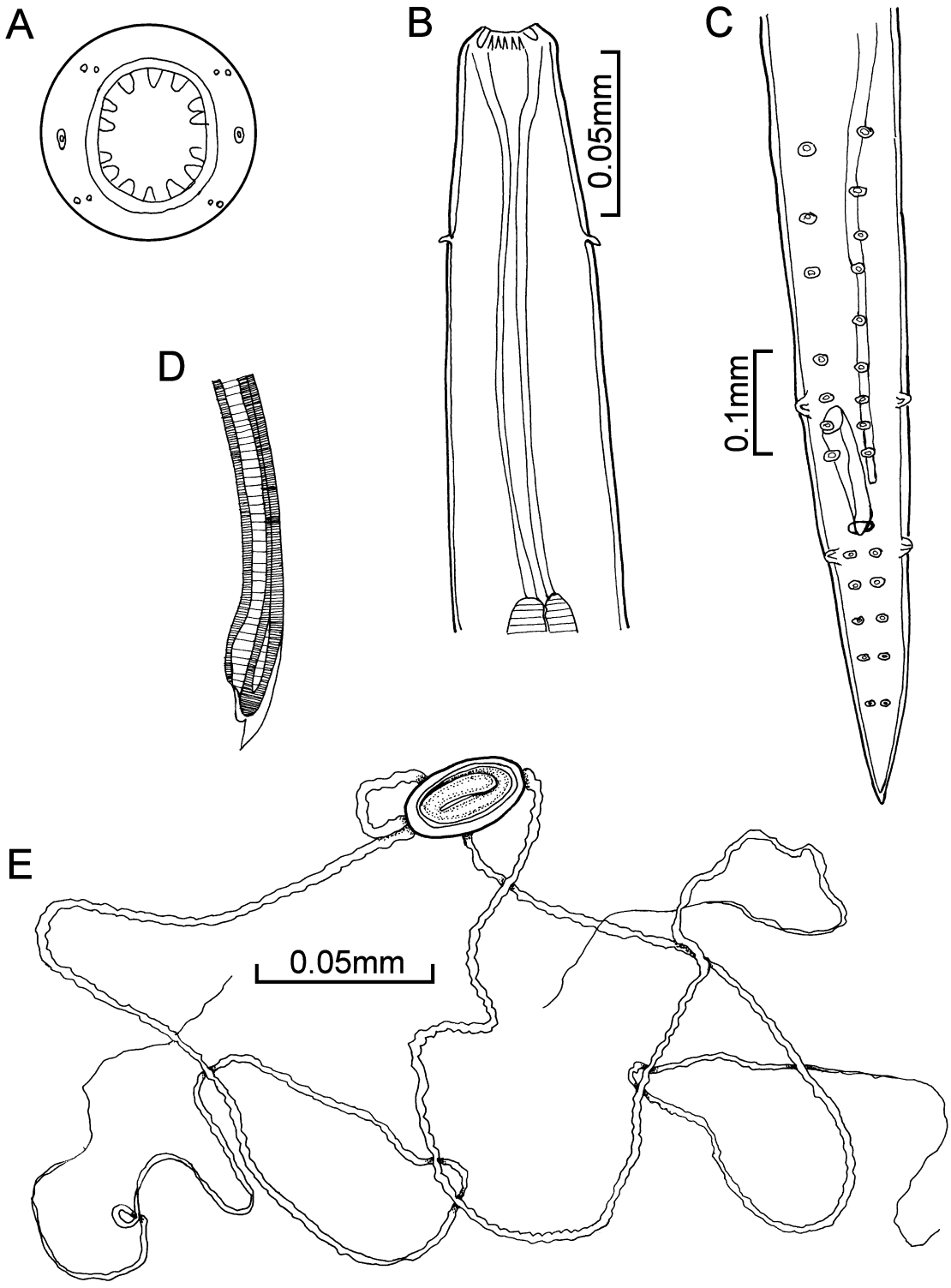

FIGURE 42. *Rhabdochona canadensis* Moravec & Arai, 1971. A. female, *en face* view; B. female, anterior end, dorsal view; C. male, posterior end, ventral view; D. distal tip of left spicule; E. mature egg. NB: scale bars were not provided in the original for either A. or D. (Redrawn from Moravec & Arai 1971)

Rhabdochona canadensis Moravec & Arai, 1971

Description (after Moravec & Arai 1971). With characteristics of the genus.

Males (holotype measurements in parentheses): 5.74–8.36 (8.32) long, 0.109–0.150 (0.122) maximum width. Pseudolabia rudimentary. Prostom conspicuously wide, funnel-shaped, without basal teeth, 0.015–0.021 (0.021) long, 0.012–0.015 maximum width. Prostom lined internally with 14 longitudinal ridges, forming small teeth at their anterior ends (Fig. 42A,B). Vestibule including prostom 0.120–0.165 (0.165), muscular oesophagus 0.186–0.306 (0.216), and glandular oesophagus 2.18–3.90 (3.90) long. Small, bifurcate deirids 0.051–0.069 (0.069), nerve ring 0.177–0.207 (0.198), and excretory pore 0.237–0.279 (not located in holotype) from anterior end. Subventral pre-cloacal papillae asymmetrical in holotype (nine on one side, and seven on the other); the following combinations were seen in paratypes: 7+7, 7+9, 8+8 and 9+9 (Fig. 42C). Additional pair of lateral pre-cloacal papillae at level of 3rd subventral pair (counted from cloaca). Six pairs of post-cloacal papillae: five subventral and one lateral (Fig. 42C). Left spicule conspicuously slender, 0.471–0.525 (0.495) long and 0.06–0.09 wide at midlength [the figures for width from Moravec *et al.* 1981], with blade representing about the posterior half; distal tip lanceolate and thin, with cuticular membrane, bifurcate (Fig. 42D). Right spicule 0.102–0.129 (0.126) long, with dorsally reflected barb distally. Length ratio of right to left spicule 1:3.86 to 1:5.14 (1:3.91). Tail conical, 0.270–0.390 (0.390) long, with sharp terminal spike (Fig. 42C).

Females (allotype measurements in parentheses): gravid worms 9.88–27.92 (14.84) long, 0.190–0.408 (0.245) maximum width. Prostom wide, 0.021–0.033 (0.030) long. Vestibule including prostom 0.144–0.195 (0.186), muscular oesophagus 0.300–0.510 (0.480), and glandular oesophagus 3.26–5.07 (4.52) long. Deirids 0.063–0.078 (0.072), nerve ring 0.219–0.270 (0.237), and excretory pore 0.351–0.420 (0.369) from anterior end. Tail conical, 0.216–0.309 (0.231) long, terminating in sharp spike. Vulva post-equatorial, 4.27–13.15 (5.90) from posterior end of body. Mature eggs oval, embryonated, 0.036–0.042 x 0.018– 0.021 (0.036–0.042 x 0.018–0.021), with one or two long filaments on each pole. Fully mature eggs usually with two filaments on one pole and only one filament on the other pole (Fig. 42E); however, often two filaments on both poles. Filaments very long (*ca* 0.6) with relatively wide bases and ends sometimes frayed.

Site: intestine

Hosts: *Catostomus commersonii* (10, 11); *Cottus* sp. (5); *Couesius plumbeus* (1, 8); *Esox lucius* (1); *Hiodon alosoides* (10, 11); *Margariscus margarita* (9); *Moxostoma anisurum* (10, 11); *Noturus flavus* (1); *Oncorhynchus mykiss* (3, 5); *Percopsis omiscomaycus* (10, 11); *Chrosomus eos* (9, 12); *Phoxinus neogaeus* (9); *Platygobio gracilis* (1); *Rhinichthys cataractae* (1, 6, 7); *Salvelinus malma* (2, 4); *Sander vitreus* (1); *Semotilus atromaculatus* (9); *Semotilus corporalis* (9)

Distribution: Alberta, British Columbia, Manitoba, Ontario

Records: 1. Moravec & Arai 1971 (AB); 2. Anon. 1978 (BC); 3. Pybus & Samuel 1978 (AB); 4. Arai & Mudry 1983 (BC); 5. McAllister & Mudry 1983 (AB); 6. Dechtiar & Christie 1988 (ON); 7. Dechtiar & Lawrie 1988 (ON); 8. Dechtiar *et al.* 1988 (ON); 9. Dechtiar *et al.* 1989 (ON); 10. Szalai 1989 (MB); 11. Szalai *et al.* 1992 (MB); 12. Marcogliese *et al*. 2001 (ON)

Rhabdochona cascadilla Wigdor, 1918

Synonyms: *Rhabdochona* sp. of Bangham (1941 *partim*); *Rhabdochona* sp. of Bangham & Venard (1946 *partim*)

Description (after Byrne 1992a). With characteristics of the genus. General characteristics: outer circle of four cephalic papillae and inner circle of four labial papillae present. Prostom armed with 14 longitudinal sclerotized rods projecting anteriorly as teeth, of which three are dorsal, three ventral, two pairs ventro-lateral, and two pairs dorso-lateral. Sclerotized protuberances present in basal part of prostom [= basal teeth?]. Deirids small, bifurcate, located about the midpoint of vestibule.

Male paratypes (means with ranges in parentheses): body 4.5 (4.0–5.1), prostom 0.016 (0.012–0.019), vestibule 0.076 (0.068–0.085), muscular oesophagus 0.159 (0.146–0.227) and glandular oesophagus 1.1 (0.8–1.8) long. Deirids 0.047 (0.039–0.054), nerve ring 0.124 (0.118–0.134) and excretory pore 0.198 (0.182–0.210) from anterior end. Caudal papillae digitiform: 14 to 19 pre-cloacal and 12 (six pairs) post-cloacal, mostly subventral.

Phasmids minute, located just distal to most posterior pair of caudal papillae. Left spicule 0.378 (0.320–0.415), its alate portion (blade) 0.171 (0.153–0.190) long. Right spicule 0.118 (0.103–0.128) long, with dorsally projecting barb at distal end, and a bulbous, convex proximal end. Length ratio of right to left spicule 1:3.20 (1:3.11 to 1:3.24). Tail 0.277 (0.212–0.322) long, tapering and ending in pointed tip (Fig. 43A,B).

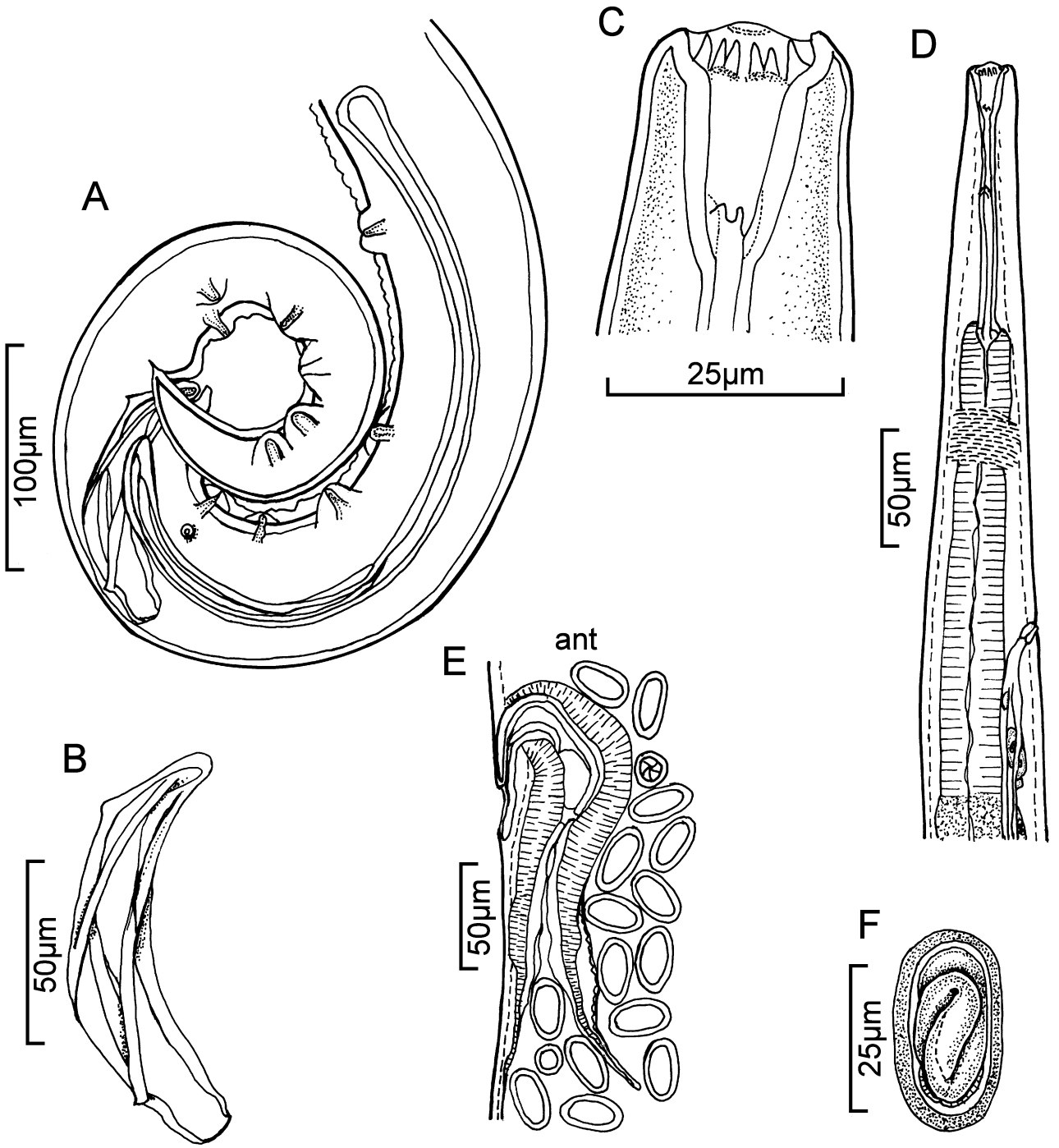

FIGURE 43. *Rhabdochona cascadilla* Wigdor, 1918. A. male, posterior end, lateral view; B. right spicule, lateral view; C. female, head, lateral view; D. female, anterior end, lateral view; E. vulva, vagina and distal uterus, lateral view; F. embryonated egg. (Redrawn from Byrne 1992a)

Female paratypes (means with ranges in parentheses): body 8.4 (6.4–9.9), prostom 0.024 (0.019–0.027), vestibule 0.089 (0.076–0.097), muscular oesophagus 0.198 (0.175–0.227) and glandular oesophagus 1.4 (1.1–1.6) long. Deirids 0.055 (0.050–0.062), nerve ring 0.147 (0.134–0.159) and excretory pore 0.235 (0.200–0.266) from anterior end (Fig. 43C,D). Vulva near midpoint of body, 4.4 (3.5–5.0) from anterior end (Fig. 43E). Phasmids

minute, posterior to midpoint of tail. Eggs ovoid, smooth, without filaments or floats (Fig. 43F), 0.017 (0.017–0.019) x 0.033 (0.031–0.034). Tail 0.228 (0.184–0.287) long, tapering and ending in pointed tip.

Comments: the 41 fish species listed below have been reported as hosts of *R. cascadilla* in Canada. However, according to Byrne (1992a) the numerous reports of this rhabdochonid species "across much of Canada and the United States, from at least 64 species of fish (Byrne 1989) should be accepted with reservation".

Site: intestine

Hosts: *Acipenser fulvescens* (7, 20, 22); *Acrocheilus alutaceus* (6); *Ambloplites rupestris* (1); *Ameiurus nebulosus* (4); *Carpiodes cyprinus* (1); *Catostomus catostomus* (6, 10, 13); *Catostomus commersonii* (4, 9, 10, 13); *Catostomus macrocheilus* (6); *Couesius plumbeus* (6); *Culaea inconstans* (17); *Cyprinella spiloptera* (1); *Etheostoma exile* (5, 7, 8); *Etheostoma nigrum* (5, 7, 8); *Hiodon tergisus* (1); *Lota lota* (8); *Luxilus cornutus* (2, 3, 5, 7, 16, 17, 18, 19); *Margariscus margarita* (2, 3, 4); *Micropterus dolomieu* (3); *Moxostoma macrolepidotum* (1); *Mylocheilus caurinus* (6, 12, 14); *Nocomis biguttatus* (18, 19); *Notemigonus crysoleucas* (23); *Notropis anogenus* (8); *Notropis hudsonius* (1, 5, 7, 8); *Notropis stramineus* (1); *Notropis volucellus* (1); *Oncorhynchus clarkii* (6); *Oncorhynchus mykiss* (6); *Oncorhynchus nerka* (6, 9, 17); *Perca flavescens* (9); *Percopsis omiscomaycus* (9); *Chrosomus eos* (3, 21); *Prosopium williamsoni* (6); *Pimephales notatus* (3, 5, 7); *Ptychocheilus oregonensis* (6, 12, 14); *Rhinichthys atratulus* (8); *Rhinichthys cataractae* (6); *Richardsonius balteatus* (6, 12, 14); *Salvelinus fontinalis* (4, 11); *Semotilus atromaculatus* (2, 3, 4, 5, 7, 15, 17); *Semotilus corporalis* (3)

Distribution: Alberta, British Columbia, Hudson Bay Drainage, Manitoba, Nova Scotia, Ontario, Quebec

Records: 1. Bangham & Hunter 1939 (ON); 2. Bangham 1941 (ON); 3. Bangham & Venard 1946 (ON); 4. Choquette 1951a (QC); 5. Bangham 1951 (ON); 6. Bangham & Adams 1954 (BC); 7. Bangham 1955 (ON); 8. Dechtiar 1972a (ON); 9. Collins & Dechtiar 1974 (ON); 10. Leong 1975 (AB); 11. Mudry & Anderson 1977 (AB); 12. Anon. 1978 (BC); 13. Leong & Holmes 1981 (AB); 14. Arai & Mudry 1983 (BC); 15. Mackie *et al.* 1983 (ON); 16. Byrne & Baker 1987 (ON); 17. Dechtiar *et al.* 1988 (ON); 18. Byrne 1992a (ON); 19. Byrne 1992b (ON); 20. Choudhury & Dick 1993 (MB); 21. Dubois *et al.* 1996 (QC); 22. Choudhury & Dick 1998 (HBD, MB); 23. Forest & Cone 2011 (NS)

Rhabdochona catostomi **Kayton, Kritsky & Tobias, 1979**

Description (after Kayton *et al.* 1979). With characteristics of the genus. Body filiform, males smaller than females. Caudal end conical with terminal spike. Mouth with two bilateral rudimentary pseudolabia, two large bilateral amphids, outer circle of cephalic papillae (inner circle apparently absent). Prostom funnel-shaped, lacking basal teeth, its inner wall with 10 longitudinal cuticular ridges terminating in anterior teeth. Cuticle lines entire vestibule. Oesophagus with anterior muscular and wider posterior glandular regions. Deirids small, bifurcate, lying slightly anterior to mid-vestibule.

Males: body 8.9–14.3 long, 0.173–0.211 maximum width. Prostom 0.022–0.034, vestibule 0.134–0.174, muscular oesophagus 0.336–0.372, and glandular oesophagus 3.5–4.8 long. Deirids 0.076–0.085, nerve ring 0.204–0.238, and excretory pore 0.484 from anterior end. Tail 0.336–0.392 long, curved ventrally. Caudal alae absent. Subventral caudal papillae variable in number, 8 or 9 pre-cloacal, and 5 post-cloacal pairs (Fig. 44A). Left spicule 0.546–0.562 long, slender, with ventral groove, its tip with ventral barb, bifurcate. Right spicule 0.151–0.154 long, with reflected distal barb (Fig. 44B). Length ratio of right to left spicule 1:3.62 to 1:3.65.

Females: body 15.3–16.7 long, 0.248–0.292 maximum width. Prostom 0.028–0.031, vestibule 0.154–0.176, muscular oesophagus 0.375–0.417, and glandular oesophagus 4.97–6.10 long. Deirids 0.090–0.097 and nerve ring 0.227–0.284 from anterior end [position of excretory pore not stated]. Tail 0.227–0.280 long, usually straight (Fig. 44C). Vulva post-equatorial comprising a transverse slit surrounded by elevated labia. Mature eggs ellipsoidal, embryonated, "poles usually with complex elongate filaments", measuring 0.031–0.036 x 0.020–0.024 (Fig. 44D).

Site: intestine

Host: *Catostomus catostomus*

Distribution: Alberta

Record: Kayton *et al.* 1979

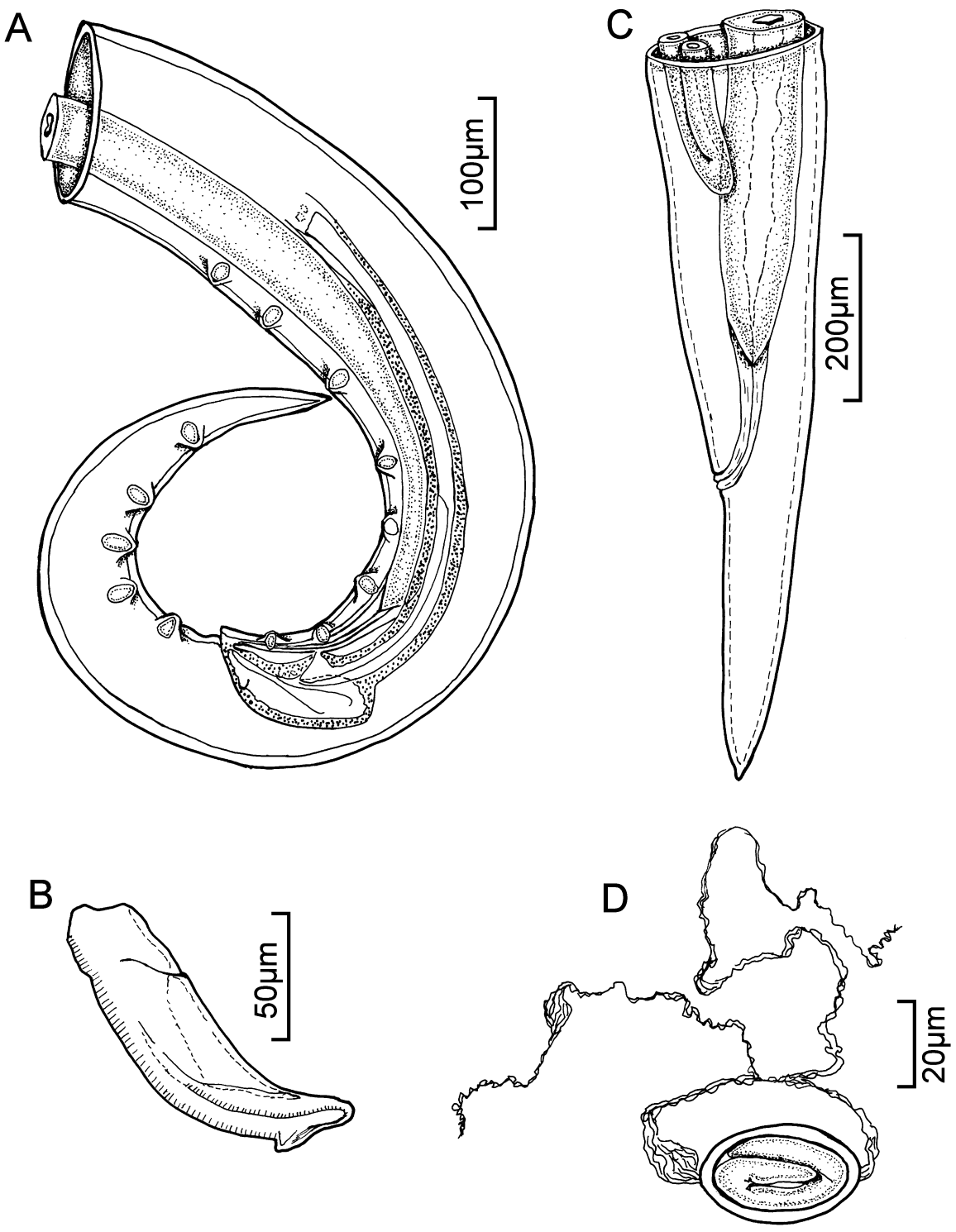

FIGURE 44. *Rhabdochona catostomi* Kayton, Kritsky & Tobias, 1979. A. male, posterior end, lateral view; B. right spicule, lateral view; C. female, posterior end, lateral view; D. mature egg. (Redrawn from Kayton *et al*. 1979)

Rhabdochona cotti **Gustafson, 1949**

Description (after Gustafson 1949, and Moravec & Arai 1971). With characteristics of the genus. Slender worms, attenuated at both ends. Pseudolabia rudimentary. Prostom funnel-shaped, without basal teeth, with 14 teeth projecting anteriorly from longitudinal ridges. Oesophagus comparatively short, divided into anterior muscular and

posterior glandular portions. Deirids small ("shape of deirids not determined"), lateral, opposite mid-portion of buccal cavity.

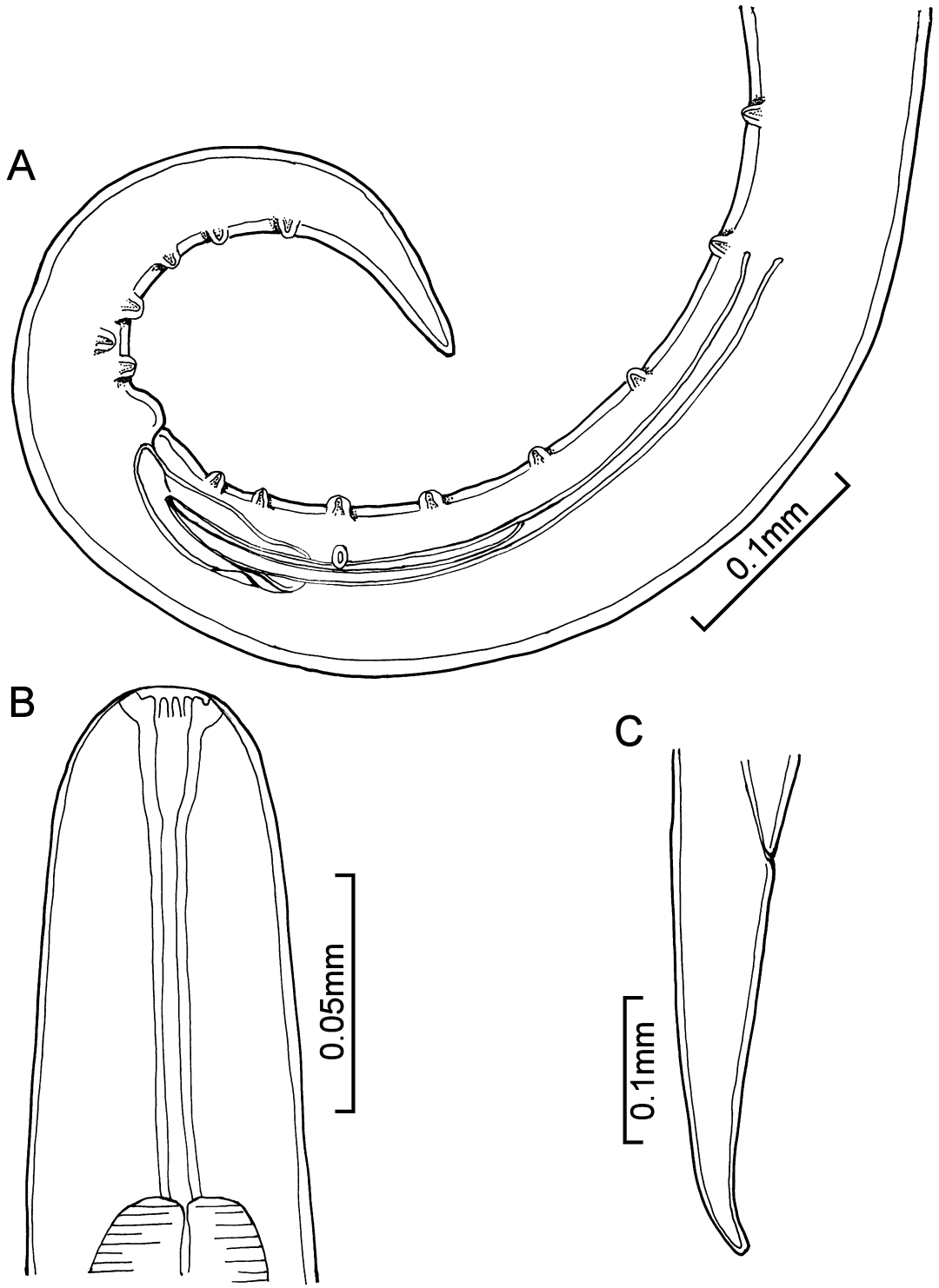

FIGURE 45. *Rhabdochona cotti* Gustafson, 1949. A. male, posterior end, lateral view; B. female, anterior end, lateral view; C. female tail, lateral view. (Redrawn from Moravec & Arai 1971)

Males (measurements of paratypes according to Moravec & Arai (1971) in parentheses): 7.65–10.6 (12.76) long, 0.080–0.131 (0.154) maximum width. Prostom 0.017–0.020 (0.015), "total stoma" 0.082–0.122 (vestibule including prostom 0.093–0.096), muscular oesophagus 0.272–0.340 (0.252–0.285), and glandular oesophagus 0.80–1.28 (0.87–1.22) long. Nerve ring 0.17–0.22 (0.165–0.195) and excretory pore 0.22–0.32 (0.216) from anterior end. Left spicule 0.309–0.370 (0.354–0.357) long, of which 0.163–0.197 is the alate portion; according to

Moravec & Arai (*op. cit.)* its distal tip appears "lanceolate and similar to that of *R. canadensis*" (see above). Right spicule 0.085–0.120 (0.102–0.105) long, scoop-shaped, with rounded posterior end lacking distinct barb distally. Length ratio of right to left spicule 1:3.08 to 1:–3.64. About eight pairs of pre-cloacal papillae, all subventral except for the 3rd sublateral pair anterior to cloaca. Six pairs of post-cloacal papillae, of which the 2nd pair is is sublateral and the others subventral. Tail conical, 0.285–0.294 long, with distinctly rounded tip, without cuticular spike (Fig. 45A).

Females (measurements of paratypes according to Moravec & Arai (1971) in parentheses): 18.3–34.2 (19.20–29.48) long, 0.19–0.31 (0.258–0.462) maximum width. Prostom 0.025–0.036 (0.024–0.027), "total stoma" 0.102–0.143 (vestibule including prostom 0.099–0.111) [Fig. 45B], muscular oesophagus 0.374–0.626 (0.330), glandular oesophagus 1.46–1.92 (not determined) long. Nerve ring 0.21–0.43, excretory pore 0.305–0.580, and vulva 11.4–20.9 from anterior end. Tail 0.204–0.350 (0.210–0.300) long, conical with distinct rounded tip, without cuticular spike (Fig. 45C). Eggs embryonated when laid, 0.032–0.033 x 0.018–0.020, with two long single (rarely double) filaments.

Site: intestine

Hosts: *Cottus asper* (1); *Cottus bairdii* (2, 6, 7); *Cottus cognatus* (1, 3, 4, 5, 8); *Cottus caeruleomentum* (9)

Distribution: Alberta, British Columbia, Ontario

Records: 1. Bangham & Adams 1954 (BC); 2. Dechtiar 1972a (ON); 3. Mudry & Anderson 1977 (AB); 4. Anon. 1978 (BC); 5. Arai & Mudry 1983 (BC); 6. Dechtiar *et al.* 1988 (ON); 7. Dechtiar & Lawrie 1988 (ON); 8. Dechtiar *et al.* 1989 (ON); 9. Moravec & Muzzall 2007 (BC)

***Rhabdochona decaturensis* Gustafson, 1949**

Description (after Gustafson 1949, and Moravec & Arai 1971). With characteristics of the genus. Small, slender, worms, attenuated at both ends. Pseudolabia rudimentary. Buccal cavity heavily sclerotized, funnel-shaped prostom containing 14 minute teeth projecting anteriorly from longitudinal ridges; four minute teeth at base of prostom (Fig. 46A). Oesophagus relatively long, divided into anterior muscular and posterior glandular portions. Deirids very small, simple, lateral, opposite mid-portion of buccal cavity.

Males (measurements of a paratype according to Moravec & Arai (1971) in parentheses): 6.8–8.0 long (13.29), 0.085–0.100 (0.132) maximum width. Prostom 0.015–0.017 (0.018), "total stoma" 0.096–0.110 (vestibule including prostom 0.120), muscular oesophagus 0.21–0.27 (0.255), glandular oesophagus 1.70–2.0 (3.52), and tail 0.25–0.31 (0.296) long, with terminal cuticular spike. Nerve ring 0.140–0.170 (0.180) and excretory pore 0.210–0.250 (0.273) from anterior end. Left spicule relatively long at 0.830–1.025 (1.074), with conical distal tip, not bifurcated; spicule shaft representing 73% of entire length. Right spicule 0.075–0.100 (0.090) long, scoop-shaped, with reflected barb near tip on left side. Length ratio of right to left spicule 1:10.25 to 1:11.93. About eight (seven) pairs of pre-cloacal papillae, of which seven pairs are subventral, and one pair sublateral. Six (six) pairs of post-cloacal papillae, of which the 2nd pair is sublateral, the others subventral (Fig. 46B).

Females (measurements of a paratype according to Moravec & Arai (1971) in parentheses): 9.2–13.4 (21.25) long, 0.093–0.160 (0.198) maximum width. Prostom 0.016–0.025 (0.024), "total stoma" 0.090–0.110 (vestibule including prostom 0.120), muscular oesophagus 0.217–0.320 (0.299), glandular oesophagus 1.92–2.6 (4.38), and tail 0.16–0.23 long (0.165) with cuticular terminal spike (Fig. 46C). Nerve ring 0.150–0.170 (0.183) and excretory pore 0.236–0.257 (0.270) from anterior end. Eggs embryonated when laid, ovoid, 0.031–0.038 x 0.015–0.023, bearing no filaments.

Site: intestine

Hosts: *Luxilus cornutus* (2, 3); *Notropis hudsonius* (1, 2, 3); *Noturus flavus* (1); *Noturus gyrinus* (1)

Distribution: Ontario

Records: 1. Dechtiar & Christie 1988; 2. Dechtiar & Lawrie 1988; 3. Dechtiar *et al.* 1988

***Rhabdochona kisutchi* Margolis, Moravec & McDonald, 1975**

Description (after Margolis *et al.* 1975). With characteristics of the genus.

Medium-sized worms with rudimentary pseudolabia. Mouth opening roughly hexagonal. Two fairly large lateral amphids and eight small submedian cephalic papillae arranged in an inner and outer circle of four each; papillae of inner circle at mouth margin. Prostom funnel-shaped with distinct basal teeth, and its anterior margin with 10 conical teeth (Fig. 47A,B). Vestibule relatively long, straight (but S-shaped in specimens that the authors claim to be "older'). Deirids medium-sized, bifurcate, located near mid-point of vestibule (Fig. 47B). Tail of both sexes "ending in blunt point".

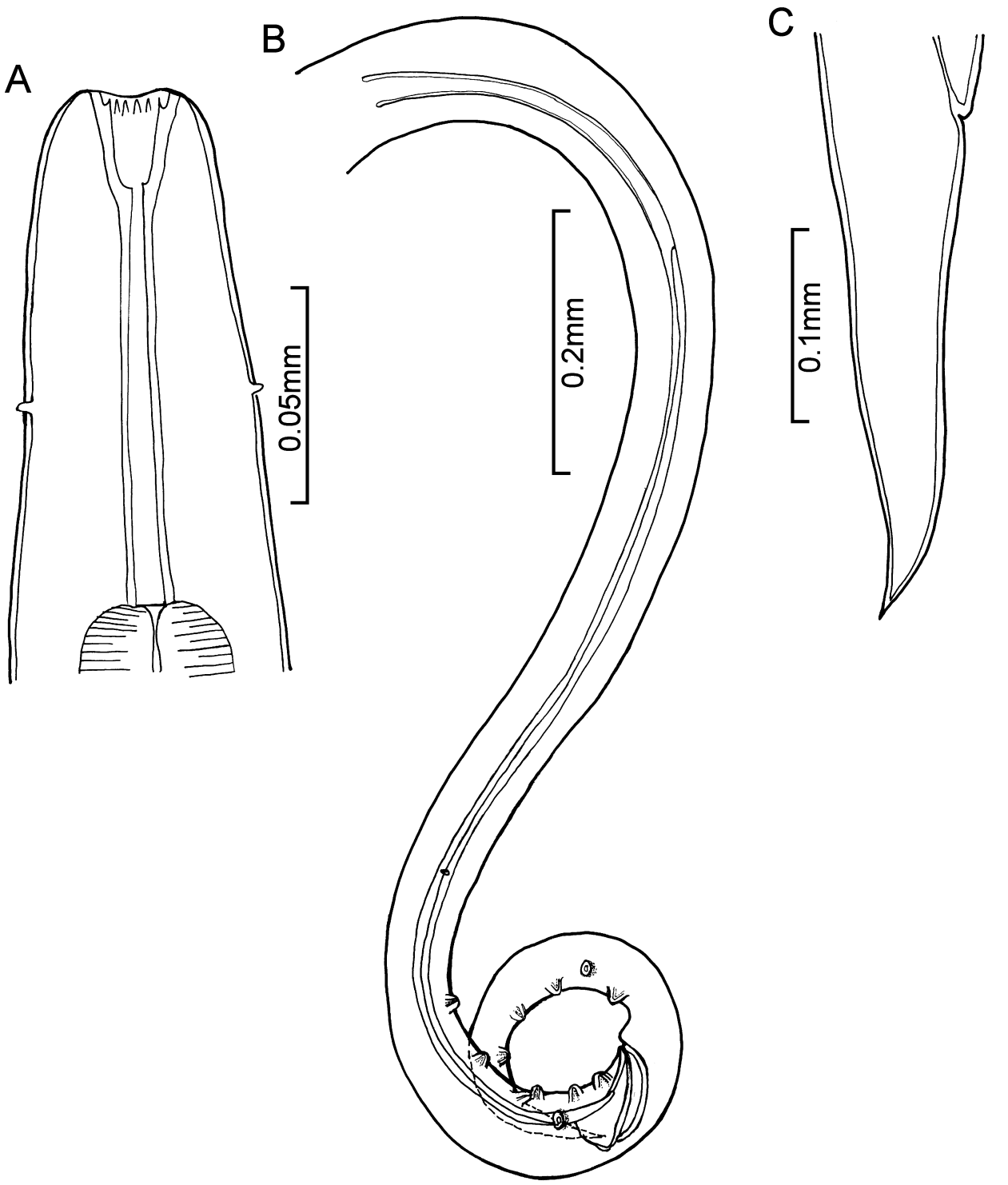

FIGURE 46. *Rhabdochona decaturensis* Gustafson, 1949. A. female, anterior end, dorsal view; B. male, posterior end, lateral view; C. female tail, lateral view. (Redrawn from Moravec & Arai 1971)

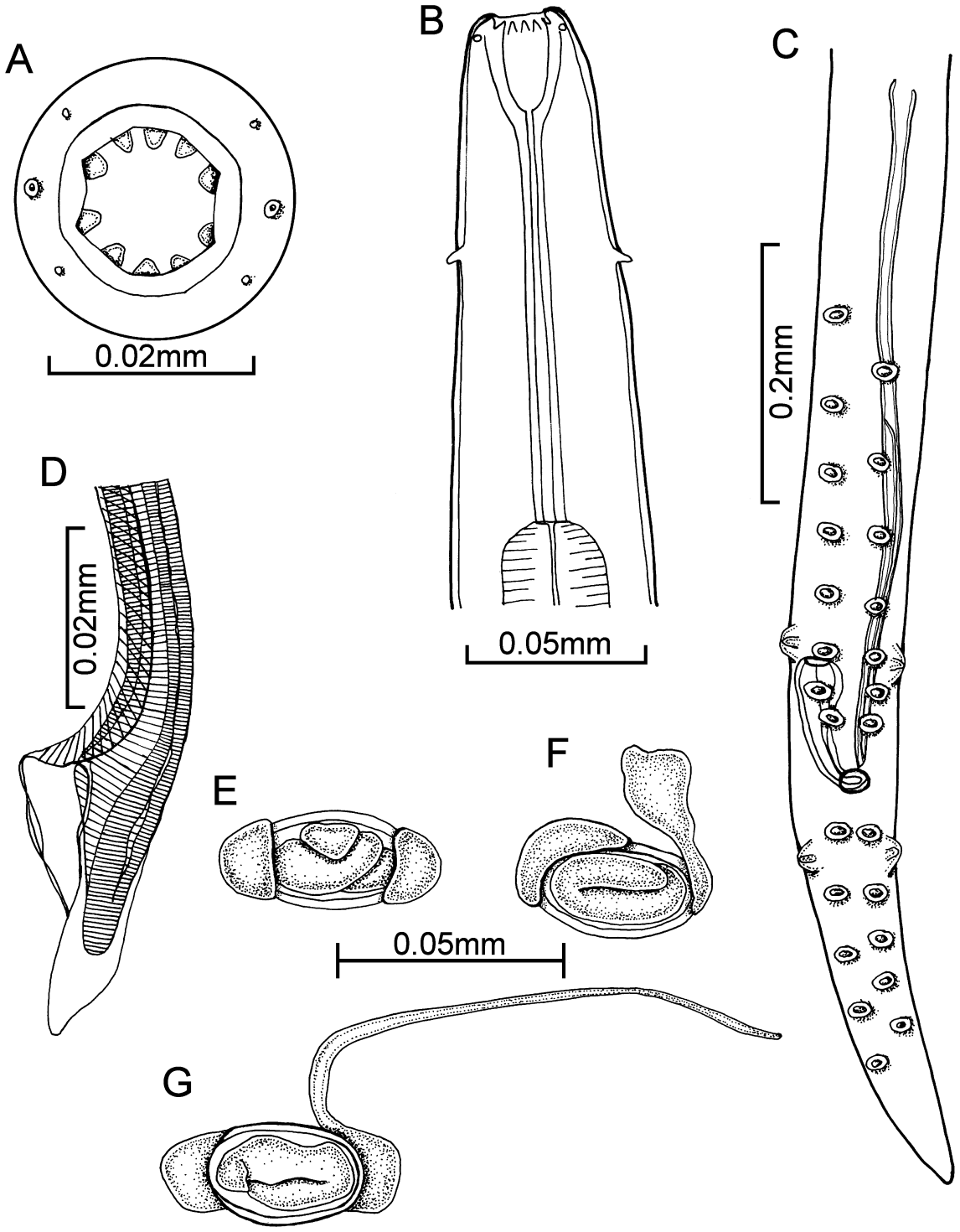

FIGURE 47. *Rhabdochona kisutchi* Margolis, Moravec & McDonald, 1975. A. female, *en face* view; B. female, anterior end, dorsal view; C. male, posterior end, ventral view; D. left spicule, distal tip; E. and F. variation in shape of polar "formations" on eggs; G. egg with polar filament (truncated). (Redrawn from Margolis *et al*. 1975)

Males (11 specimens, allotype in parentheses): 6.61–8.41 (6.90) long, 0.110–0.150 (0.150) maximum width. Prostom 0.024–0.027 (0.024), vestibule including prostom 0.108–0.153 (0.123), muscular oesophagus 0.225–0.270 (0.233) and glandular oesophagus 1.35–2.29 (1.69) long. Deirids 0.060–0.075 (0.066), nerve ring 0.168–0.240 (0.195) and excretory pore 0.249–0.351 (0.286) from anterior end. Subventral pre-cloacal papillae variable in number: allotype has nine on each side, paratypes with the combinations 7+8, 8+8, 8+9, 7+9, 8+10, and 10+10. Additional pair of lateral pre-cloacal papillae at level of 3rd subventral pair or slightly posterior to it. One paratype

had two pairs of lateral papillae. Six pairs of post-cloacal papillae—five subventral and one lateral (Fig. 47C). Left spicule 0.564–0.660 (0.627) long, with shaft representing about its distal half; proximal end slightly widened, distal tip lanceolate, with wide cuticular membrane; ventral process seen on distal tip when spicule protruding from cloacal opening (Fig. 47D). Right spicule variable in shape, 0.087–0.135 (0.120) long; dorsal barb feebly developed, usually indistinct, its apparent presence depending perhaps on angle from which it is viewed. Length ratio of right to left spicule 1:4.80 to 1:6.48 (1:5.22). Tail 0.300–0.390 (0.360) long, "ending in blunt point".

Females (nine specimens, holotype in parentheses): gravid worms 12.04–17.38 (13.59) long, 0.190–0.272 (0.231) maximum width. Prostom funnel–shaped 0.030–0.036 (0.033), vestibule including prostom 0.126–0.198 (0.192), muscular oesophagus 0.285–0.361 (0.330), and glandular oesophagus 2.34–3.36 (2.87) long. Deirids 0.060–0.096 (0.090), nerve ring 0.174–0.276 (0.261) and excretory pore 0.411–0.420 (0.411) from anterior end. Tail 0.351–0.450 (0.351) long, ending in "a blunt point". Vulva slightly post-equatorial located 6.16–8.02 (6.25) from posterior end. Amphidelphic. Mature eggs oval, embryonated, always with gelatinous "formations" most often in shape of caps or lobes covering egg poles and partly their lateral surfaces; rarely polar "formations" tendril-shaped and as long as 0.045; in some eggs a long filiform filament, about 0.45 long, arises from proximo-lateral corner of one polar cap (Fig. 47E,F,G). Eggs, excluding polar "formations", "0.039–0.042 x 0.024 (0.039–0.042 x 0.024) [*sic*]", polar caps usually 0.006–0.009 high.

Sites: intestine, pyloric caeca

Hosts: *Oncorhynchus kisutch* (1); *Oncorhynchus mykiss* (2, 3); *Oncorhynchus nerka* (2, 3); *Prosopium williamsoni* (2, 3); *Salvelinus malma* (2, 3, 4)

Distribution: British Columbia

Records: 1. Margolis *et al.* 1975; 2. Anon. 1978; 3. Arai & Mudry 1983; 4. Anon. 1984

Rhabdochona milleri **Choquette, 1951**

Description (after Choquette 1951a, and Moravec & Arai 1971). With characteristics of the genus.

Male (1 specimen): 6.94 long, 0.176 maximum width. Prostom funnel-shaped, 0.018 long, with distinct basal teeth, lined internally with longitudinal ribs forming teeth directed forwardly (exact number not determined). Vestibule including prostom 0.144, muscular oesophagus 0.300, and glandular oesophagus 1.36 long. Small, bifurcate deirids 0.063, nerve ring 0.168, and excretory pore 0.237 from anterior end. Eight pairs of subventral and one pair of [presumably lateral] pre-cloacal papillae, and six pairs of post-cloacal papillae—five pairs subventral, one pair lateral (Fig. 48A). Left spicule 0.402 long, with relatively blunt distal tip, and "slightly outlined" bifurcation (Fig. 48B). Right spicule 0.129 long, with dorsal barb at distal end (Fig. 48A). Length ratio of right to left spicule 1:3.12. Tail conical, 0.300 long, with sharp cuticular spike at tip.

Females (3 specimens): 10.91–12.10 long, 0.136–0.163 maximum width. Prostom funnel-shaped, 0.021–0.024 long, with distinct basal teeth, and 14 teeth projecting forwardly (Fig. 48C,D). Vestibule including prostom 0.111–0.138, muscular oesophagus 0.270–0.297, and glandular oesophagus 1.59–2.35 long. Medium sized bifurcate deirids 0.063–0.081, nerve ring 0.186–0.189, and excretory pore 0.261 from anterior end. Vulva slightly post-equatorial, 5.03–6.12 from posterior end. Eggs oval, 0.030–0.036 x 0.018–0.021. Surface of advanced eggs (containing larvae) smooth; poles provided with numerous fine filaments (Fig. 48E), those on one pole arranged mostly in parallel giving the appearance of a short ribbon-like filament with the end frayed (Fig. 48E, lower egg). Tail conical, 0.210–0.243 long, with sharp cuticular point.

Comment: Moravec & Arai (1971) stated that "in many important features *R. milleri* resembles *R. ovifilamenta*, and subsequent detailed studies might prove their conspecificity".

Site: intestine

Hosts: *Carpiodes cyprinus* (7); *Moxostoma erythrurum* (2); *Moxostoma macrolepidotum* (1, 2, 6); *Oncorhynchus clarkii* (3); *Oncorhynchus mykiss* (3); *Prosopium coulterii* (3); *Prosopium williamsoni* (4, 5); *Rhinichthys cataractae* (4, 5); *Salvelinus fontinalis* (3); *Salvelinus malma* (3)

Distribution: Alberta, British Columbia, Ontario, Quebec

Records: 1. Choquette 1951a (QC); 2. Dechtiar 1972b (ON); 3. Mudry & Anderson 1977 (AB); 4. Anon. 1978 (BC); 5. Arai & Mudry 1983 (BC); 6. Dechtiar & Christie 1988 (ON); 7. Dechtiar & Nepszy 1988 (ON)

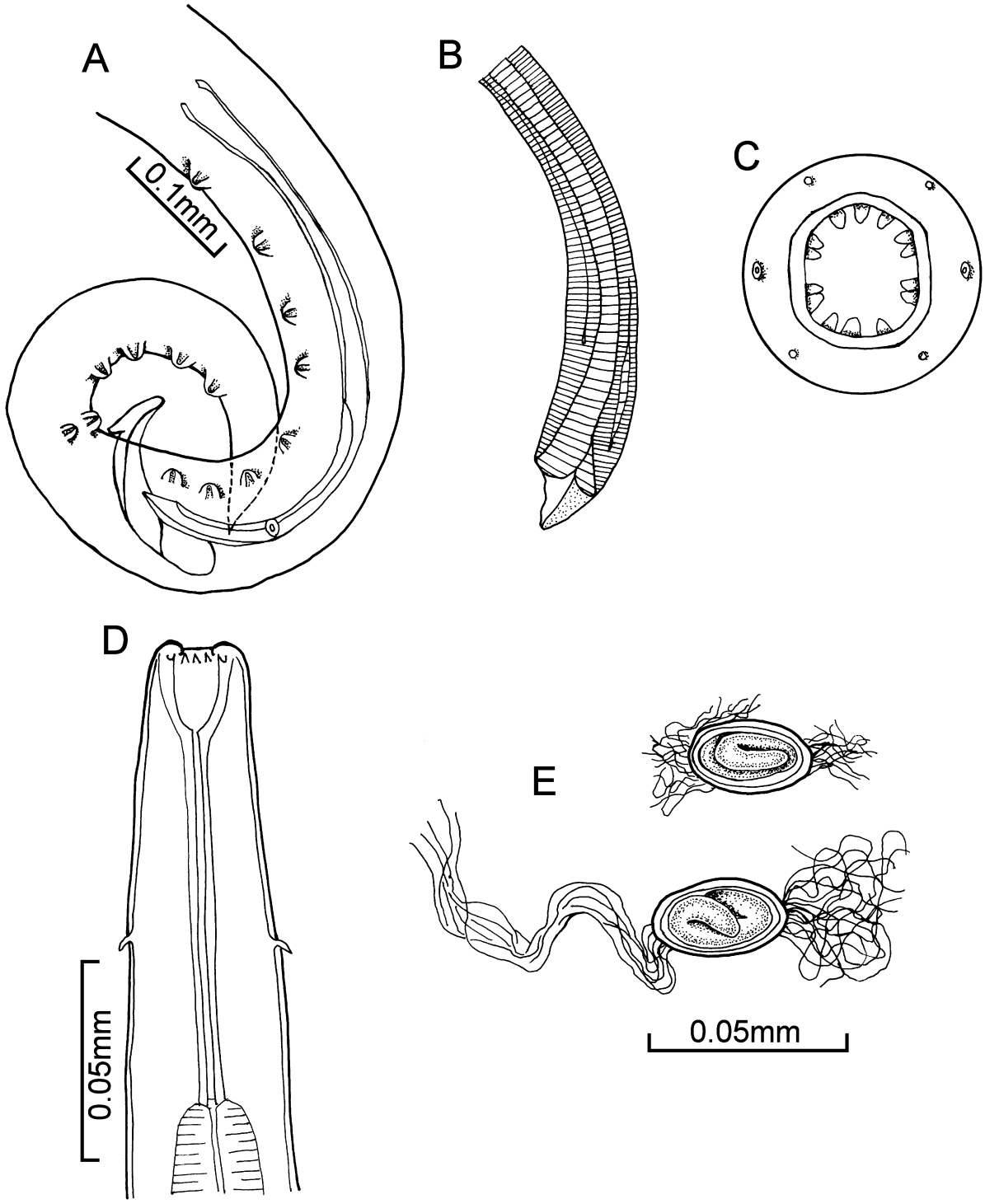

FIGURE 48. *Rhabdochona milleri* Choquette, 1951. A. male, posterior end, lateral view; B. left spicule, distal tip; C. female, *en face* view; D. female, anterior end; E. mature eggs. NB: scale bars were not provided in the original for either B. or C. (Redrawn from Moravec & Arai 1971)

***Rhabdochona ovifilamenta* Weller, 1938**

Synonyms: *Rhabdochona laurentiana* Lyster, 1940: *Rhabdochona fortunatowi* Dinnick, 1931 of Kussat (1969); *Rhabdochona* sp. of Arai & Kussat (1967)

Description (after Moravec & Arai 1971). With characteristics of the genus.

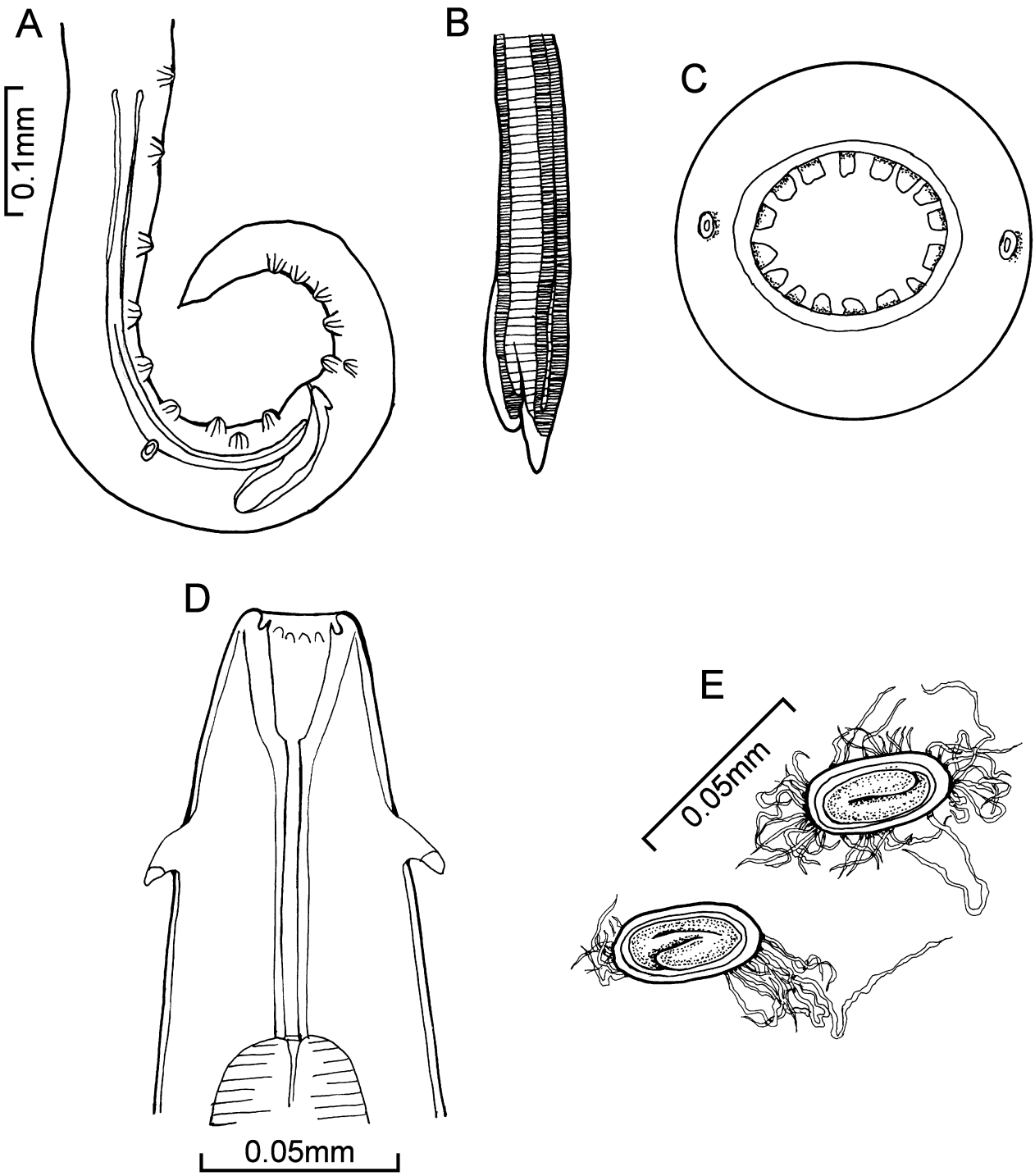

FIGURE 49. *Rhabdochona ovifilamenta* Weller, 1938. A. male, posterior end, lateral view; B. left spicule, distal tip; C. female, *en face* view; D. female, anterior end, dorsal view; E. mature eggs. NB: scale bars were not provided in the original for either B. or C. (Redrawn from Moravec & Arai 1971)

Males (three complete and three fragments): body 6.55–8.02 long, 0.095–0.136 maximum width. Pseudolabia rudimentary. Prostom relatively narrow, funnel-shaped, with indistinct basal teeth, lined internally with ribs forming forwardly projecting teeth (exact number not determined). Vestibule including prostom 0.111–0.138, muscular oesophagus 0.255–0.300, and glandular oesophagus 1.90–3.59 long. Relatively small bifurcate deirids 0.051–0.078, nerve ring 0.156–0.204, and excretory pore 0.237–0.264 from anterior end. Pairs of subventral pre-cloacal papillae variable in number: the following combinations were observed—6+7, 7+9, 8+9 and 9+10. Another pair was located laterally at level of 4th subventral pair. Six pairs of post-cloacal papillae present, the 2nd pair lateral,

the rest subventral (Fig. 49A). Left spicule 0.390–0.420 long, slender, with lanceolate distal tip, and "slightly outlined" bifurcation with fine cuticular membrane (Fig. 49B). Right spicule scoop-shaped, 0.105–0.117 long with reflected barb at tip. Length ratio of right to left spicule 1:3.52 to 1:3.78. Tail conical, 0.303–0.372 long, with distinct cuticular spike.

Females (three complete and two fragments): body 11.75–21.76 long, 0.204–0.258 maximum width. Pseudolabia rudimentary. Prostom thick–walled with distinct basal teeth, 0.030–0.039 long, and 16 teeth projecting forwardly (Fig. 49C). Vestibule including prostom 0.090–0.135, muscular oesophagus 0.276–0.558, and glandular oesophagus 1.60–4.42 long. Relatively large, "somewhat bifurcate" deirids 0.039–0.060 (Fig. 49D), nerve ring 0.126–0.210, and excretory pore 0.243 from anterior end. Vulva of younger females slightly pre-equatorial, in larger females distinctly post-equatorial, 6.23–8.98 from posterior end. Eggs oval, 0.036–0.042 x 0.018–0.021. Mature eggs embryonated. Entire surface covered with fine protuberances and numerous, short thread-like filaments (Fig. 49E); filaments distributed uniformly over entire surface of most eggs but, in some, filaments appear restricted to area near poles. Tail conical, 0.294–0.315 long, with short cuticular spike.

Comment: as already noted, Moravec & Arai (1971) suggested that *R. ovifilamenta* and *R. milleri* might be conspecific.

Site: intestine

Hosts: *Catostomus catostomus* (3, 4, 7); *Catostomus commersonii* (1, 8, 9, 11, 12); *Catostomus platyrhynchus* (4, 7, 8); *Perca flavescens* (5, 6, 10); *Salvelinus fontinalis* (2, 13)

Distribution: Alberta, Ontario, Quebec

Records: 1. Lyster 1940 (QC); 2. Choquette 1948a (QC); 3. Kussat 1966 (AB); 4. Arai & Kussat 1967 (AB); 5. Tedla & Fernando 1969a (ON); 6. Tedla 1969 (ON); 7. Kussat 1969 (AB); 8. Moravec & Arai 1971 (AB); 9. Dechtiar & Christie 1988 (ON); 10. Dechtiar & Lawrie 1988 (ON); 11. Dechtiar & Nepszy 1988 (ON); 12. Dechtiar *et al.* 1989 (ON); 13. Marcogliese & Cone 1991a (QC)

***Rhabdochona rotundicaudatum* Byrne, 1992**

Description (after Byrne 1992a). With characteristics of the genus. General characteristics: see those for *R. cascadilla* above.

Male paratypes (means with ranges in parentheses): body 5.8 (5.0–6.7), prostom 0.018 (0.017–0.023), vestibule 0.090 (0.081–0.100), muscular oesophagus 0.224 (0.188–0.251) and glandular oesophagus 1.6 (1.2–1.9) long. Small bifurcate deirids 0.051 (0.033–0.057), nerve ring 0.133 (0.127–0.137) and excretory pore 0.200 (0.195–0.208) from anterior end. Caudal papillae digitiform: 18 to 21 pre-cloacal and 11 to 13 post-cloacal, mostly subventral. Phasmids minute, located just distal to most posterior pair of caudal papillae. Left spicule 0.388 (0.342–0.421), its alate portion (blade) 0.183 (0.0.159–0.196) long. Right spicule 0.092 (0.087–0.101) long, relatively stout, with dorsal projecting barb at distal end and a bulbous, convex proximal end (Fig. 50B). Length ratio of right to left spicule 1:3.93 to 1:4.22. Tail 0.306 (0.266–0.365) long, tapering and ending in a rounded tip (Fig. 50A).

Female paratypes (means with ranges in parentheses): body 10.6 (8.9–13.4), prostom 0.026 (0.023–0.028), vestibule 0.107 (0.097–0.120), muscular oesophagus 0.278 (0.261–0.290) and glandular oesophagus 2.27 (2.08–2.54) long. Deirids 0.066 (0.060–0.076), nerve ring 0.158 (0.146–0.179) and excretory pore 0.233 (0.212–0.265) from anterior end. Vulva located near midpoint of body, 6.0 (4.9–7.3) from anterior end. Phasmids minute, posterior to midpoint of tail. Eggs ovoid, smooth, without filaments or floats, 0.023 (0.023–0.024) x 0.038 (0.036–0.039). Tail 0.215 (0.188–0.241) long, tapering and ending in a rounded tip (Fig. 50C).

Note: Byrne (*op. cit.*) also provided measurements for the male holotype and female allotype of *R. rotundicaudatum*.

Site: intestine

Hosts: *Ambloplites rupestris* (1, 2); *Ameiurus nebulosus* (1, 2); *Etheostoma caeruleum* (1, 2); *Luxilus cornutus* (1, 2); *Nocomis biguttatus* (1, 2); *Nocomis micropogon* (2); *Semotilus atromaculatus* (1, 2)

Distribution: Ontario

Records: 1. Byrne 1992 a (ON); 2. Byrne 1992b (EX, ON)

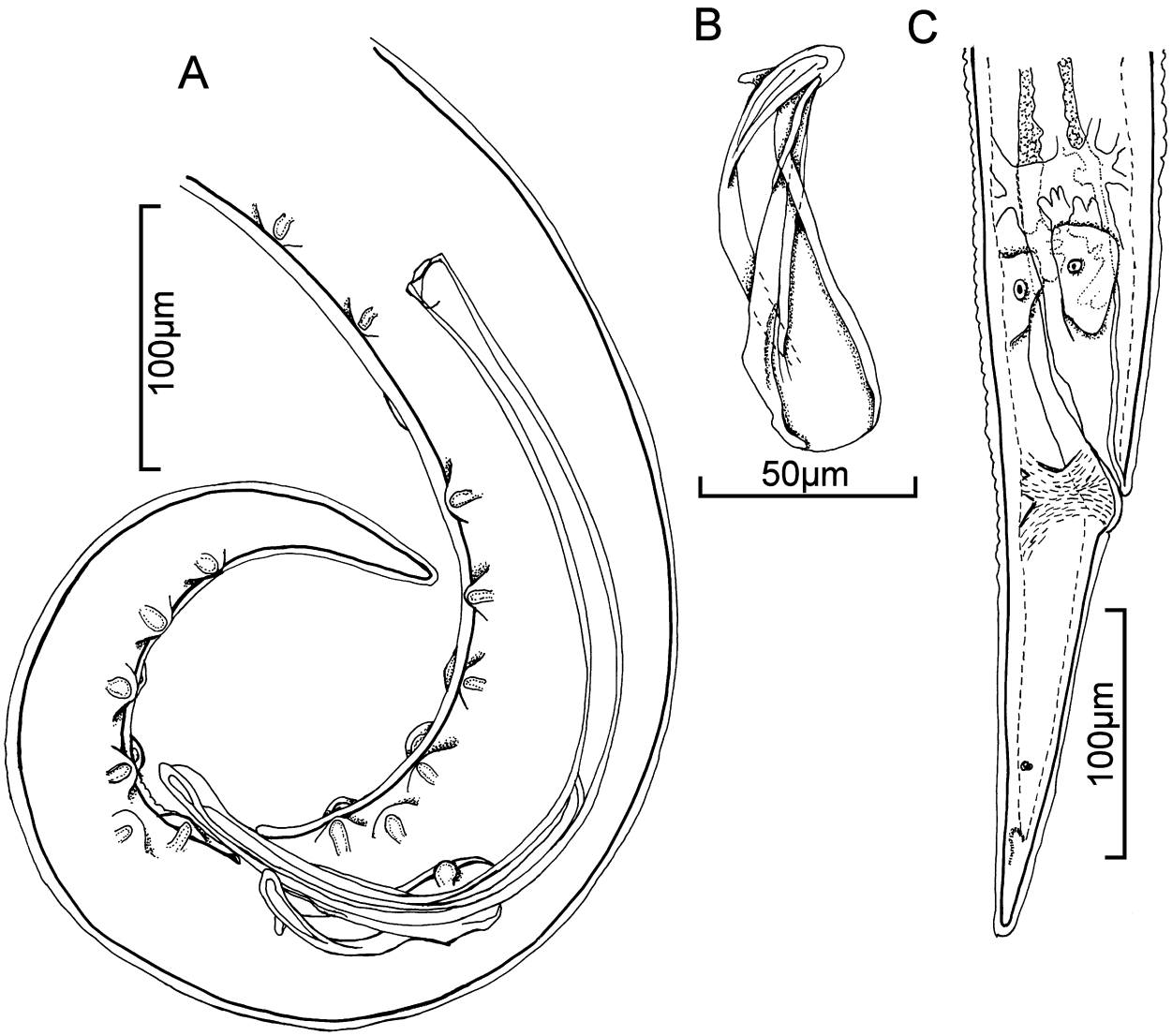

FIGURE 50. *Rhabdochona rotundicaudatum* Byrne, 1992. A. male, posterior end, lateral view; B. right spicule, lateral view; C. female, posterior end, lateral view. (Redrawn from Byrne 1992a)

***Rhabdochona zacconis* Yamaguti, 1935**

Description (after Moravec, Margolis & Boyce 1981). With characteristics of the genus. Medium-sized worms with smooth cuticle. Mouth approximately hexagonal, slightly compressed dorso-ventrally, surrounded by two large lateral amphids and four small sub-apical papillae. Prostom thick-walled, funnel-shaped, without basal teeth but with 14 teeth projecting anteriorly. Deirids medium-sized, bifurcate, located posterior to middle of vestibule (Fig. 51A). Tail of both sexes conical, ending in sharp point (Fig. 51B,E).

Males: body 6.69–10.06 long, 0.122–0.177 maximum width. Prostom 0.018–0.021, vestibule including prostom 0.135–0.207, muscular oesophagus 0.279–0.390 and glandular oesophagus 2.45–4.90 long. Deirids 0.075–0.090, nerve ring 0.192–0.237 and excretory pore 0.303 from anterior end. Pairs of subventral pre-cloacal papillae variable in number; the following combinations were observed: 7+8, 8+9 and 9+9. Another pair was located laterally at level of 3rd subventral pair. Six pairs of post-cloacal papillae present, the 2nd pair lateral, the rest subventral (Fig. 51B). Longitudinal ventral cuticular ridges anterior to pre-cloacal papillae well developed. Left spicule 0.435–0.510 long and 0.012–0.015 wide at mid-length, shaft representing its anterior half, with its distal tip moderately extended, provided with wide cuticular membrane forming large ventral process (Fig. 51C). Right spicule 0.108–0.120 long, boat-shaped, sometimes with dorsal barb on distal tip (Fig. 51D). Length ratio of right to left spicule 1:3.84 to 1:4.47. Tail conical, 0.354–0.411 long, its tip with sharp point (Fig. 51B).

Females: body 16.32–18.31 long, 0.245– 0.285 maximum width. Prostom 0.030–0.033, vestibule including prostom 0.177–0.210, muscular oesophagus 0.450–0.525 and glandular oesophagus 4.15–5.98 long. Deirids 0.105–0.123, nerve ring 0.264–0.309 and excretory pore 0.414–0.453 from anterior end. Tail conical, 0.273–0.303 long, its tip with sharp point (Fig. 51E). Vulva post-equatorial, located 6.94 –8.30 from posterior end. Eggs elongate–oval, 0.036–0.039 x 0.021. Each pole of mature eggs (containing larvae) with one, less frequently two, narrow filaments up to 0.57 long (Fig. 51F).

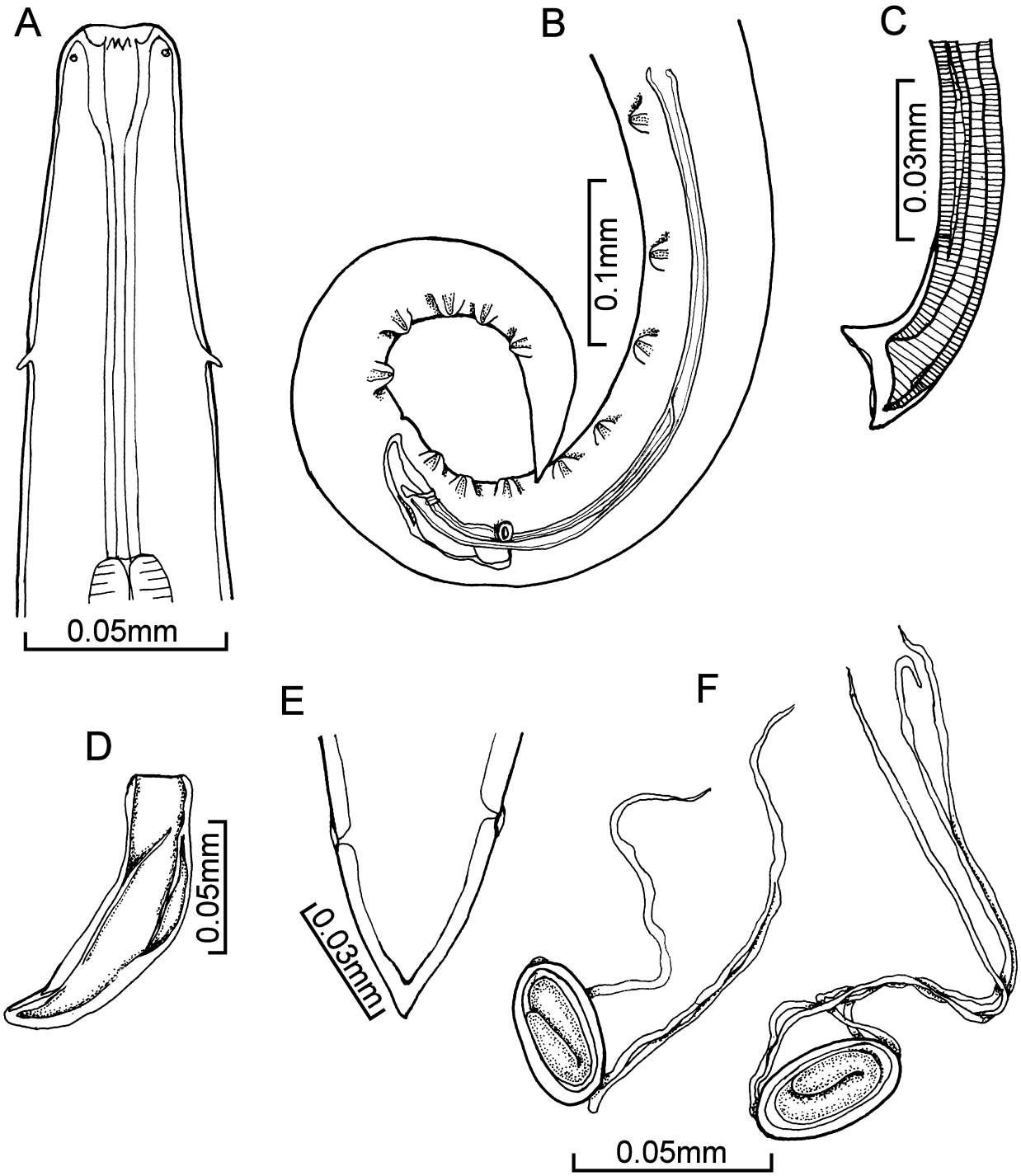

FIGURE 51. *Rhabdochona zacconis* Yamaguti, 1935. A. young female, anterior end, dorsal view; B. male, posterior end, lateral view; C. young male, left spicule, distal tip; D. young male, right spicule; E. female tail, dorsal view; F. eggs. (Redrawn from Moravec *et al*. 1981)

Site: intestine
Host: *Catostomus macrocheilus*
Distribution: British Columbia
Records: Anon. 1978; Arai & Mudry 1983

****_Rhabdochona_ sp.**

Site: intestine
Hosts: *Ambloplites rupestris* (1, 17); *Ameiurus melas* (6); *Ameiurus nebulosus* (2, 21); *Catostomus catostomus* (9, 11, 14, 23); *Catostomus commersonii* (2, 3, 9); *Catostomus macrocheilus* (11, 14); *Coregonus clupeaformis* (3); *Cottus cognatus* (11, 14); *Couesius plumbeus* (5, 7); *Etheostoma caeruleum* (17, 21); *Etheostoma exile* (19); *Fundulus diaphanus* (1); *Lepomis gibbosus* (2, 3); *Lepomis macrochirus* (1); *Luxilus cornutus* (16, 20, 21); *Micropterus dolomieu* (6); *Morone chrysops* (1); *Mylocheilus caurinus* (14, 15); *Nocomis biguttatus* (21); *Notemigonus crysoleucas* (17, 20); *Notropis atherinoides* (21); *Notropis hudsonius* (4); *Oncorhynchus kisutch* (6, 13, 15); *Oncorhynchus mykiss* (11, 13, 14); *Oncorhynchus nerka* (8); *Oncorhynchus tshawytscha* (13, 14, 15); *Perca flavescens* (2, 5, 7, 10); *Percopsis omiscomaycus* (18); *Pimephales promelas* (3); *Prosopium williamsoni* (11, 13, 14, 15, 22); *Ptychocheilus oregonensis* (11, 14, 15); *Richardsonius balteatus* (11, 14); *Salvelinus fontinalis* (6); *Salvelinus fontinalis x Salvelinus namyacush* (12); *Salvelinus malma* (11, 13, 14, 15); *Semotilus atromaculatus* (21)
Distribution: Alberta, British Columbia, Labrador, Manitoba, Ontario
Records: 1. Bangham & Hunter 1939 (ON); 2. Bangham 1941 (ON); 3. Bangham & Venard 1946 (ON); 4. Stewart-Hay 1951c (MB); 5. Bangham 1951 (ON); 6. Bangham & Adams 1954 (BC); 7. Bangham 1955 (ON); 8. Margolis 1957 (BC); 9. Threlfall & Hanek 1970a (LB); 10. Mudry & Anderson 1977 (AB); 11. Anon. 1978 (BC); 12. Dechtiar & Berst 1978 (ON); 13. Anon. 1981 (BC); 14. Arai & Mudry 1983 (BC); 15. Anon. 1984 (BC); 16. Byrne & Baker 1987 (ON); 17. Dechtiar & Christie 1988 (ON); 18. Dechtiar & Lawrie 1988 (ON); 19. Dechtiar *et al.* 1988 (ON); 20. Dechtiar *et al.* 1989 (ON); 21. Byrne 1992b (ON); 22. Nener *et al.* 1995 (BC); 23. Baldwin & Goater 2003 (AB)

Rhabdochonidae gen. sp.

Site: intestine
Host: *Acipenser fulvescens*
Distribution: Saskatchewan
Record: Choudhury *et al.* 1990

Superfamily SPIRUROIDEA Orley, 1885

Preamble: None of the following records of spiruroids in Canadian fishes is supported by a description or illustration.

***Spirurida gen. sp.**

Sites: intestinal wall, mesenteries, stomach wall
Hosts: *Acipenser transmontanus* (7); *Atheresthes stomias* (6); *Clupea pallasi* (2, 3); *Hippoglossus stenolepis* (9, 10, 11); *Mallotus villosus* (8); *Microstomus pacificus* (6); *Oncorhynchus mykiss* (4); *Theragra chalcogramma* (5, 6); unspecified "fish" (1)
Distribution: Atlantic, British Columbia, Pacific
Records: 1. Boyce 1971 (PA); 2. Arthur 1978 (PA); 3. Arthur & Arai 1980a (PA); 4. Anon. 1984 (BC); 5. Arthur 1984 (PA); 6. Kabata & Whitaker 1984 (PA); 7. Margolis & McDonald 1986 (BC); 8. Arthur *et al.* 1985 (AT); 9. Blaycock 1996 (PA); 10. Blaycock *et al.* 1998a (PA); 11. Blaycock *et al.* 1998b (PA)

***Spiruridae gen. sp.**

Site: body cavity
Hosts: *Hippoglossus stenolepis* (2, 3, 4, 5); unspecified "fish" (1)
Distribution: Pacific
Records: 1. Boyce 1971; 2. Blaycock 1996; 3. Blaycock *et al.* 1998a; 4. Blaycock *et al.* 1998b; 5. Blaycock *et al.* 2003

***Spirurinae gen. sp.**

Site: mesenteries
Host: *Myoxocephalus thompsonii*
Distribution: Ontario
Record: Black & Lankester 1981b

***Spiruroidea gen. sp.**

Sites: body cavity, mesenteries, musculature
Host: *Acipenser transmontanus*
Distribution: British Columbia
Record: Margolis & McDonald 1986

Superfamily HABRONEMATOIDEA Chitwood and Wehr, 1932

Preamble: Representatives of the following Families of habronematoids have been reported from Canadian fishes: Cystidicolidae, Hedruridae and Tetrameridae. Of these Families, however, representatives of only the Cystidicolidae have been adequately described and illustrated. Records of larval *Hedruris* sp. (Hedruridae) and of larval *Tetrameres* sp. (Tetrameridae) are included below for the sake of completeness but neither record can be verified in the absence of descriptions or illustrations. In these circumstances, design of a key to the Families of habronematoids would be superfluous.

Family CYSTIDICOLIDAE Skryabin, 1946

Family diagnosis (after Moravec 2013). Large or medium sized worms. Cuticle sometimes ornamented. Mouth opening slit-like or dorso-ventrally elongated. Pseudolabia large or small, sometimes much reduced. Cephalic papillae usually reduced to four at base of pseudolabia. Anterior end of buccal cavity sometimes armed with small teeth. Oesophagus usually divided into anterior muscular and posterior glandular portions. Caudal alae present in males. Eggs oval, larvated, sometimes with special surface ornamentations. Parasites of alimentary tract and swim bladder of fishes.

Comments: Moravec (2007) pointed out that erection of several cystidicolid genera has been based on the fine details of cephalic structures that are visible only with the aid of scanning electon microscopy (SEM). The generic importance of these minute features must await examination by SEM of more cystidicolids and the availability of further comparative molecular data. However, such developments may be irrelevant to users of this part of the Guide.

Key to genera of CYSTIDICOLIDAE

1 Cuticular ornamentation in form of transverse rings with spines; parasitic in alimentary tract of fishes, generally freshwater . . . . . *Spinitectus*

- Cuticular ornamentation, if present, never in form of transverse rings with spines; parasitic in alimentary tract or swim bladder of fishes 2
2 Four pairs of pre-cloacal papillae in male 3
- Six or more pairs of pre-cloacal papillae in male 5
3 Bidentate plate-like structure arising from antero-lateral wall of buccal cavity present; anterior margin of pseudolabia forming narrow ridge; parasitic in alimentary tract of fishes, mostly sturgeons. . . . . *Capillospirura*
- Bidentate plate-like structure arising from antero-lateral wall of buccal cavity absent; pseudolabia narrow or broad 4
4 Pseudolabia very broad and flat; anterior surface of each pseudolabium with small protuberance (pseudolabial protrusion); submedian labia absent . . . . . *Salmonema*
- Buccal cavity dilated anteriorly forming buccal capsule divided into ventral and dorsal chambers; parasitic in swim bladder of salmonid fishes . . . . . *Salvelinema*
5 Pseudolabia narrow: anterior extension of each lateral wall of buccal cavity projecting beyond junction with pseudolabium in a two-pronged horn-like structure, prongs of each projection lying on either side of pseudolabium . . . . . *Caballeronema*
- P seudolabia narrow: horn-like structures absent; anterior surface of each pseudolabium with a prominent conical protuberance or a blunt knob; four submedian labia present . . . . . *Ascarophis*
6 Anterior margin of vestibule armed with two rows of denticles; pseudolabia rudimentary, each forming small, conical, anteriorly protruding structure; 12 to 18 pairs of pre-cloacal papillae in male; parasitic in swim bladder of salmonid fishes . . . . . *Cystidicola*

Comments: Moravec *et al*. (2008) considered *Sterliadochona* Skryabin, 1948 to be a *genus inquirendum*. The genus *Salmonema* Moravec, Santos & Brasil-Sato, 2008, was erected with type species *Salmonema ephemeridarum* (Linstow, 1872) and *S. prevosti* (Choquette, 1951).

Ascarophis van Beneden, 1871

Synonym: *Pseudocystidicola* Layman, 1933

Generic diagnosis (after Moravec 2013). Cystidicolidae. Small to medium sized worms. Pseudolabia continuous medially with anterior extensions of lateral walls of buccal cavity; anterior surface of each pseudolabium with prominent conical protuberance or blunt knob. Flap-like or bilobed sublabium along inner margin of each submedian labium. Four cephalic papillae. Mouth opening dorso-ventrally elongated, with four lateral recesses. Deirids simple, small. Male with pre-cloacal cuticular ridges (an *area rugosa*). Male caudal alae well developed supported by pedunculate papillae. Spicules unequal and dissimilar. Female tail ends bluntly or with knob-like structure. Uterus amphidelphic. Vulva equatorial or postequatorial. Eggs elliptical, embryonated, with or without polar filaments. Parasitic in alimentary tract of fishes.

Key to species of *Ascarophis*

1 Tufts of filaments on both poles of eggs; left spicule 0.59–0.88 long . . . . . *A. arctica*
- Filaments on only one egg pole. 2
2 Left spicule < 0.15 long. Females 7.1– 9.4 long . . . . . *A. sebastodis*
- Left spicule > 0.50 long. Females 8.5–12.7 long . . . . . *A. morrhuae*
3 Left spicule between 0.25 and 0.40 long 4
4 Females 5.9–8.7 long . . . . . *A. extalicola*
- Females 19.3–35.9 long . . . . . *A. filiformis*

Ascarophis arctica Polyanski, 1952

Description (after Appy 1981). With characteristics of the genus.

Males: 6.6 (5.7–7.9) long, 0.089 (0.062–0.105) wide at *vas deferens*. Muscular oesophagus 0.274 (0.233–0.325) and glandular oesophagus 1.650 (1.325–2.045) long. Deirids, nerve ring and excretory pore 0.132 (0.110–0.151), 0.179 (0.155–0.202) and 0.267 (0.232–0.338), respectively, from anterior end (Fig. 52A). Tail 0.151 (0.129–0.182) long. Right spicule 0.100 (0.085–0.111) long, spicule arcuate, notched distally. Left spicule 0.808 (0.585–0.882) long, tubular, divided into proximal shaft and blade. Ratio of left to right 1:8.1 (1:5.9 to 1:10.4).

Area rugosa with about 14 longitudinal rows of cuticular elevations. Ten pairs caudal papillae: two double pairs pre-cloacal, six pairs post-cloacal; 5th post-cloacal pair relatively small, ventral to 6th pair. Caudal alae narrow. Phasmids immediately behind last pair post-cloacal papillae (Fig. 52B).

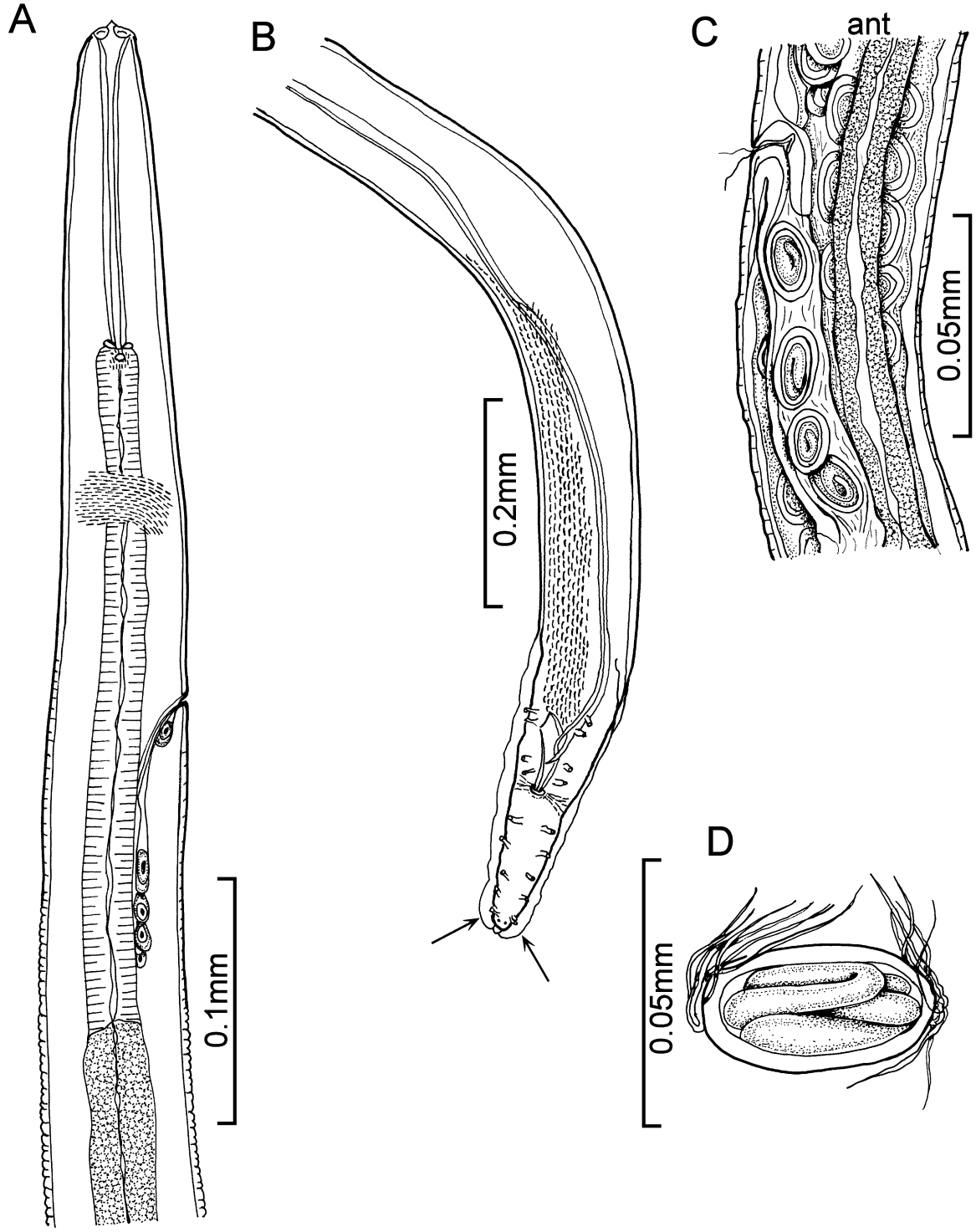

FIGURE 52. *Ascarophis arctica* Polyanski, 1952. A. male, anterior end, lateral view; B. male, posterior end, ventral view, arrows indicate the 5th and 6th pairs of post-caudal papillae; C. female, vulvar region, lateral view [NB: for presentational reasons, polar filaments have been omitted from *in utero* eggs to avoid clutter]; D. egg from uterus. (Redrawn from Appy 1981)

Females: 13.3 (10.5–15.4) long, 0.124 (0.092–0.157) wide at vulva. Muscular oesophagus 0.321 (0.235–0.414) and glandular oesophagus 1.928 (1.474–2.554) long. Deirids, nerve ring, excretory pore and vulva 0.147 (0.131–0.166), 0.194 (0.172–0.221), 0.295 (0.269–0.338) and 7.0 (5.5–8.3), respectively, from anterior end (Fig. 52C). [NB: to avoid clutter in Figure 52C the *in utero* eggs have been drawn as if they lack polar filaments.] Tail 0.052 (0.034–0.071) long. Eggs 0.045 (0.043–0.048) x 0.024 (0.022–0.027) with filaments at both poles (Fig. 52D).

[For comments on *A. arctica* see page 90–91]

Sites: alimentary tract, stomach

Hosts: *Gadus morhua* (1, 3); *Hemitripterus americanus* (1); *Hippoglossoides platessoides* (5); *Melanogrammus aeglefinus* (1, 2, 4); *Merluccius bilinearis* (1); *Microgadus tomcod* (1); *Osmerus mordax* (1); *Pholis gunnellus* (1); *Pseudopleuronectes americanus* (1, 7); *Reinhardtius hippoglossoides* (6); *Urophycis tenuis* (1); *Zoarces americanus* (1)

Distribution: Atlantic

Records: 1. Appy 1981; 2. Scott 1981; 3. Appy & Burt 1982; 4. Scott 1982; 5. Zubchenko 1985a; 6. Arthur & Albert 1994; 7. McClelland *et al.* 2005

Ascarophis extalicola Appy, 1981

Description (after Appy 1981). With characteristics of the genus.

Males: 5.3 (4.0–6.3) long, 0.039 (0.033–0.051) wide at *vas deferens*. Muscular oesophagus 0.184 (0.159–0.224) and glandular oesophagus 1.018 (0.732–1.269) long. Deirids, nerve ring and excretory pore 0.113 (0.097–0.127), 0.134 (0.116–0.148) and 0.212 (0.183–0.244), respectively, from anterior end (Fig. 53A). Tail 0.098 (0.078–0.117) long. Right spicule 0.070 (0.061–0.083) long, spicule arcuate, notched distally. Left spicule 0.313 (0.276–0.359) long, divided into proximal shaft and blade. Ratio of left to right 1:4.5 (1:3.6 to 1:5.6). *Area rugosa* with about nine longitudinal rows of cuticular elevations. 10 pairs caudal papillae: four pairs pre-cloacal, six pairs post-cloacal; 5th post-cloacal pair relatively small, ventral to 6th pair. Caudal alae narrow. Phasmids behind last pair of post-cloacal papillae (Fig. 53B).

Females: 7.2 (5.9–8.7) long, 0.050 (0.037–0.072) wide at vulva. Muscular oesophagus 0.187(0.163–0.202) and glandular oesophagus 1.196 (1.015–1.363) long. Deirids, nerve ring, excretory pore and vulva 0.115 (0.101–0.128), 0.133 (0.116–0.148), 0.215(0.180–0.237) and 5.2 (4.2–6.2), respectively, from anterior end. Tail 0.052 (0.037–0.066) long (Fig. 53C). Eggs 0.044 (0.041–0.046) x 0.027 (0.026–0.031) with two to 11 filaments at one pole (Fig. 53D).

[For comments on *A. extalicola* see pages 90–91.]

Sites: intestine, rectum

Hosts: *Gadus morhua* (1, 3); *Melanogrammus aeglefinus* (2); *Myoxocephalus octodecemspinosus* (1)

Distribution: Atlantic

Records: 1. Appy 1981; 2. Scott 1981; 3. Appy & Burt 1982

Ascarophis filiformis Polyanski, 1952

Description (after Appy 1981). With characteristics of the genus.

Males: 12.4 (9.0–14.7) long, 0.105 (0.077–0.130) wide at *vas deferens*. Muscular oesophagus 0.343 (0.260–0.403) and glandular oesophagus 2.117 (1.445–2.864) long. Deirids, nerve ring and excretory pore 0.175 (0.140–0.209), 0.219 (0.185–0.258) and 0.325 (0.264–0.367), respectively, from anterior end (Fig. 54A). Tail 0.158 (0.125–0.189) long. Right spicule 0.109 (0.094–0.129) long, spicule arcuate, notched distally. Left spicule 0.328 (0.271–0.392) long, tubular, divided into proximal shaft and blade. Ratio of left to right 1:3.0 (1:2.5 to 1:3.5). *Area rugosa* with about 11 longitudinal rows of cuticular elevations. 10 pairs caudal papillae: two double pairs pre-cloacal, six pairs post-cloacal; 5th post-cloacal pair relatively small, ventral to 6th pair. Caudal alae narrow. Phasmids behind last pair post-cloacal papillae (Fig. 54B).

Females: 25.1 (19.3–35.9) long, 0.160 (0.112–0.207) wide at vulva. Muscular oesophagus 0.386 (0.330–0.462) and glandular oesophagus 2.606 (1.845–3.424) long. Deirids, nerve ring, excretory pore and vulva 0.186 (0.143–

0.228), 0.228 (0.179–0.265), 0.340 (0.258–0.415) and 12.7 (9.5–18.3), respectively, from anterior end. Tail 0.090 (0.058–0.120) long (Fig. 54C). Eggs 0.047 (0.042–0.050) x 0.031 (0.028–0.035) with two filaments arising from prominent knob at one pole (Fig. 54D).

[For comments on *A. filiformis* see page 90–91]

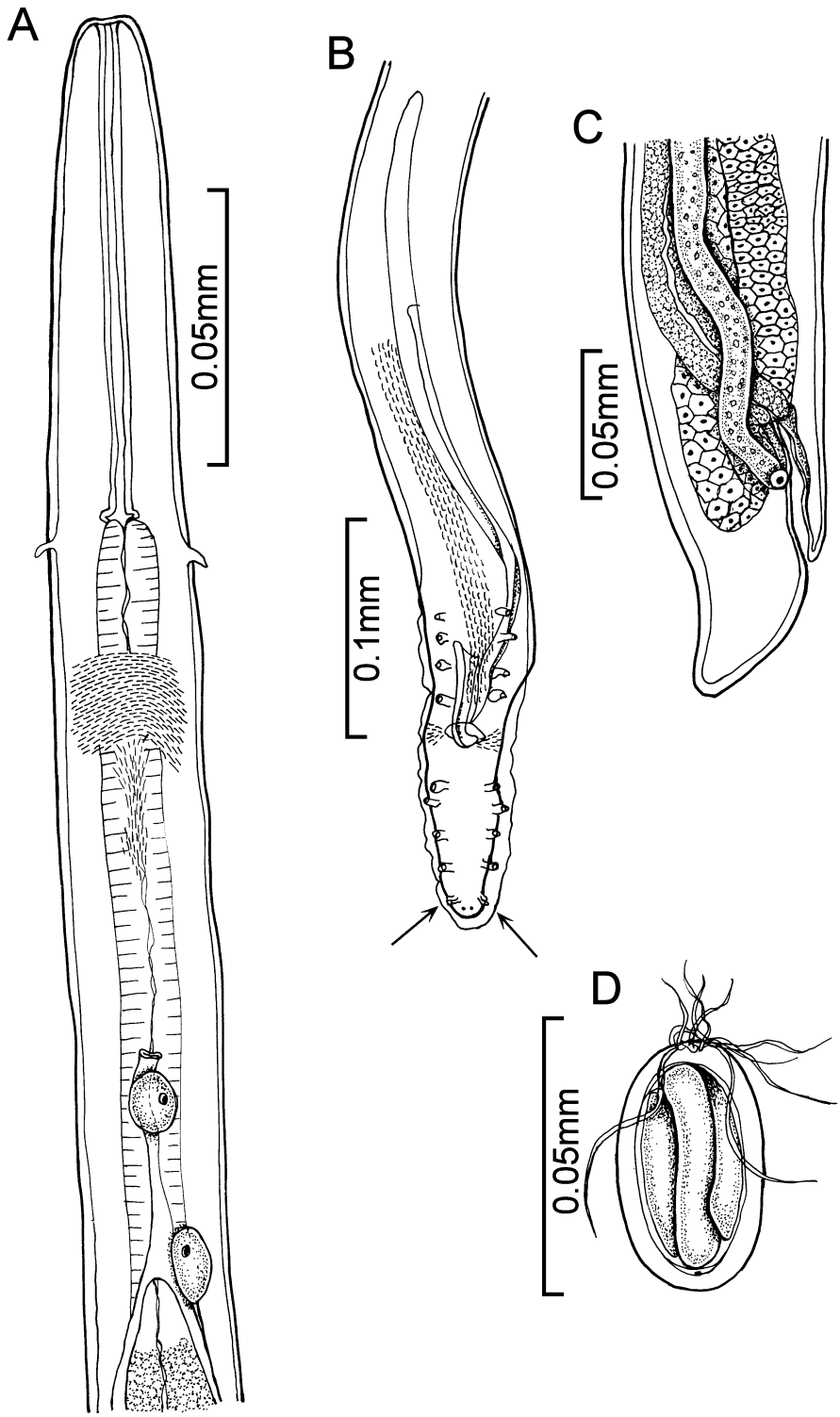

FIGURE 53. *Ascarophis extalicola* Appy, 1981. A. female, anterior end, ventral view; B. male, posterior end, ventral view, arrows indicate the 5th and 6th pairs of post-caudal papillae; C. female, posterior end, lateral view; D. egg from uterus. (Redrawn from Appy 1981)

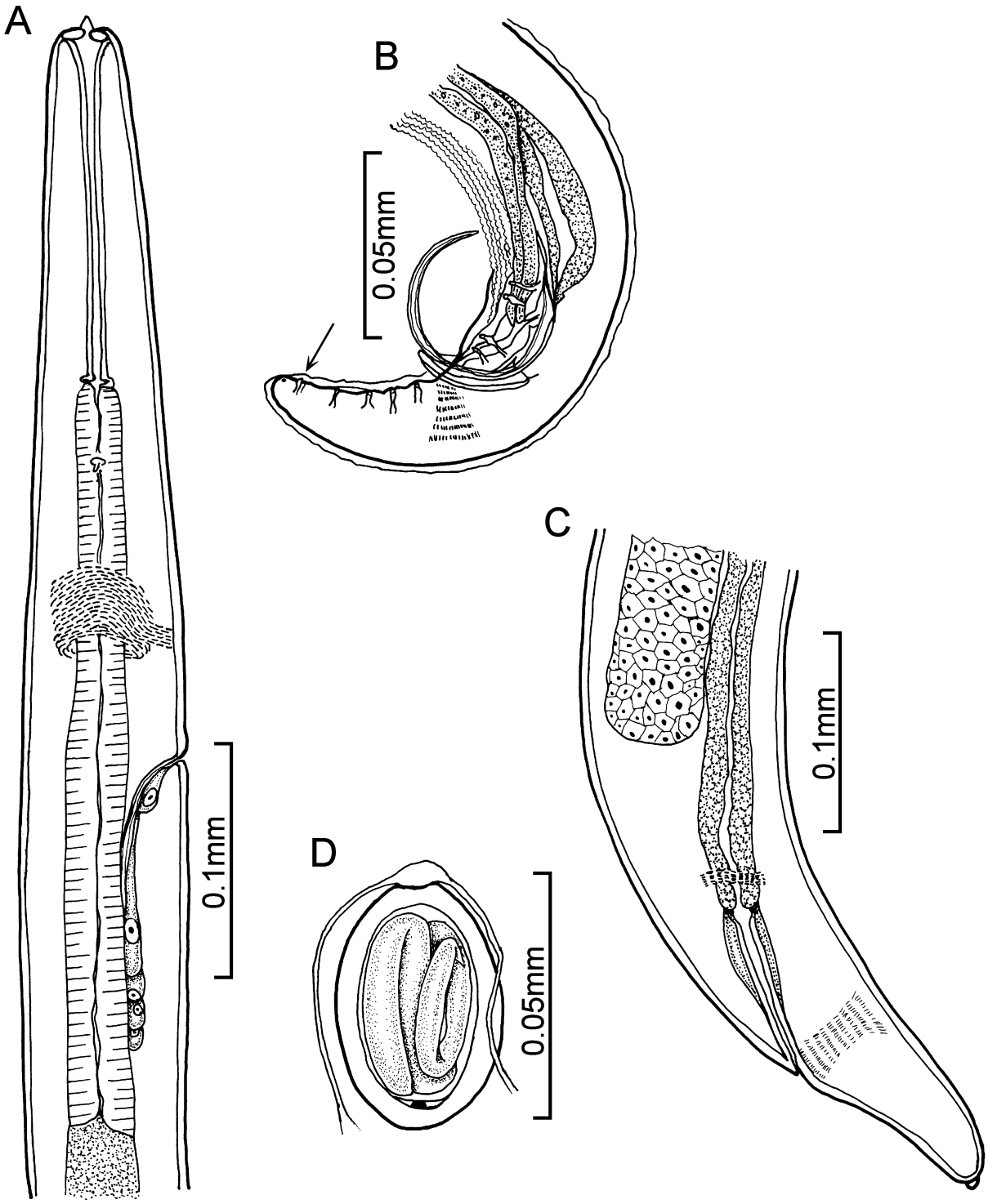

FIGURE 54. *Ascarophis filiformis* Polyanski, 1952. A. male, anterior end, lateral view; B. male, posterior end, lateral view, arrow indicates left-hand pair 5th and 6th post-caudal papillae; C. female, posterior end, lateral view; D. egg from uterus. (Redrawn from Appy 1981)

Site: stomach

Hosts: *Boreogadus saida* (9); *Gadus morhua* (1, 2, 3, 4); *Hippoglossus stenolepis* (7, 8); *Liparis dennyi* (5); *Reinhardtius hippoglossoides* (6)

Distribution: Atlantic, Nunavut, Pacific

Records: 1. Redkozubova 1976 (AT); 2. Linkletter *et al.* 1977 (AT); 3. Appy 1981 (AT); 4. Appy & Burt 1982 (AT); 5. Ko 1986 (PA); 6. Arthur & Albert 1994 (AT); 7. Blaycock 1996 (PA); 8. Blaycock *et al.* 1998a (PA); Køie 2009 (NU)

Ascarophis morrhuae van Beneden, 1871

Description (after Ko 1986). With characteristics of the genus.

Males: 5.9 (5.1–7.2) long, 0.028 (0.026–0.029) wide at nerve ring. Buccal cavity 0.097 (0.086–0.108) long (Fig. 55A). Muscular oesophagus 0.271 (0.226–0.297) and glandular oesophagus 1.75 (1.34–2.43) long. Nerve ring 0.134 and excretory pore 0.242 from anterior end. Four pairs pre-cloacal, and six pairs post-cloacal papillae. Left spicule 0.765 (0.740–0.790), right spicule 0.098 (0.095–0.100) long (Fig. 55B). Tail 0.105 (0.084–0.134) long.

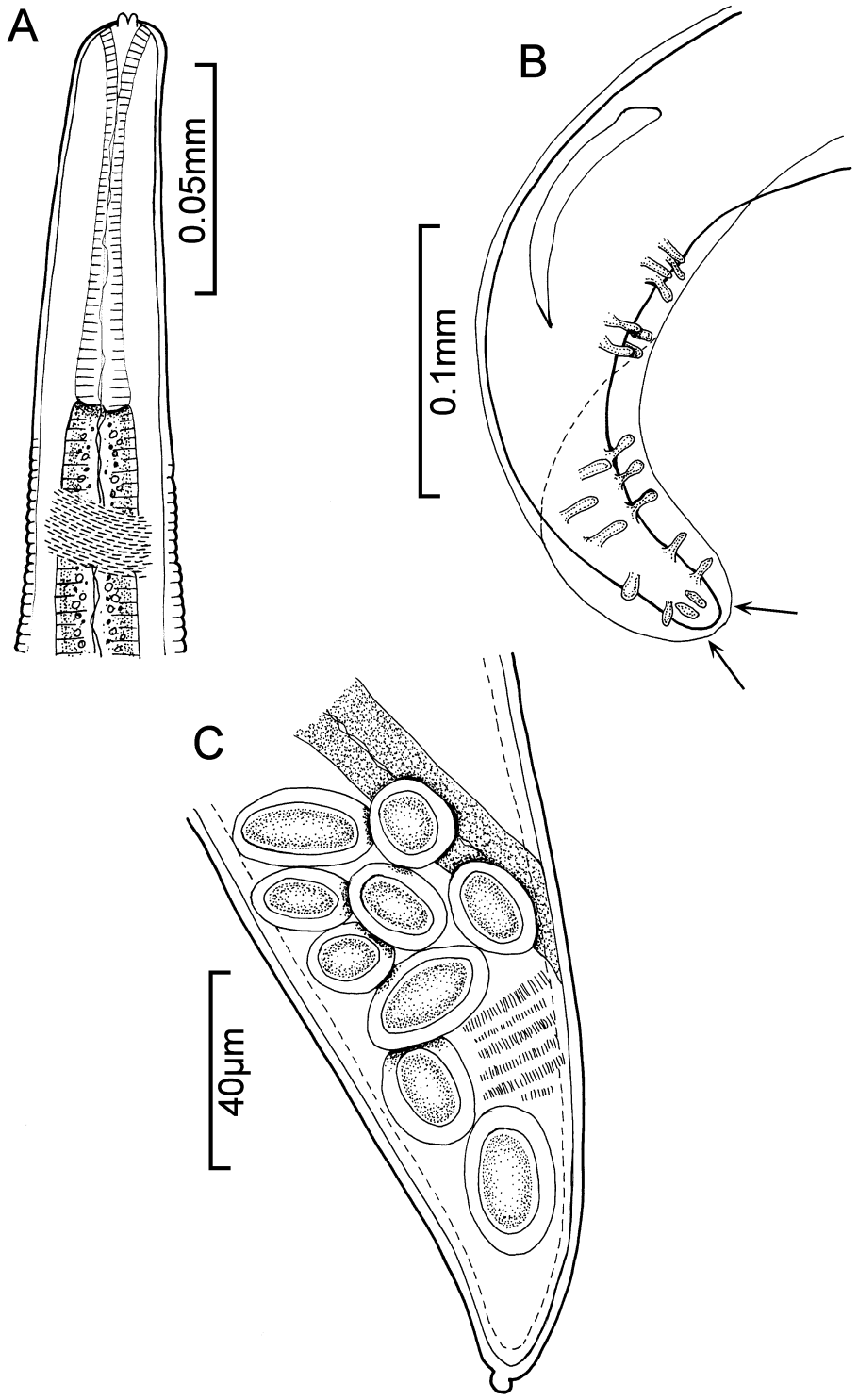

FIGURE 55. *Ascarophis morrhuae* van Beneden, 1871. A. anterior end, lateral view; B. male, posterior end with short (right) spicule, arrows indicate structures that are "possibly the phasmids" [*sic*]; C. female, posterior end showing extent of uterus, eggs evidently lacking polar filaments. (A. and B. redrawn from Berland 1961; C. redrawn from Ko 1986)

Females: 10.8 (8.5–12.7) long, 0.036 (0.031–0.041) wide at nerve ring. Buccal cavity 0.098 (0.085–0.115) long. Muscular oesophagus 0.246 (0.216–0.288) and glandular oesophagus 1.9 (1.1–2.3) long. Nerve ring 0.140 (0.113–0.178) and excretory pore 0.212 (0.161–0.240) from anterior end. Vulva 5.3 (4.7–6.0) from posterior end. Uterus extends from region of glandular oesophagus almost to tail tip. Tail 0.116 (0.072–0.146) long with knob-like tip (Fig. 55C). Embryonated eggs 0.036 (0.026–0.046) x 0.024 (0.022–0.026) with one polar plug bearing two filaments although, according to Ko (1986), eggs in the posterior extension of the uterus apparently lack filaments (Fig. 55C).

[For comments on *A. morrhuae* see below]

Site: alimentary tract

Hosts: *Alosa sapidissima* (4); *Anarhichas lupus* (3); *Gadus morhua* (2); *Gasterosteus aculeatus* (1); *Glyptocephalus cynoglossus* (3)

Distribution: Atlantic, Labrador, Newfoundland

Records: 1. Hanek & Threlfall 1970a (AT, LB, NL); 2. Gaevskaya & Umnova 1977 (AT); 3. Zubchenko 1980 (AT); 4. Hogans *et al.* 1993 (AT)

Ascarophis sebastodis Olsen, 1952

Description (after Ko 1986). With characteristics of the genus.

Males: 5.1 (3.7–6.4) long, 0.026 (0.020–0.030) wide at nerve ring. Buccal cavity 0.080 (0.070–0.100), muscular oesophagus 0.282 (0.220–0.377) and glandular oesophagus 2.5 (1.7–2.5) long. Nerve ring 0.117 (0.090–0.144) from anterior end (Fig. 56A). Four pairs pre-cloacal and six pairs post-cloacal papillae. Left spicule 0.135 and right spicule 0.047 (0.036–0.053) long. Tail 0.065 (0.053–0.074) long.

Females: 8.7 (7.1–9.4) long, 0.028 (0.022–0.030) at nerve ring. Buccal cavity 0.086 (0.080–0.090), muscular oesophagus 0.374 (0.310–0.410) and glandular oesophagus 2.5 (1.8–2.9) long. Nerve ring 0.136 (0.115–0.144) from anterior end. Vulva 2.2 from posterior end. Tail 0.055 (0.041–0.070) long, ending in small knob (Fig. 56B). Eggs 0.037 (0.036–0.038) x 0.023 (0.019–0.024) with polar plug bearing two filaments (Fig. 56C).

[For comments on *A. sebastodis* see below]

Site: intestinal lumen

Hosts: *Anoplarchus purpurescens* (1); *Artedius harringtoni* (1); *Aulorhynchus flavidus* (1); *Hemilepidotus hemilepidotus* (1); *Hexagrammos lagocephalus* (1); *Microstomus pacificus* (3); *Myoxocephalus polyacanthocephalus* (1); *Nautichthys oculofasciatus* (1); *Oncorhynchus kisutch* (1, 4); *Oncorhynchus nerka* (1); *Parophrys vetulus* (3); *Rhamphocottus richardsonii* (1); *Sebastes alutus* (2); *Sebastes borealis* (2); *Sebastes caurinus* (1, 2, 4); *Sebastes diploproa* (2); *Sebastes variegatus* (1, 2); *Sebastes flavidus* (2); *Sebastes maliger* (2); *Sebastes nebulosus* (5); *Sebastes proriger* (2); *Sebastes ruberrimus* (2); *Sebastes variegatus* (2); *Sebastes zacentrus* (2)

Distribution: Pacific

Records: 1. Arai 1969; 2. Sekerak & Arai 1977; 3. Kabata & Whitaker 1984; 4. Ko 1986; 5. Holmes 1990

Ascarophis sp.

Sites: intestinal lumen, stomach

Hosts: *Coregonus nasus* (8); *Cottus aleuticus* (5); *Gadus macrocephalus* (5); *Gadus morhua* (9); *Hexagrammos decagrammus* (1, 5); *Mallotus villosus* (6); *Nautichthys oculofasciatus* (5); *Oncorhynchus gorbuscha* (2, 4); *Reinhardtius hippoglossoides* (7)

Distribution: Atlantic, British Columbia, Newfoundland, Northwest Territories, Pacific

Records: 1. Margolis 1977 (PA); 2. Anon. 1981 (BC); 3. Sankurathri *et al.* 1983 (PA); 4. Anon. 1984 (BC); 5. Ko 1986 (BC, PA); 6. Arthur *et al.* 1995 (AT); 7. Boje *et al.* 1997 (AT); 8. Choudhury & Dick 1997 (NT): 9. Khan *et al*. 2011 (NF)

Comments: Five *Ascarophis* species are known currently from Canadian fishes. Appy (1981) provided good descriptions and illustrations for *A. arctica, A. extalicola* and *A. filiformis*; the original descriptions of *A. morrhuae* and *A. sebastodis* are relatively poor. Taxonomic problems concern morphology of the head of both sexes, and the tails of males. Regarding the head, the pseudolabia of *A. extalicola* have a blunt knob rather than the prominent

conical apex of *A. arctica* and *A. filiformis*, so Appy (*op. cit.*) and Ko (1986) suggested that *A. extalicola* might be related to "*Cystidicoloides*" [species of which have been transferred to *Salmonema*; see page 100]. Regarding male tails, an *area rugosa*, narrow caudal alae, six pairs of post-cloacal papillae, and paired phasmids behind the 6th pair of papillae appear to be diagnostic. Appy (*op. cit.*) pointed out that papillae of the 5th pair are relatively small and ventral to the 6th pair, so earlier workers might have overlooked them. Indeed, Figure 55B illustrates an *A. morrhuae* male, redrawn from Berland (1961), apparently with only five pairs of post-cloacal papillae, and structures that are [*sic*] "possibly the phasmids". The description of neither *A. morrhuae* nor *A. sebastodis* mentions an *area rugosa*; there is no reference to paired phasmids for *A. sebastodis*; and caudal alae are not mentioned in the descriptions for either species, although Figure 55B illustrates them for *A. morrhuae*. Both *A. morrhuae* and *A. sebastodis* should be redescribed and illustrated with special attention to the morphology of heads and tails.

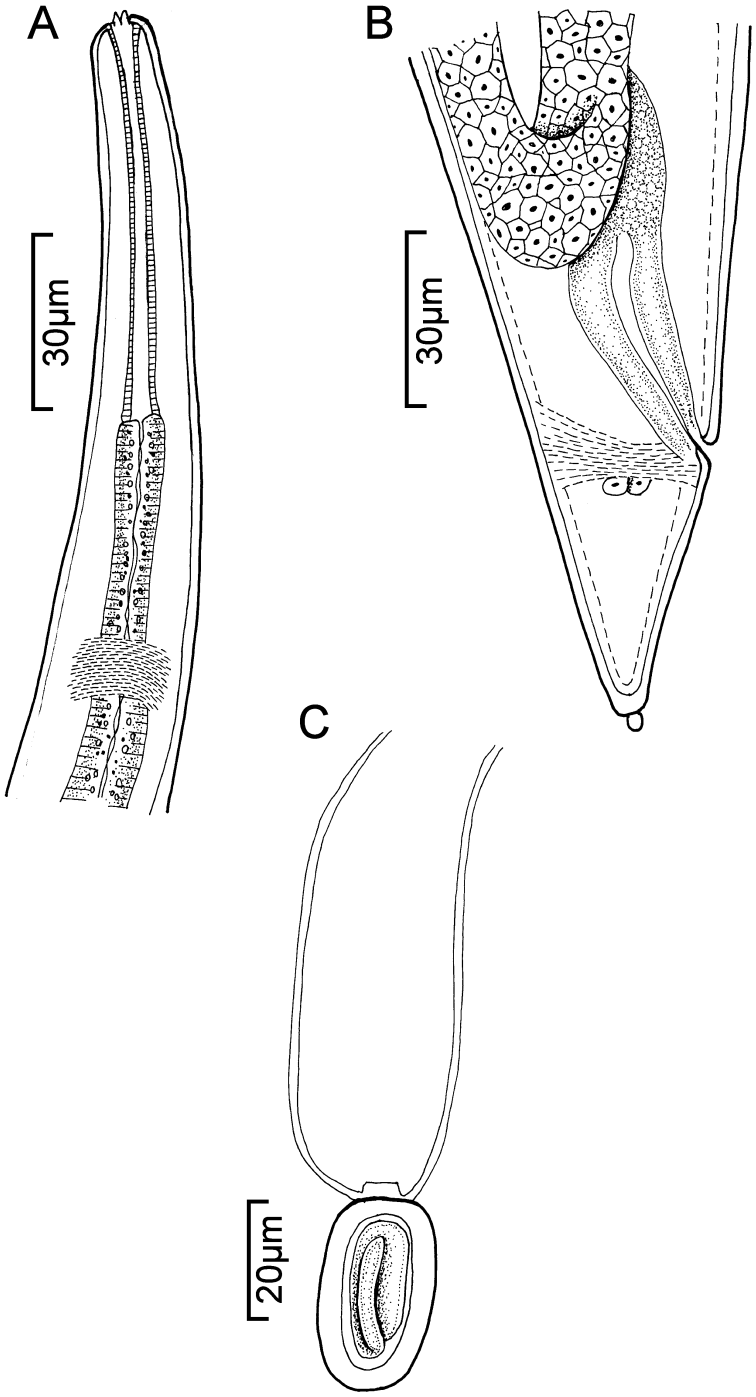

FIGURE 56. *Ascarophis sebastodis* Olsen, 1952. A. male, anterior end, lateral view; B. female, posterior end, lateral view; C. egg showing two polar filaments. (Redrawn from Ko 1986).

Caballeronema Margolis, 1977

Generic diagnosis (after Margolis 1977). Cystidicolidae. Relatively large worms, tapering at both ends, cuticle transversely striated. Mouth dorso-ventrally elongated, surrounded by four submedian labia (two subdorsal and two subventral) and two narrow lateral pseudolabia; bilobed structure (sublabium), with thickened free margin, attached by its base to inner surface of each labium; pseudolabia continuous on inner margin with lateral anterior extensions of buccal cavity wall; these extensions terminating in two-pronged horn-like projections, prongs lying on either side of corresponding pseudolabium.of each projection. Four submedian cephalic papillae and two lateral amphids. Buccal cavity with thick cuticularized walls, sigmoid, longer than broad. Oesophagus divided into short anterior muscular and long posterior glandular portions. Nerve ring and excretory pore at level of muscular oesophagus. Caudal end of male spirally coiled, tip rounded, caudal alae present. Four pairs pre-cloacal and six pairs post-cloacal pedunculated papillae. Several longitudinal rows of pre-cloacal cuticular elevations. Spicules grossly unequal and dissimilar. Gubernaculum absent. Female tail with rounded tip. Amphidelphic. Vulva equatorial. Fully developed eggs thick shelled, with polar plugs and filaments at both poles, containing larvae when deposited.

Caballeronema wardlei, the type species, is known from two fish species in the Canadian Pacific.

Caballeronema wardlei (Smedley, 1934) Margolis, 1977

Synonym: *Metabronema wardlei* Smedley, 1934

Description (after Margolis 1977). With characterisitics of the genus.

Males: 26.3–36.9 long, 0.19–0.21 maximum width. Nerve ring 0.264–0.281 and excretory pore 0.401–0.446 from anterior end. Buccal cavity 0.077–0.115 long. Muscular oesophagus 0.894–1.030, and glandular oesophagus 6.41–8.83 long; ratio of their lengths 1: 7.2 to 1:1:8.6. Testis straight originating anterior to oesophago-intestinal junction, 7.14–9.75 from anterior end. Tail 0.275–0.326 long with rounded tip. Left spicule slender, 2.29–2.69 long; right spicule 0.168–0.184 long; ratio 13.6–15.4:1. Pre-cloacal papillae arranged in couples, two pairs immediately pre-cloacal, and two pairs slightly anterior to level of proximal end of withdrawn right spicule. First five pairs post-cloacal papillae approximately evenly distributed over length of tail. Phasmids at tail tip (Fig. 57A).

Females: 46.3–74.2 long, 0.22–0.34 maximum width. Nerve ring 0.261–0.349 and excretory pore 0.374–0.588 from anterior end. Buccal cavity 0.092–0.117 long. Muscular oesophagus 0.870–1.166 and glandular oesophagus 7.33–11.61 long: ratio of their lengths 1:8.1 to 1:1:9.9 (Fig. 57B). Anterior ovary originates near oesophago-intestinal junction; posterior ovary originates near level of anus. Vulva 26.25–36.15 or 48.7%–56.7% of total body length from anterior end of body. Eggs with vermiform larvae when shed, 0.043–0.047 x 0.028–0.032: at one pole a large plug with two long and up to six shorter more delicate filaments; at opposite pole a small plug with up to four of the shorter filaments (Fig. 57C). Tail 0.196–0.285 long. Phasmids near tail tip (Fig. 57D).

Sites: intestinal lumen, pyloric caeca

Hosts: *Scorpaenichthys marmoratus* (1, 2); *Sebastes nebulosus* (3)

Distribution: Pacific

Records: 1. Smedley 1934; 2. Margolis 1977; 3. Holmes 1990

Capillospirura Skryabin, 1924

Generic diagnosis (after Appy & Anderson 1982). Cystidicolidae. Filiform worms. Four cephalic papillae present. Mouth dorso-ventrally elongate. Pseudolabia narrow and with a ridge-like apex. Submedian labia present. Mouth opening with opposing plates projecting from antero-lateral wall of buccal cavity. Sublabium in each subdorsal and subventral quadrant of mouth opening. Buccal cavity long and slender, dilated posteriorly behind mouth opening. Ten pairs caudal papillae, four pre-cloacal and six post-cloacal. Left spicule longer than right. Vulva near midbody. Parasitic in alimentary tract of fishes, mostly sturgeons.

One species, *C. pseudoargumentosa*, is known from several fish species in Canada.

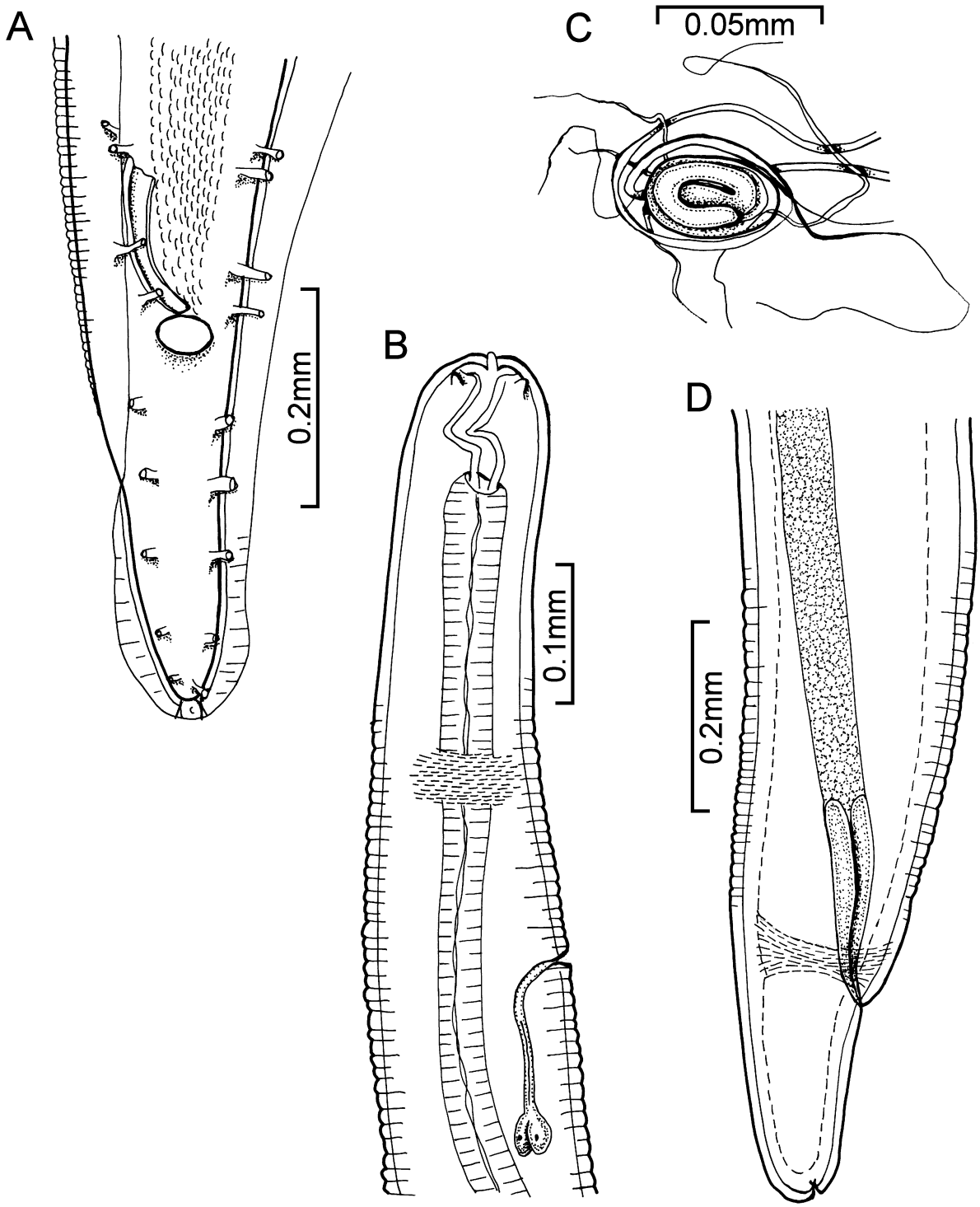

FIGURE 57. *Caballeronema wardlei* (Smedley, 1934) Margolis, 1977. A. male, posterior end, ventral view; B. female, anterior end, lateral view; C. egg [long filaments truncated]; D. female, posterior end, lateral view. (Redrawn from Margolis 1977)

Capillospirura pseudoargumentosa (Appy & Dadswell, 1978) Appy & Anderson, 1982

Synonym: *Caballeronema pseudoargumentosus* Appy & Dadswell, 1978

Description (after Appy & Dadswell 1978). With characteristics of the genus.

Males:7.7 –10.0 long, 0.073–0.087 wide. Buccal cavity 0.065–0.090 long. Muscular oesophagus 0.277–0.439,

glandular oesophagus 1.466–1.931 (Fig. 58A), and tail 0.087–0.127 long. Nerve ring 0.135–0.225, excretory pore 0.259–0.394 and testis 2.463–4.018, respectively, from anterior end. Right spicule 0.110–0.138 and left spicule 0.492–0.598 long; ratio of right spicule to left spicule length 1:4.5. Right spicule has notch in distal tip; left spicule has ridge beginning near proximal end and extending posteriorly to near distal tip. Four pre-cloacal and six post-cloacal papillae. *Area rugosa* comprises about seven longitudinal rows of cuticular elevations (Fig. 58B). Caudal alae present.

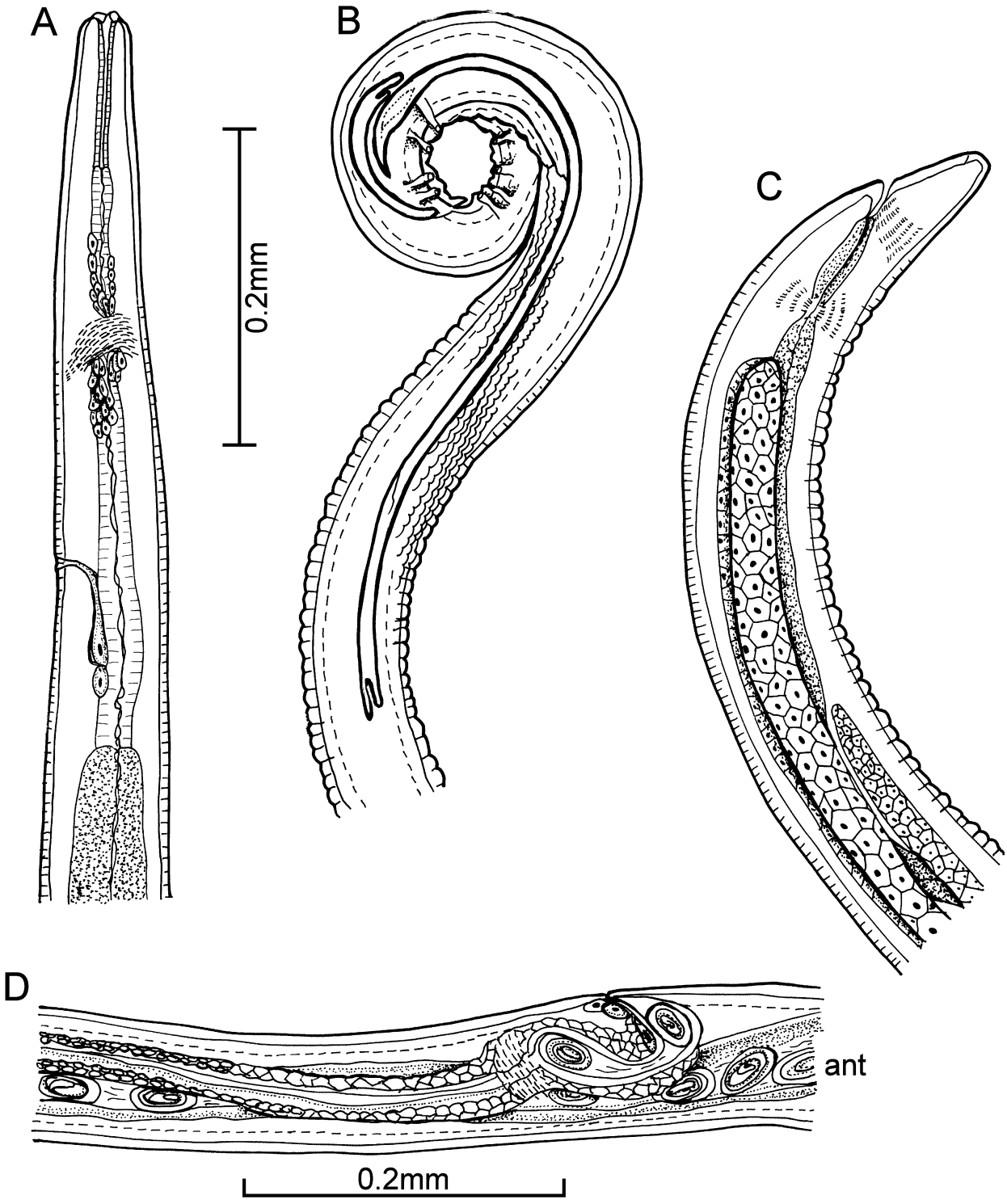

FIGURE 58. *Capillospirura pseudoargumentosa* (Appy & Dadswell, 1978) Appy & Anderson, 1982. A. male, anterior end; B. male, posterior end; C. female, posterior end; D. female, vulva, vagina and uterus [NB: for presentational reasons, polar filaments have been omitted from *in utero* eggs to avoid clutter]. (Redrawn from Appy & Dadswell 1978).

Females:12.0–18.5 long, 0.089–0.109 wide. Buccal cavity 0.072–0.092 long. Muscular oesophagus 0.292–0.486, glandular oesophagus 1.456–1.962 long and tail 0.052–0.077 (Fig. 58C) long. Nerve ring 0.149–0.224, excretory pore 0.276–0.426, anterior ovary 1.528–2.025 and vulva 5.599–8.493 (Fig. 58D), respectively, from anterior end. Eggs 0.038–0.044 x 0.019–0.022. One polar plug with four to10 filaments.

Site: alimentary tract

Hosts: *Acipenser brevirostrum* (1, 2, 3, 4); *Acipenser fulvescens* (5); *Acipenser oxyrinchus* (3); *Oncorhynchus mykiss* (4)

Distribution: Atlantic

Records: 1. Appy & Dadswell 1978 ; 2. Appy & Dadswell 1980 ; 3. Appy & Anderson 1982 ; 4. Appy & Dadswell 1983 (EX, AT)

Cystidicola Fischer, 1798

Synonyms: *Fissula* Lamarck, 1801; *Ophiostoma* Rudolphi, 1801; *Ancyracanthus* Schneider, 1866; *Pseudancyracanthus* Skryabin, 1925; *Comephoronema* Layman, 1933

Preamble: Two species of *Cystidicola* are currently recognised: *C. farionis* and *C. stigmatura.* The species differ in adult and egg morphology, longevity, reproductive strategy, and host and geographical range (Miscampbell *et al.* 2004). *C. farionis* is short lived (about one year) and occurs in Salmonidae and Osmeridae in North America and Eurasia, whilst *C. stigmatura* is long lived (over 10 years) and occurs exclusively in *Salvelinus* spp. in North America. Suggestions over the years that Canadian fishes may harbour "strains" of *C. farionis* or that there is a third *Cystidicola* species (see Miscampbell *et al*. 2004, and references therein) are best addressed by further morphological and molecular studies.

Generic diagnosis (after Ko & Anderson 1969). Cystidicolidae. Pseudolabia small. Mouth opening dumb-bell shaped; armed with two rows of teeth, an exterior row comprising one large ventral, one large dorsal, two prominent lateral, and numerous small teeth in the form of fine serrations, and an internal row of 16 large teeth, four in each quadrant formed by the ventral, dorsal, and lateral teeth (Fig. 59A). Buccal cavity long and slender. Oesophagus divided into short anterior muscular and long posterior glandular portions. Excretory pore posterior to nerve ring, near junction of muscular and glandular oesophagus (Fig. 59B). Vulva slightly posterior to mid–body length. Tail short. Fully developed eggs bear lateral and/or polar filaments or a pair of lateral "lobes" ("floats" or "mammillations" *in litt*.). Parasitic in swim bladder of fishes.

Key to species of *Cystidicola*

1 Males 14–19 and females 15–21 long; fully developed eggs bear lateral and/or polar filaments . . . . . *C. farionis*

\- Males 17–31 and females 19–37 long; fully developed eggs bear lateral "lobes" ("floats" or "mammillations" *in litt*.) . . . . . *C. stigmatura*

Cystidicola farionis Fischer, 1798

Synonyms: *Cystidicola stigmatura* (Leidy, 1886) Ward & Magath, 1917 (*partim*); *Cystidicola canadensis* Skinker, 1930

Description (after Ko & Anderson 1969, and Miscampbell *et al.* 2004). With characteristics of the genus.

Males: body 16 (14–19) long. Width at nerve ring 0.117 (0.103–0.134), at anus 0.102 (0.104–0.134). Buccal cavity 0.122 (0.113–0.133) long (Fig. 59B). Nerve ring 0.315 (0.278–0.319) and excretory pore 0.512 (0.474–0.577) from anterior end. Muscular oesophagus 0.463 (0.402–0.608) long [length of glandular oesophagus not given]. Cuticular bosses present on ventro-lateral surface of caudal alae. Spicules unequal: left one 0.690 (0.640–0.730), right one 0.133 (0.103–0.148) long (Fig. 59C). Seven to nine double pairs of pre-cloacal papillae present. Four pairs of post-cloacal papillae present, the 1st and 3rd single pairs, the 2nd and 4th double pairs. Phasmids 0.025 (0.016–0.035) from posterior end. Tail 0.196 (0.155–0.227) long (Fig. 59C).

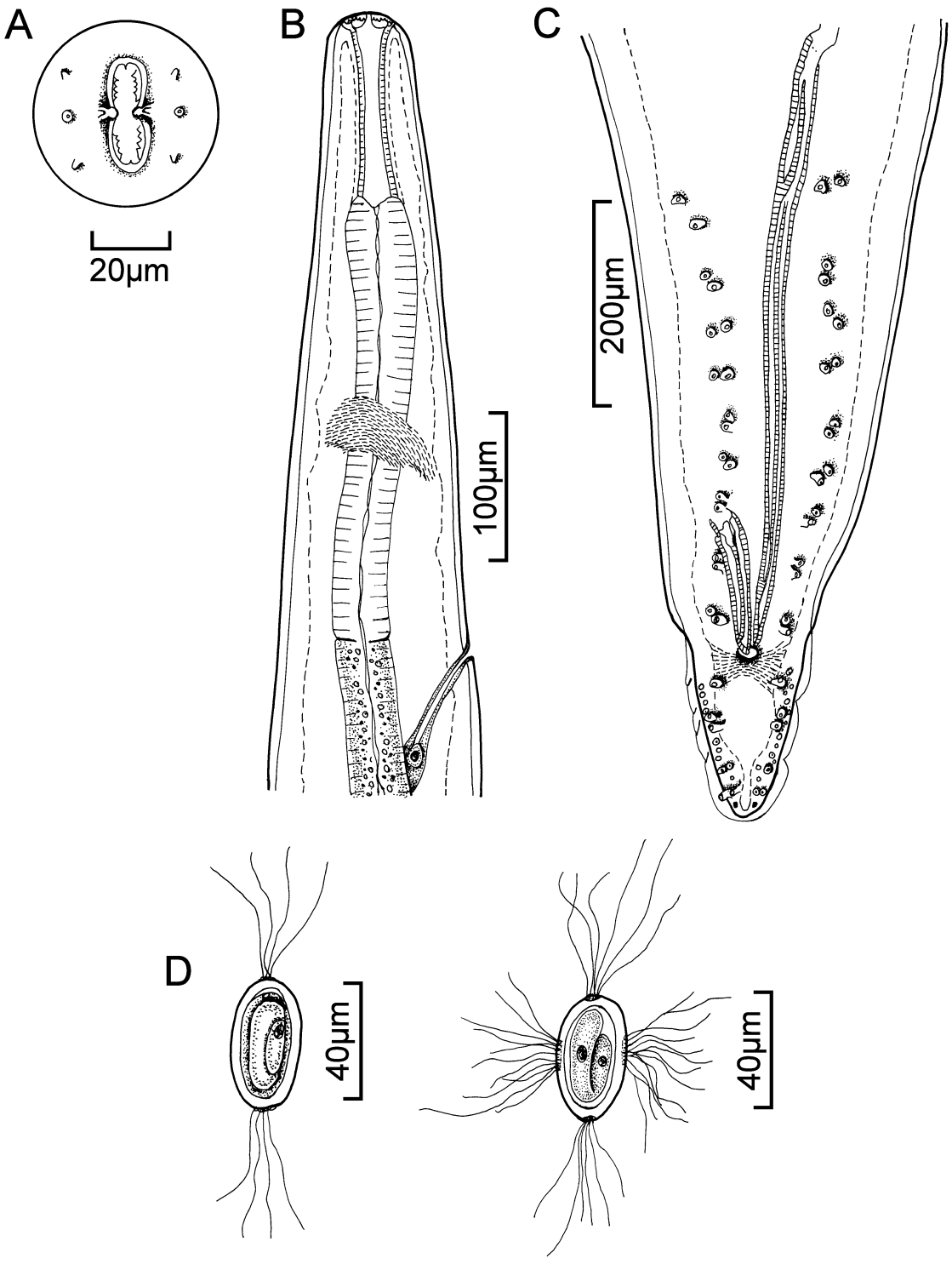

FIGURE 59. *Cystidicola farionis* Fischer, 1798. A. female, *en face* view; B. male, anterior end, lateral view; C. male, posterior end, ventral view; D. fully developed eggs with polar filaments only and with both lateral and polar filaments. (Redrawn from Ko & Anderson 1969).

Females: body 18 (15–21) long. Width at nerve ring 0.126 (0.124–0.134), at anus 0.100 (0.078–0.113). Buccal cavity 0.128 (0.113–0.134) long. Nerve ring 0.305 (0.278–0.330) and excretory pore 0.462 (0.412–0.515) from anterior end. Muscular oesophagus 0.443 (0.412–0.474) and glandular oesophagus 1.100 (0.958–1.185) long. Uterus amphidelphic, didelphic. Vulva slightly posterior to mid-body length, 11 (8–13) from anterior end. Phasmids 0.035 (0.034–0.037) from posterior end. Tail 0.130 (0.103–0.156) long. Fully developed eggs 0.042 (0.039–0.044) x 0.021 (0.021–0.023), bearing lateral and/or polar filaments (Fig. 59D).

Sites: body cavity, mesenteries, stomach, swim bladder

Hosts: *Apeltes quadracus* (9); *Catostomus catostomus* (10); *Coregonus artedi* (3, 4, 5, 17, 19, 30, 31, 35); *Coregonus clupeaformis* (4, 5, 10, 11, 15, 16, 17, 19, 20, 22, 23, 24, 25, 28, 29, 30, 31, 32, 35); *Coregonus hoyi* (3, 17, 31); *Coregonus nasus* (34); *Coregonus nigripinnis* (17); *Coregonus reighardi* (3); *Coregonus* sp. (8); *Esox americanus americanus* (2); *Oncorhynchus gorbuscha* (17, 31); *Oncorhynchus kisutch* (17, 19, 30, 31); *Oncorhynchus mykiss* (6, 12, 16, 17, 18, 22, 25, 30, 31); *Oncorhynchus nerka* (22, 25, 30); *Oncorhynchus tshawytscha* (17); *Osmerus mordax* (17, 29, 30, 31); *Perca flavescens* (11); *Prosopium coulterii* (12); *Prosopium cylindraceum* (5, 6, 10, 17, 30, 31); *Prosopium williamsoni* (6, 8, 12, 13, 21, 22, 25); Salmonidae gen. sp. (14); *Salmo trutta* (17); *Salvelinus alpinus* (22, 24, 26, 27); *Salvelinus fontinalis* (17, 33); *Salvelinus fontinalis x Salvelinus namaycush* (17, 30); *Salvelinus malma* (13, 18, 21, 22); *Salvelinus namaycush* (1, 8, 10, 12, 13, 17, 21, 22, 25, 35); *Sander vitreus* (11); *Thymallus arcticus* (10)

Distribution: Alberta, Atlantic, British Columbia, Manitoba, Northwest Territories, Newfoundland, Ontario, Quebec, Saskatchewan, Yukon Territory

Records: 1. Wright 1879 (ON); 2. Walton 1928 (ON); 3. Skinker 1930 (ON); 4. Ekbaum 1936 (MB, ON); 5. Bangham 1951 (ON); 6. Bangham & Adams 1954 (BC); 7. Dickson 1964 (MB); 8. Margolis 1967a (BC, ON); 9. Hanek & Threlfall 1970c (AT); 10. Arthur *et al.* 1976 (YT); 11. Watson 1977 (MB); 12. Mudry & Anderson 1977 (AB); 13. Anon. 1978 (BC); 14. J. D. Smith & Lankester 1979 (ON); 15. Watson & Dick 1979 (MB); 16. Black & Lankester 1980 (EX, ON); 17. Lankester & Smith 1980 (ON); 18. Anon. 1981 (BC); 19. Leong & Holmes 1981 (AB); 20. Samuel 1981 (AB); 21. Arai & Mudry 1983 (BC); 22. G. A. Black 1983c (NT); 23. McAllister & Mudry 1983 (AB); 24. Stewart & Bernier 1983 (NT); 25. Anon. 1984 (BC); 26. Stewart & Bernier 1984 (NT); 27. Black & Lankester 1984 (NT); 28. Dextrase & Lankester 1987 (ON); 29. Dechtiar & Christie 1988 (ON); 30. Dechtiar *et al.* 1988 (ON); 31. Dechtiar & Lawrie 1988 (ON); 32. Stock 1988 (AB); 33. Marcogliese & Cone 1991a (QC); 34. Choudhury & Dick 1997 (NT); 35. Baldwin & Goater 2003 (AB)

Cystidicola lepisostei Hunter & Bangham, 1933 *sp. inq.*

On the basis of its cephalic structures Ko & Anderson (1969) considered this species to belong to *Cystidicola*. The specimens were recovered from the intestinal lumen rather than the swim bladder so it is likely they were from a salmonoid fish ingested by the host. Ko & Anderson (*op. cit*.) regarded it as a *species inquirendum*.

Site: intestinal lumen

Host: *Lepisosteus osseus*

Distribution: Ontario

Records: Hunter & Bangham 1933; Bangham & Hunter 1939

Cystidicola serratus (Wright, 1879) Railliet, 1916 *sp. inq.*

From the cephalic structure and other morphological features Ko & Anderson (1969) concluded that this species should be regarded as *Rhabdochona species inquirendum*.

Site: heart

Host: *Coregonus artedi* or *Coregonus clupeaformis*

Distribution: Ontario

Record: Wright 1879

Cystidicola stigmatura (Leidy, 1886) Ward & Magath, 1917

Synonym: *Cystidicola cristivomeri* White, 1941

Description (after White & Cable 1942, Ko & Anderson 1969, and Miscampbell *et al*. 2004). With characteristics of the genus.

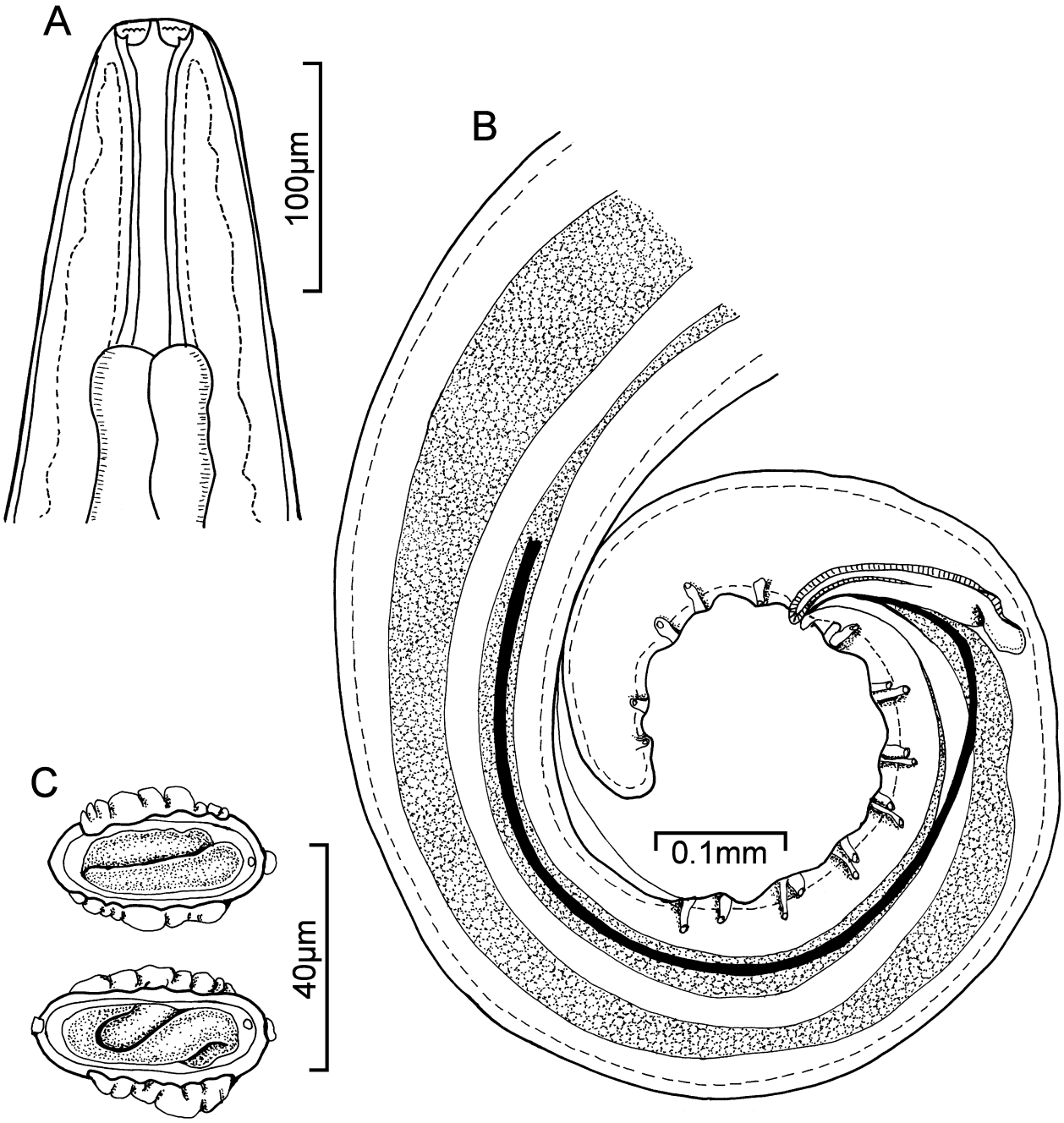

FIGURE 60. *Cystidicola stigmatura* (Leidy, 1886) Ward & Magath, 1917. A. male, anterior end, lateral view; B. male, posterior end, lateral view; C. fully developed eggs. (A. redrawn from Ko & Anderson 1969; B. redrawn from Skinker 1931; C. redrawn from White & Cable 1942)

Males: body 23 (17–31) long. Width at nerve ring 0.126 (0.101–0.144), at anus 0.125 (0.103–0.155). Buccal cavity 0.148 (0.124–0.174) long (Fig. 60A). Nerve ring 0.399 (0.371–0.443) from anterior end [position of excretory pore not given]. Muscular oesophagus 0.527 (0.433–0.597) and glandular oesophagus 3.110 (2.370–3.970) long. Cuticular bosses present on ventro-lateral surface of caudal alae. Spicules unequal: left one 0.900 (0.760–1.150), right one 0.200 (0.170–0.250) long. Seven to nine double pairs of pre-cloacal papillae present, the last pair sometimes single. Four pairs of post-cloacal papillae present, the 1st and 3rd single pairs, the 2nd and 4th double pairs. Phasmids 0.033 (0.025–0.037) from posterior end. Tail 0.244 (0.200–0.278) long (Fig. 60B).

Females: body 28 (19–37) long. Width at nerve ring 0.142 (0.124–0.155), at anus 0.131 (0.113–0.151). Buccal cavity 0.149 (0.134–0.165) long. Nerve ring 0.405 (0.371–0.433) and excretory pore 0.608 (0.525–0.690) from anterior end. Muscular oesophagus 0.524 (0.474–0.567) and glandular oesophagus 3.070 (2.630–3.310) long.

Uterus amphidelphic, didelphic. Vulva slightly posterior to middle of body, 16 (10–21) from anterior end. Phasmids 0.036 (0.034–0.037) from posterior end. Tail 0.212 (0.175–0.265) long. Fully developed eggs 0.045 (0.042–0.049) x 0.025 (0.023–0.026), bearing lateral "lobes" ("floats" or "mammillations" *in litt*.) (Fig. 60C).

Site: swim bladder

Hosts: *Coregonus artedi** (10, 14, 15, 19); *Coregonus clupeaformis** (1, 6, 9, 10, 12, 14, 15, 16, 19, 24, 41); *Coregonus hoyi**(10); *Myoxocephalus thompsonii* (29); *Oncorhynchus gorbuscha* (42); *Oncorhynchus kisutch* (17, 19); *Oncorhynchus nerka* (16); *Osmerus mordax* (16); *Prosopium cylindraceum* (10); *Salvelinus alpinus* (18, 20, 22, 23, 28, 30, 33, 34, 36, 37, 38, 39, 40); *Salvelinus fontinalis* (3, 5, 25); *Salvelinus fontinalis x Salvelinus namaycush* (16, 21); *Salvelinus namaycush* (2, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 25, 26, 27, 30, 31, 32, 33, 34, 35, 36, 37, 43)

Distribution: Alberta, British Columbia, Manitoba, Nunavut, NorthWest Territories, Ontario, Quebec, Saskatchewan, Yukon Territory

Records: 1. Smedley 1933 (AB, MB, SK); 2. White 1941 (ON); 3. Richardson 1942 (QC); 4. White and Cable 1942 (ON); 5. MacLulich 1943 (ON); 6. Miller 1945 (AB, NT); 7. Miller & Kennedy 1948 (NT); 8. Rawson 1951 (AB); 9. Stewart-Hay 1953a (MB); 10. Bangham 1955 (ON); 11. Rawson 1959 (SK); 12. Boyes & Anderson 1961 (ON); 13. Rawson 1961 (SK); 14. Ko & Anderson 1969 (ON); 15. Dechtiar 1972a (ON); 16. Collins & Dechtiar 1974 (ON); 17. Leong & Holmes 1974 (AB); 18. Jamieson & Freeman 1975 (NT); 19. Leong 1975 (AB); 20. Mudry & McCart 1978 (YT); 21. Dechtiar & Berst 1978 (ON); 22. Beverley-Burton 1978a (NT); 23. Eddy & Lankester 1978 (NT); 24. Pybus & Samuel 1978 (AB); 25. Lankester & Smith 1980 (ON); 26. Black & Lankester 1980 (EX, ON); 27. G. A. Black 1981b (EX, ON); 28. Black & Lankester 1981a (NT); 29. Black & Lankester 1981b (ON); 30. Black & Anderson 1982 (NU, ON); 31. Stewart & Bernier 1982 (NU); 32. G. A. Black 1983a (ON); 33. G. A. Black 1983b (NT, ON, QC, SK); 34. Stewart & Bernier 1983 (NT); 35. G. A. Black 1984a (ON); 36. G. A. Black 1984b (NT, NU, ON, SK); 37. Black & Lankester 1984 (NT, ON); 38. Curtis 1984 (NT, QC); 39. Stewart & Bernier 1984 (NT); 40. G. A. Black 1985 (NT); 41. Samuel 1985 (AB); 42. Anthony 1986 (ON); 43. Dechtiar & Lawrie 1988 (ON)

*Footnote: nematodes recovered from species of *Coregonus* were probably *Cystidicola farionis* misidentified as *C. stigmatura*. Most of the early records of *C. stigmatura* from other non-*Salvelinus* hosts pre-date the work of G. A. Black and coworkers and should be viewed with caution. Later records should be verified by examination of deposited specimens.

***Cystidicola* sp.**

Sites: body cavity, swim bladder

Hosts: *Coregonus artedi* (1, 9, 13); *Coregonus clupeaformis* (3, 5, 13); *Coregonus hoyi* (1); *Coregonus kiyi* (1); *Coregonus reighardi* (1); *Esox lucius* (10, 12); *Fundulus diaphanus* (6); *Oncorhynchus mykiss* (7); *Oncorhynchus tshawytscha* (4); *Prosopium coulterii* (8); *Prosopium williamsoni* (5, 13); *Salvelinus alpinus* (11); *Salvelinus namaycush* (2, 8)

Distribution: Alberta, British Columbia, Manitoba, Nova Scotia, Northwest Territories, Ontario, Pacific

Records: 1. Pritchard 1931 (ON); 2. White 1940 (ON); 3. Stewart-Hay 1953b (MB); 4. Godfrey 1968 (PA); 5. Paetz & Nelson 1970 (AB); 6. Wiles 1975 (NS); 7. Hoskins *et al.* 1976 (BC); 8. Mudry & Anderson 1977 (AB); 9. Anthony 1978a (ON); 10. McAllister & Mudry 1983 (AB); 11. Dick 1984 (NT); 12. Samuel 1985 (AB); 13. Nelson & Paetz 1992 (AB)

****Metabronema* sp.**

Site: ?

Host: *Thymallus arcticus*

Distribution: British Columbia

Record: Bangham & Adams 1954

Comment: This record is included for the sake of completeness. According to Margolis & Arthur (1979) the record

"is probably referable to the genus *Cystidicoloides*" but McDonald & Margolis (1995) made no reference to it. The larva—or larvae—may in fact represent *Salmonema* Moravec, Santos & Brasil-Sato, 2008 (see below).

Salmonema Moravec, Santos & Brasil-Sato, 2008

Generic diagnosis (after Moravec *et al*. 2008). Cystidicolidae. Medium sized nematodes. Pseudolabia broad, flat; surface of each pseudolabium with small protuberance (pseudolabial protrusion). Mouth opening broad, somewhat dorso-ventrally elongated, demarcated by four narrow, unlobed sclerotized plates (sublabia). Four submedian cephalic papillae present. Vestibule elongated, dilated anteriorly (dorso-ventrally) to form funnel-shaped prostom. Deirids simple, small. Male with an *area rugosa*. Caudal alae in male well developed, supported by pedunculate papillae; four pairs of pre-cloacal papillae present. Spicules unequal and dissimilar. Female tail short. Uterus amphidelphic. Vulva in posterior half of body. Eggs elliptical, nonfilamented [*sic*], containing fully formed larva. Parasites of fresh-water fishes. Type species *S. ephemeridarum* (von Linstow, 1872).

Comments: design of a key to distinguish *Salmonema ephemeridarum* from *S. prevosti* (synonym *Metabronema prevosti*) would be fraught. Apart from the fact that *S. prevosti* males were inadequately described, and that neither males nor females were well illustrated (see below), there is the structure of the eggs. The foregoing generic diagnosis of *Salmonema* states that eggs are "nonfilamented" whilst Choquette's (1951) original description refers to eggs bearing "coarse filaments at either poles which are provided with knobs".

Salmonema ephemeridarum (von Linstow, 1872) Moravec, Santos & Brasil-Sato, 2008

Synonyms: *Sterliadochona ephemeridarum* (von Linstow, 1872) Petter, 1974; *Metabronema harwoodi* Chandler, 1931; *Metabronema canadense* Skinker, 1931; *Metabronema salvelini* (Fujita, 1920) Baylis, 1935; *Cystidicoloides harwoodi* (Chandler, 1931) Dollfus & Campana-Rouget, 1956; *Sterliadochona tenuissima* (Zeder, 1800) Spassky & Roitman, 1957; *Cystidicoloides tenuissima* (Zeder, 1800) Rasheed, 1965; *Cystidicoloides ephemeridarum* (von Linstow, 1872) Moravec, 1981

Description (after Moravec 2013). With characteristics of the genus. Whitish, medium-sized worms with transversely striated cuticle; posterior margins of cuticular rings somewhat elevated. Pseudolabia broad, flat; each pseudolabium with dorsal and ventral lobes and a small papilla-like protrusion. Mouth opening oval, dorso-ventrally flattened, with two subdorsal and two subventral elongate sclerotized plates. Mouth surrounded by two dorso-lateral and two ventro-lateral cephalic papillae, and a pair small lateral amphids. Vestibule well sclerotized, long, in lateral view forming small funnel-shaped prostom. Deirids simple, very small, at level of posterior half of vestibule. Oesophagus comprises muscular and glandular portions. Nerve ring encircling muscular oesophagus, excretory pore below nerve ring level. Males much smaller than females.

Males: 5.25–8.16 long, 0.087–0.163 maximum width. Vestibule 0.094–0.147, muscular oesophagus 0.600–1.183, and glandular oesophagus 1.38–2.62 long. Nerve ring 0.177–0.255 and excretory pore 0.246–0.300 from anterior end (Fig. 61A). Posterior end usually spirally coiled, with fairly wide caudal alae. Caudal papillae: four pairs subventral pedunculate pre-cloacal papillae, and five pairs subventral pedunculate post-cloacal papillae. One pair very small ventral sessile papillae at level of last subventral pair. *Area rugosa* anterior to cloaca (Fig. 61B). Spicules unequal and dissimilar: large (left) one 0.262–0.345 long, distal end with conical cuticular membrane (Fig. 61C); short (right) one boat-shaped 0.081–0.140 long, with ventral cuticular ala along its entire length (Fig. 61D). Tail conical, 0.108–0.156 long, with rounded end.

Females: gravid worms 12.74–14.86 long, 0.244–0.313 maximum width. Vestibule 0.136–0.165, muscular oesophagus 1.36–1.50, and glandular oesophagus 2.12–3.26 long. Nerve ring 0.210–0.240 and excretory pore 0.303–0.330 from anterior end. Tail very short, rounded, 0.045–0.060 long. Vulva in posterior half of body, 8.09–9.18 from anterior end. Uterus amphidelphic. Eggs oval, thick-walled, with smooth surface, 0.036–0.048 x 0.024–0.030. Mature eggs contain a formed larva.

Sites: alimentary tract, swim bladder

Hosts: *Anguilla rostrata* (18); *Coregonus artedi* (42); *Coregonus clupeaformis* (17, 35, 41, 42, 43); *Cottus asper* (10); *Esox masquinongy* (8, 9); *Hiodon tergisus* (28); *Oncorhynchus clarkii* (10); *Oncorhynchus kisutch* (10,

13, 42, 43); *Oncorhynchus mykiss* (7, 10, 11, 25, 30, 34, 35, 41, 43); *Oncorhynchus nerka* (10, 13, 43); *Prosopium cylindraceum* (10); *Prosopium williamsoni* (10); *Rhinichthys cataractae* (10); *Salmo salar* (14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 29, 47); *Salmo trutta* (14, 16, 43); *Salvelinus alpinus* (6, 17, 18, 32, 37, 45); *Salvelinus fontinalis* (1, 2, 3, 4, 5, 7, 11, 12, 14, 16, 17, 18, 19, 20, 26, 27, 31, 36, 38, 39, 40, 41, 44, 46, 48); *Salvelinus malma* (10, 25, 34); *Salvelinus namaycush* (17, 42); *Thymallus arcticus* (25, 34); unspecified "dace" (8); unspecified "salmonids" (33)

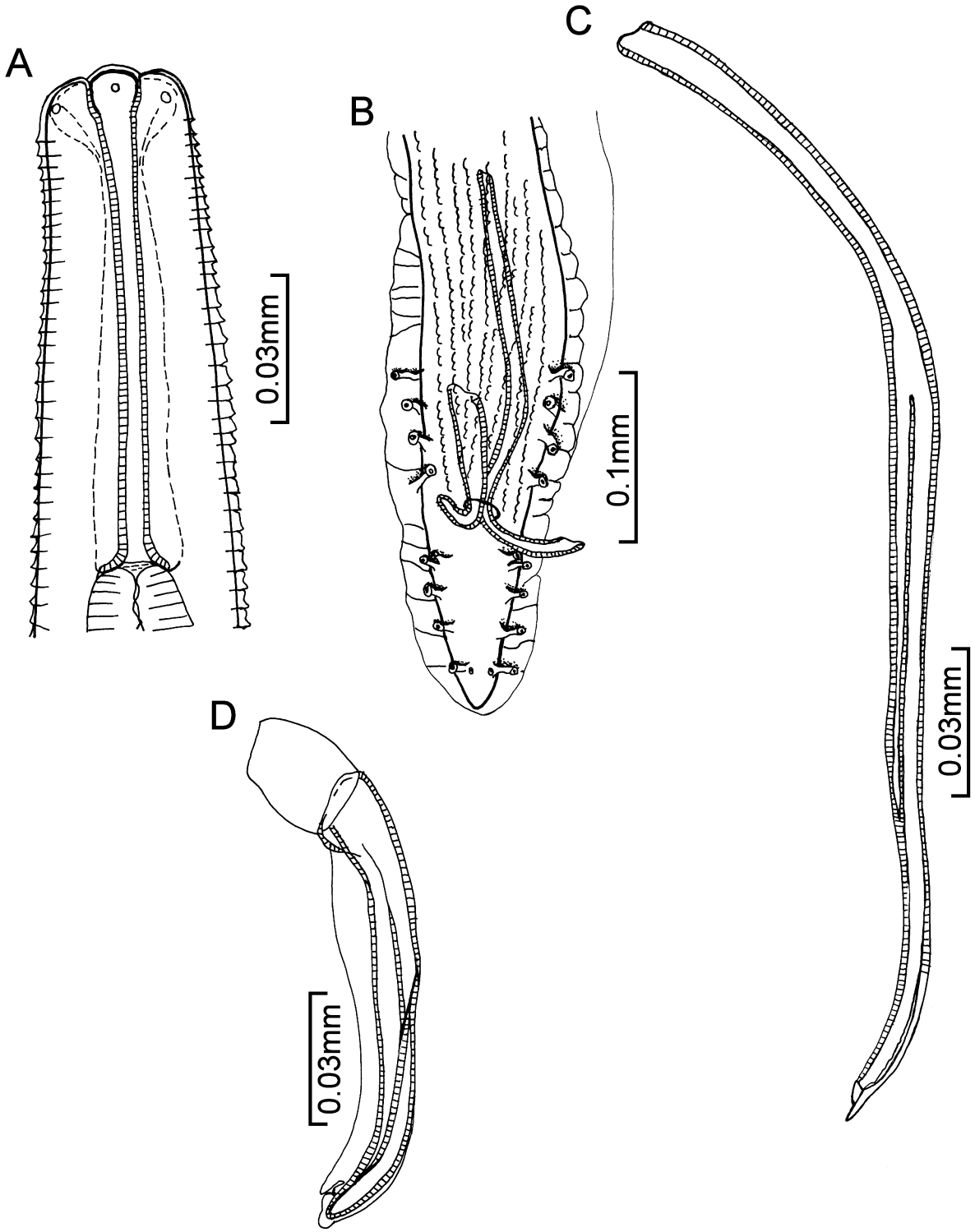

FIGURE 61. *Salmonema ephemeridarum* (von Linstow, 1872) Moravec, Santos & Brasil-Sato, 2008. A. anterior end, lateral view; B. male, posterior end, ventral view; C. left spicule; D. right spicule. (Redrawn from Moravec 2013).

Distribution: British Columbia, Central Canada, Labrador, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Northwest Territories, Ontario, Prince Edward Island, Quebec

Records: 1. Skinker 1931 (QC); 2. Bangham & Hunter 1939 (ON); 3. Lyster 1940 (QC); 4. Richardson 1942 (QC); 5. Choquette 1948a (QC); 6. Choquette 1948b (QC); 7. Bangham 1951 (ON); 8. Choquette 1951b (QC); 9. Choquette 1951c (QC); 10. Bangham & Adams 1954 (BC); 11. Bangham 1955 (ON); 12. Choquette 1955 (QC); 13. Margolis 1965 (BC); 14. Pippy 1965 (NF); 15. Pippy 1967 (LB, NB, NL, PE); 16. Sandeman & Pippy 1967 (NF); 17. Hicks & Threlfall 1973 (LB); 18. Hanek & Molnar 1974 (QC); 19. Hare & Frantsi 1974 (NS); 20. Frantsi *et al.* 1975 (NB); 21. Hare 1975 (NB); 22. Hare & Burt 1975a (NB); 23. Hare & Burt 1975b (NB); 24. Hare & Burt 1976 (NB); 25. Anon. 1978 (BC); 26. Chinniah & Threlfall 1978 (LB); 27. Thompson & Threlfall 1978 (QC); 28. Glenn 1980 (MB); 29. Pippy 1980 (AT); 30. Anon. 1981 (BC); 31. G. A. Black 1981a (QC); 32. Dick & Belosevic 1981 (NT); 33. Margolis & Moravec 1982 (BC); 34. Arai & Mudry 1983 (BC); 35. Anon. 1984 (BC); 36. Cone & Ryan 1984 (NF); 37. Dick 1987 (NT); 38. Frimeth 1987a (NB); 39. Frimeth 1987b (NB); 40. Greenwood & Baker 1987 (ON); 41. Dechtiar & Christie 1988 (ON); 42. Dechtiar & Lawrie 1988 (ON); 43. Dechtiar *et al.* 1988 (ON); 44. Baggs & McT. Cowan 1989 (NF); 45. Bouillon & Dempson 1989 (QC); 46. Marcogliese & Cone 1991a (NB, NS, QC, LB, NL); 47. Marcogliese & Cone 1991b (NF); 48. Dubois *et al.* 1996 (QC)

Salmonema prevosti (Choquette, 1951) Moravec, Santos & Brasil-Sato, 2008

Synonym: *Metabronema prevosti* Choquette, 1951

Description (after Choquette 1951b). With characteristics of the genus. Slender worms, the greatest width near posterior end, cuticle with transverse striations. Mouth opening dorso-ventrally elongated, surrounded by two slightly trilobed pseudolabia, leading to vestibule. Four large cephalic papillae at base of pseudolabia (Fig. 62A). Oesophagus comprises a muscular and a longer glandular portion.

Males (two specimens in "rather poor condition" were available—most measurements are for the type specimen only): 7.0 and 10.0 long. Vestibule 0.12, muscular oesophagus 0.38, and glandular oesophagus 2.91 long. Nerve ring 0.19 and excretory pore 0.30 from anterior end. Posterior end coiled with well developed caudal alae supported by four pairs pre-cloacal and five pairs post-cloacal papillae (Fig. 62B). Spicules unequal: left ones 0.8 and 1.2 , and right ones 0.08 and 0.12. Gubernaculum not seen.

Females (14 specimens were available): 9.4 to 13.2 long. Vestibule 0.10 to 0.16, muscular oesophagus 0.22 to 0.39, and glandular oesophagus 1.67 to 2.35 long. Nerve ring 0.14 to 0.20, and excretory pore 0.22 to 0.25 from anterior end. Vulva situated slightly posterior to mid body. Eggs embryonated, 0.048 to 0.051 x 0.025, bear "coarse filaments at either poles which are provided with knobs".

Site: intestinal lumen
Host: *Ameiurus nebulosus*
Distribution: Quebec
Record: Choquette 1951b

Salmonema sp.

Site: alimentary tract
Host: *Acipenser fulvescens*
Distribution: Central Canada, Hudson Bay Drainage, Manitoba
Records: Choudhury & Dick 1993 (CC); Choudhury & Dick 1998 (HBD, MB)

Salvelinema Trofimenko, 1962

Synonym: *Pseudometabronema* Bogdanova, 1963

Generic diagnosis (after Margolis & Kabata 1967, and Hoffman 1999). Cystidicolidae. Body slender, whitish, transparent when living, tapering at both ends. Mouth consists of dorsal and ventral semicircular or oval openings joined by narrow laterally compressed isthmus bounded by two well developed pseudolabia (Fig. 64A). Four inconspicuous submedian cephalic papillae present. Buccal cavity divided into an anterior expanded buccal capsule and a posterior slender pharynx which leads to a muscular oesophagus. Males with well developed tail, subventral cuticular alae and special ornamentation. Paired pedunculated pre-cloacal papillae variable in number. Five pairs of post-cloacal papillae present. Left spicule much longer than right one. Gubernaculum absent. Vulva anterior to mid-body region. Eggs thick-shelled with one or two polar plugs bearing filaments, and containing vermiform larvae when fully developed. Young eggs lack both polar plugs and filaments. Parasites of the swim bladder of salmonid fishes.

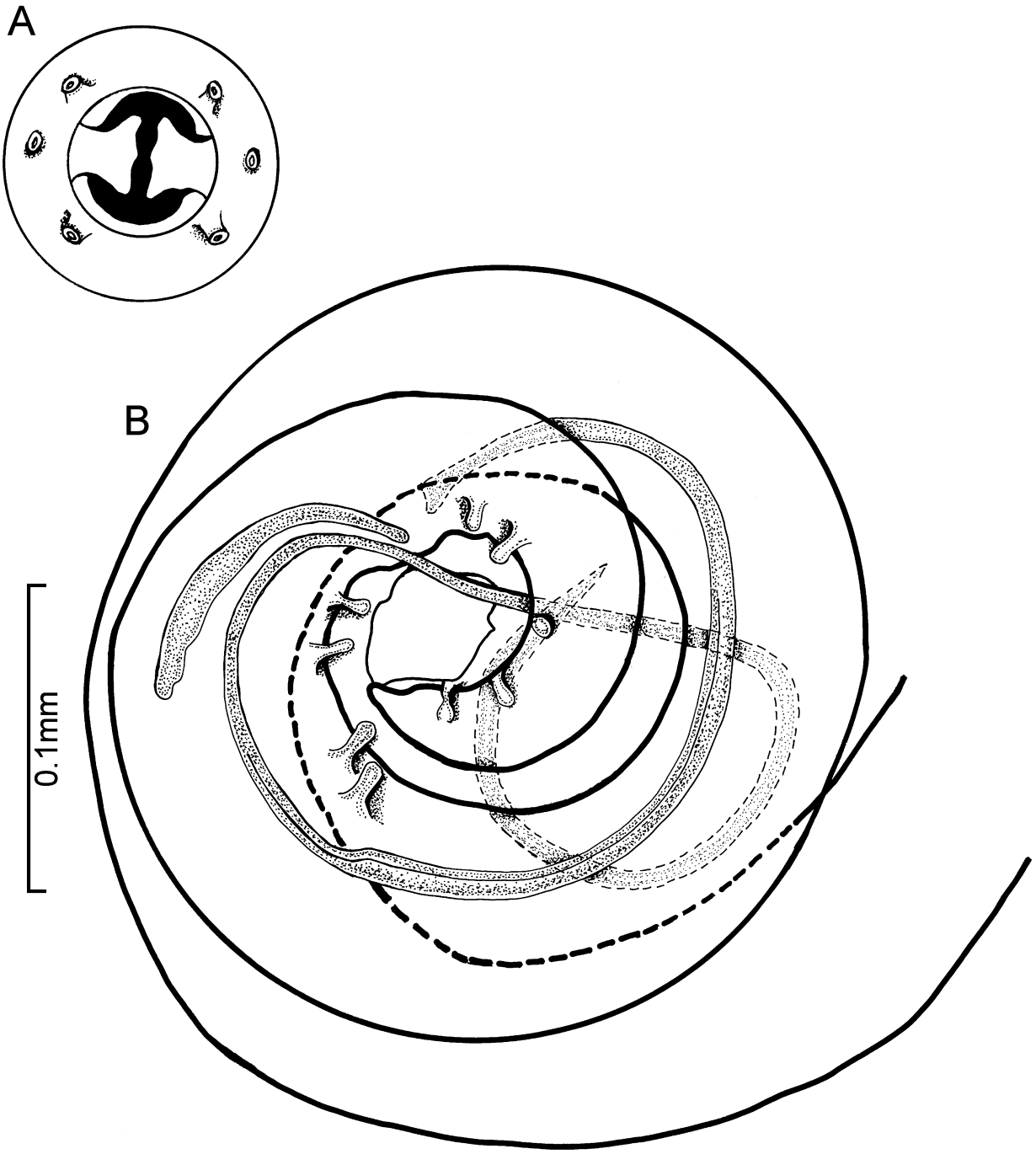

FIGURE 62. *Salmonema prevosti* (Choquette, 1951) Moravec, Santos & Brasil-Sato, 2008. A. *en face* view; B. male, posterior end, lateral view. NB: a scale bar was not provided in the original for A. (Redrawn from Choquette 1951)

Key to species of *Salvelinema*

1 Vagina directed anteriorly from vulva; both poles of mature egg with small polar plug and two thread-like filaments, exceptionally three threads on one pole . . . . . *S. salmonicola*

- Vagina directed posteriorly from vulva; only one pole of mature egg with small polar plug and two thread–like filaments . . . . . *S. walkeri*

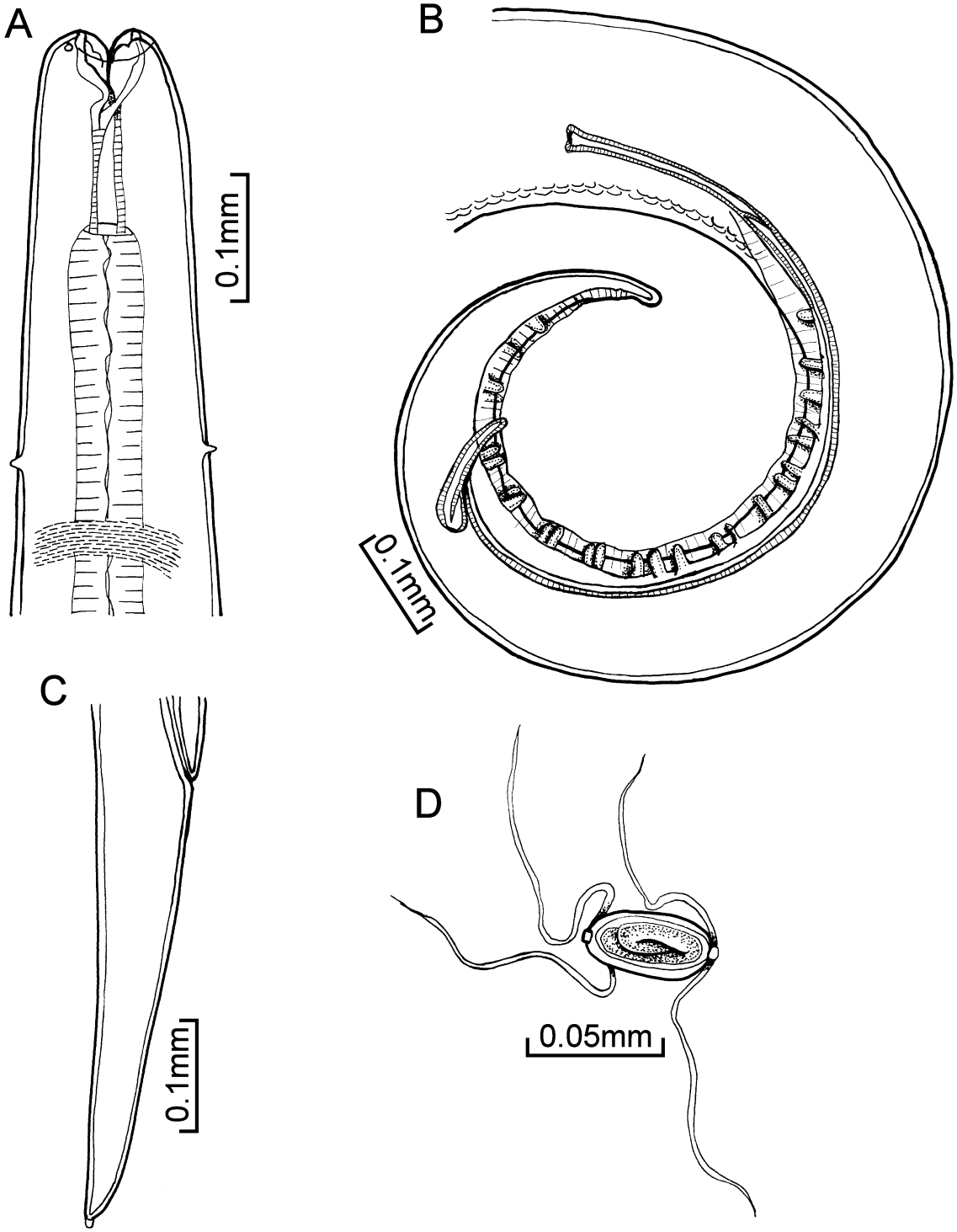

FIGURE 63. *Salvelinema salmonicola* (Ishii, 1916) Margolis, 1966. A. female, anterior end, dorso-ventral view; B. male, posterior end, lateral view; C. gravid female, tail, lateral view; D. mature egg. (Redrawn from Moravec & Nagasawa 1999b)

Salvelinema salmonicola (Ishii, 1916) Margolis, 1966

Synonym: *Cystidicola salmonicola* Ishii, 1916

Description (after Moravec & Nagasawa 1999b). With characteristics of the genus.

Males (from *Oncorhynchus mykiss*): 15.66–18.99 long, 0.288–0.474 maximum width. Vestibule including prostom 0.116–0.144, muscular oesophagus 0.444–0.487, and glandular oesophagus 1.440–1.820 long. Deirids, nerve ring and excretory pore 0.278–0.320, 0.365–0.426 and 0.609–0.705, respectively, from anterior end. Caudal alae and ventral pre-cloacal cuticular ridges well developed. Pre-cloacal papillae: 19 to 21 pairs of subventral papillae, mostly arranged in couples. Post-cloacal papillae; six pairs of single papillae (occasionally seven papillae on right side and six on left). Left spicule slender 0.960–1.050 long, proximal end broader, distal end sharply pointed. Right spicule short, boat-shaped, 0.128–0.160 long, proximal end blunt, distal end rounded. Tail 0.224–0.264 long (Fig. 63B).

Females (from *O. mykiss*): gravid worms 20.830–27.910 long, 0.577–0.824 maximum width. Vestibule including prostom 0.120–0.160 (Fig. 63A), muscular oesophagus 0.539–0.566, and glandular oesophagus 1.700–2.130 long. Deirids, nerve ring and excretory pore 0.344–0.348, 0.409–0.522 and 0.679–0.722, respectively, from anterior end. Tail slender, 0.409–0.487 long with distal tip separated by cuticular constriction to form knob-like appendage (Fig. 63C). Vulva near midbody, 48–54% of body length. Vagina directed anteriorly from vulva. Uterus amphidelphic, ovaries in anterior and posterior parts of body. Mature eggs oval, thick walled, larvated, 42–50 µm x 18–20 µm; each pole with small plug and two thread-like filaments about 140 µm long (Fig. 63D); exceptionally there may be three filaments at one pole.

Site: swim bladder

Hosts: *Oncorhynchus kisutch* (1); *Salvelinus malma* (2, 3)

Distribution: British Columbia

Records: 1. Margolis 1966; 2. Margolis 1967a; 3. Margolis & Kabata 1967

Salvelinema walkeri (Ekbaum, 1935) Margolis, 1967

Synonym: *Cystidicola walkeri* Ekbaum, 1935

Description (after Moravec & Nagasawa 1999b). With characteristics of the genus.

Males (from *Oncorhynchus kisutch*): 16.89–20.19 long, 0.371–0.412 maximum width. Vestibule including prostom 0.180–0.208, muscular oesophagus 0.383–0.539, and glandular oesophagus 1.510–1.870 long. Deirids, nerve ring and excretory pore 0.310–0.362, 0.383–0.461 and 0.635–0.679, respectively, from anterior end (Fig. 64B). Caudal alae and ventral pre-cloacal ridges well developed. Precloacal papillae: 18 to 26 pairs of subventral papillae arranged in couples. Post-cloacal papillae: six pairs of single papillae. Left spicule slender, 1.140–1.170 long, proximal end broad, distal tip sharply pointed. Right spicule short, boat-shaped, 0.152–0.192 long, proximal end blunt, distal end rounded. Tail 0.310–0.362 long (Fig. 64C).

Females (from *O. kisutch*): gravid worms 18.150–29.030 long, 0.453–0.597 maximum width. Vestibule including prostom 0.136–0.220, muscular oesophagus 0.365–0.531, and glandular oesophagus 1.470–1.840 long. Deirids, nerve ring and excretory pore 0.246–0.400, 0.296–0.487, and 0.661–0.809, respectively, from anterior end. Tail conical, 0.357–0.409 long, with rounded tip (Fig. 64D). Vulva in anterior half of body, 30–40% of body length. Vagina directed posteriorly from vulva. Uterus amphidelphic. Mature eggs oval, thick-walled, larvated, 42–54 µm x 20–24 µm; one pole with small plug and two thread-like filaments each about 360 µm long (Fig. 64E).

Site: swim bladder

Hosts: *Oncorhynchus clarkii* (6); *Oncorhynchus keta* (4, 6); *Oncorhynchus kisutch* (1, 2, 3, 4, 5); *Oncorhynchus tshawytscha* (5)

Distribution: Pacific

Records: 1. Ekbaum 1935; 2. Margolis 1967a; 3. Margolis 1967b; 4. Margolis & Kabata 1967; 5. Godfrey 1968; 6. Margolis & Moravec 1982

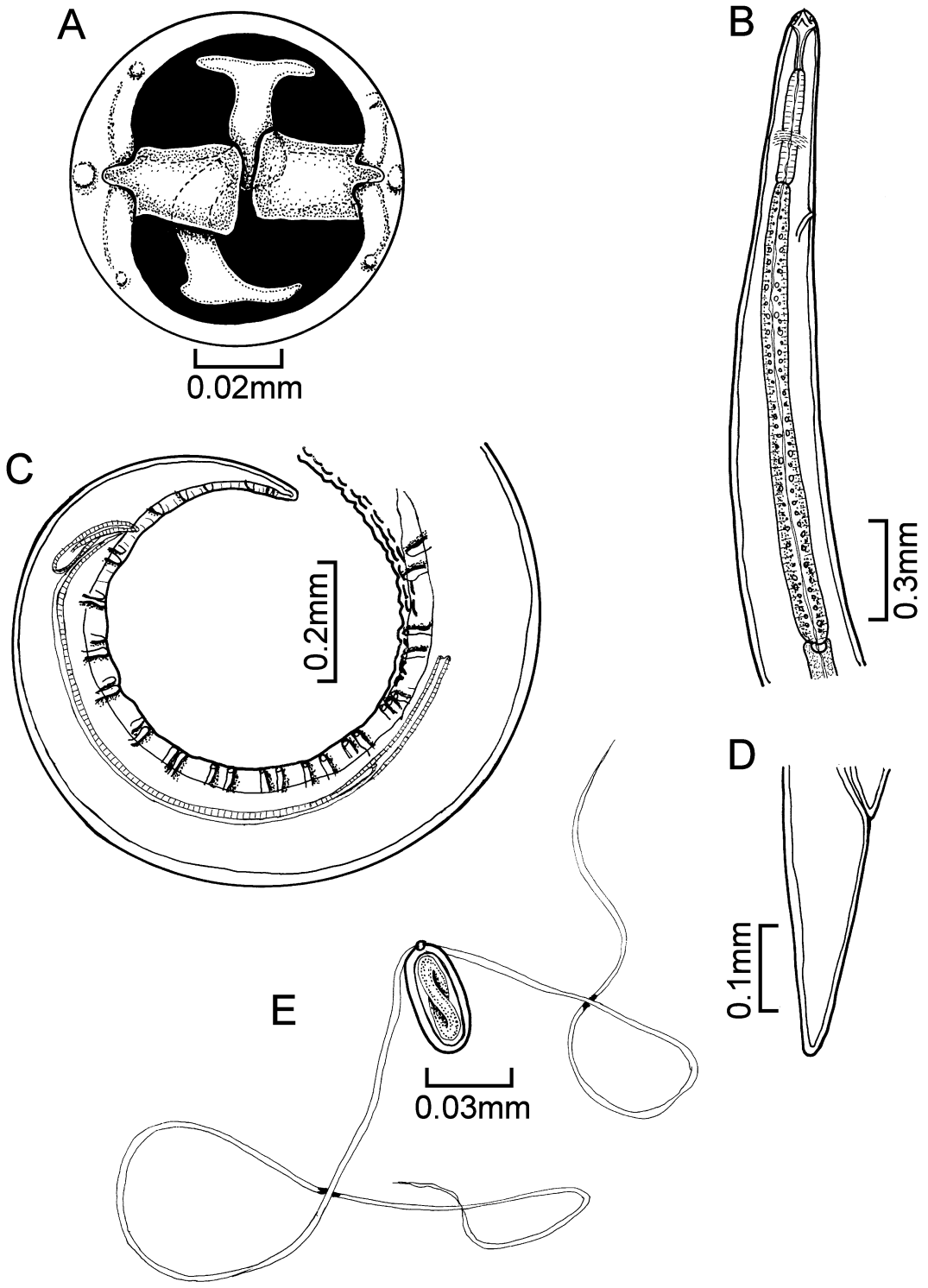

FIGURE 64. *Salvelinema walkeri* (Ekbaum, 1935) Margolis, 1967. A. *en face* view; B. male, anterior end, lateral view; C. male, posterior end, lateral view; D. gravid female, tail, lateral view; E. mature egg. (A. redrawn from Margolis & Kabata 1967; B. to E. redrawn from Moravec & Nagasawa 1999b)

Spinitectus Fourment, 1883

Generic diagnosis (after Moravec 2013). Cystidicolidae. Medium-sized worms with short unspined "head" region. Cuticle behind "head" with numerous transverse rings, each provided with row of posteriorly directed cuticular spines diminishing posteriorly. Pseudolabia broad, flat. Mouth opening elongated dorso-ventrally. Buccal cavity sclerotized, cylindrical, usually with dilated anterior part forming prostom. Oesophagus divided into muscular and

glandular portions. Males with caudal alae, supported by three to six pairs pre-cloacal pedunculate papillae, and an *area rugosa*. Gubernaculum absent. Vulva in posterior half of body. Uterus amphidelphic. Eggs elliptical, larvated, mature ones with or without filaments or polar caps. Parasites of alimentary tract of fresh-water and marine fishes, and amphibians. Type species *S. oviflagellis* Fourment, 1883.

Key to species of *Spinitectus*

Preamble: *Spinitectus cristatus* Railliet & Henry, 1915, from various species of hake *Urophycis* in the Atlantic, is recorded here for the sake of completeness. As discussed below, the description is inadequate, and the species cannot be included in the following key.

1 Buccal cavity less than half length of "head"; vagina directed anteriorly; excretory pore between the 4th and 5th spine rows . 2
- Buccal cavity at least as long as "head"; vagina directed posteriorly; excretory pore between the 6th and 7th or 8th and 9th spine rows . . . 3
2 Circlets and semicirclets of spines reach near anus in females; ratio of oesophagus to body length 1:4 to 1:5; right spicule with heel-like barb . . . *S. acipenseri*
- Spines not reaching near anus in females; ratio of oesophagus to body length 1:2 to 1:3; right spicule lacks heel-like barb . . . *S. gracilis*
3 Excretory pore between the 8th and 9th spine rows; spines < 0.015 long . . . *S. carolini*
- Excretory pore between the 6th and 7th spine rows; spines > 0.020 long . . . *S. macrospinosus*

Spinitectus acipenseri Choudhury & Dick, 1992

Includes: *Spinitectus gracilis acipenseri* of Choudhury, Dick, Holloway & Ottinger (1990); *Spinitectus acipenseri* of Choudhury & Dick (1991); *Spinitectus gracilis acipenseri* of Swanson, Kansas, Matkowski & Graveline (1991). Description (after Choudhury & Dick 1992). With characteristics of the genus. "Head" region without spines but rest of body possessing transverse rows of spines. Spine rows discontinuous over lateral lines, appearing as two semicirclets of spines in same plane. First spine row with 20 to 22 spines, numbers increasing posteriorly to as many as 30 (row 6). Spines < 0.015 long. Mouth slit-like, bordered by two sublabia with straight inner margins. Four barely visible cephalic papillae, two posterior to each lip base. Amphids not observed. Excretory gland short and narrow with basal nucleus lying beside muscular oesophagus; excretory pore opens between the 4th and 5th spine rows. Nerve ring immediately posterior to 2nd row of spines. Buccal cavity short (Fig. 65A).

Males (measurements of holotype, and range of paratypes in parentheses): Body 4.85 (3.65–6.1) long, 0.091 (0.805–0.124) wide. "Head" 0.104 (0.073–0.132), buccal capsule 0.032 (0.029–0.044), muscular oesophagus 0.243 (0.226–0.336) and glandular oesophagus 0.918 (0.700–1.066) long. Nerve ring 0.125 (0.102–0.161) from anterior end. Left spicule 0.315 (0.300–0.350) long; arcuate, scoop shaped distally, pointed tip. Right spicule 0.100 (0.096–0.103) long; helically bent like ram's horn, prominent terminal barb, resembling an heel (Fig. 65C). Tail 0.127 (0.102–0.139) long. Maximum spine size 0.012 (0.012–0.013). Tail end often twisted into one or two turns. Four pairs pre-cloacal and six pairs post-cloacal pedunculated papillae present (Fig. 65B). *Area rugosa* comprises about eight longitudinal rows of cuticular elevations.

Females (measurements of allotype, and range of paratypes in parentheses): Body 7.25 (4.2–8.8) long, 0.136 (0.085–0.175) wide. "Head" 0.125 (0.073–0.139), buccal capsule 0.043 (0.029–0.044), muscular oesophagus 0.300 (0.227–0.416), and glandular oesophagus 0.909 (0.643–1.336) long. Nerve ring 0.143 (0.139–0.0.197) from anterior end. Two folded ovaries, one posterior near end of gut (Fig. 65D), the other in region of glandular oesophagus. Amphidelphic, vagina fairly long, directed anteriorly, opening into prominent vulva with bulbous lip (Fig. 65E). Tail 0.068 (0.066–0.110) long, bears terminal spine. Maximum spine size 0.012 (0.011–0.015). Vaginal eggs 0.037 (0.034–0.040) x 0.023 (0.023–0.025).

Site: alimentary tract

Host: *Acipenser fulvescens*

Distribution: Central Canada, Hudson Bay Drainage, Manitoba, Ontario, Saskatchewan

Records: Choudhury *et al.* 1990 (MB, ON, SK); Choudhury & Dick 1991 (MB, SK); Swanson *et al.* 1991 (MB); Choudhury & Dick 1992 (MB, SK); Choudhury & Dick 1993 (CC); Choudhury & Dick 2001 (HBD)

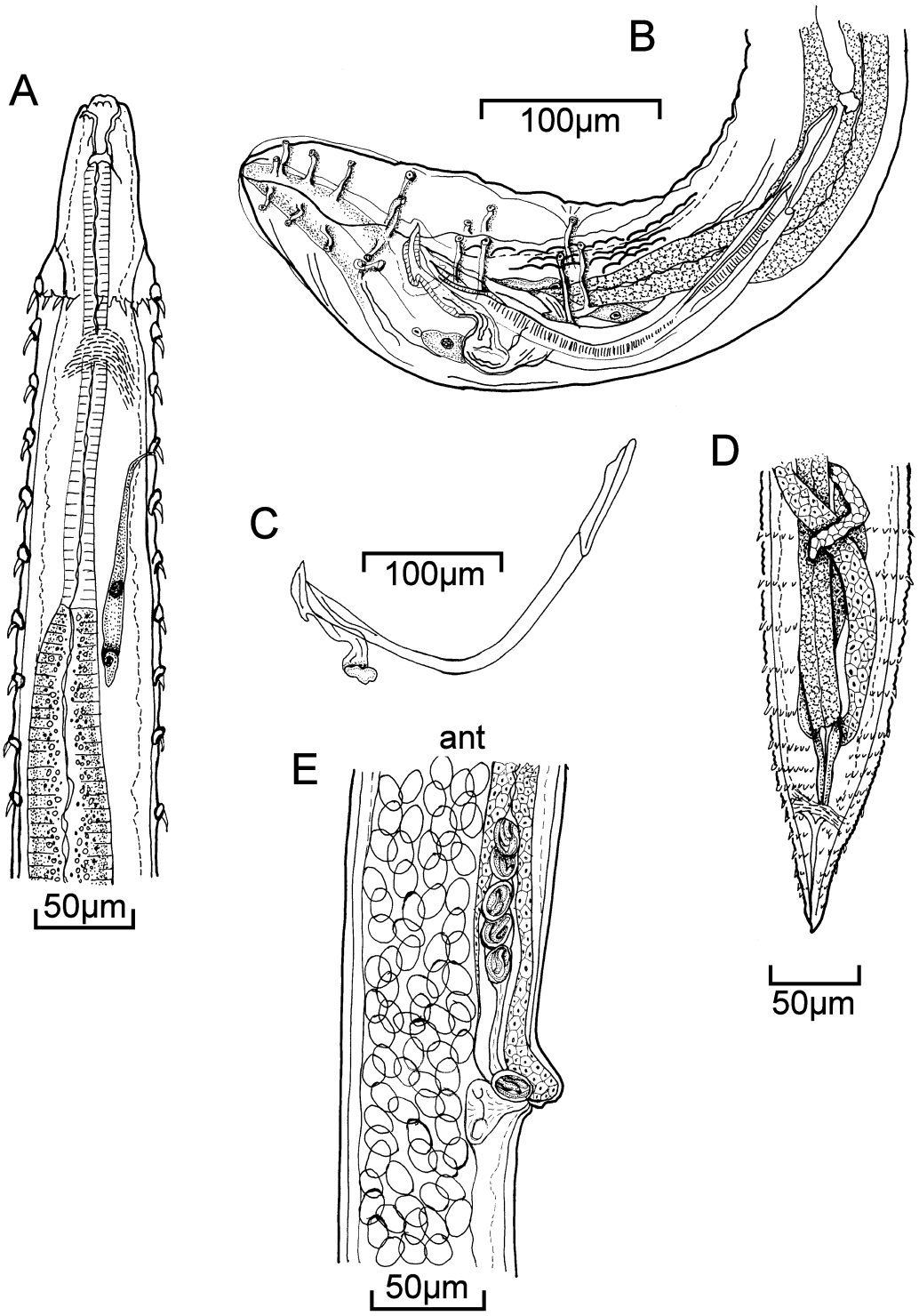

FIGURE 65. *Spinitectus acipenseri* Choudhury & Dick, 1992. A. female, anterior end, lateral view; B. male, posterior end; C. spicules; D. female, posterior end, ventral view; E. female, vaginal region. (Redrawn from Choudhury & Dick 1992)

***Spinitectus carolini* Holl, 1928**

Description (after Mueller & Van Cleave 1932, Jilek & Crites 1982a, and Christian 1972). With characteristics of the genus. "Head" region without spines. Four cephalic papillae present. Two amphids each with two pore-like

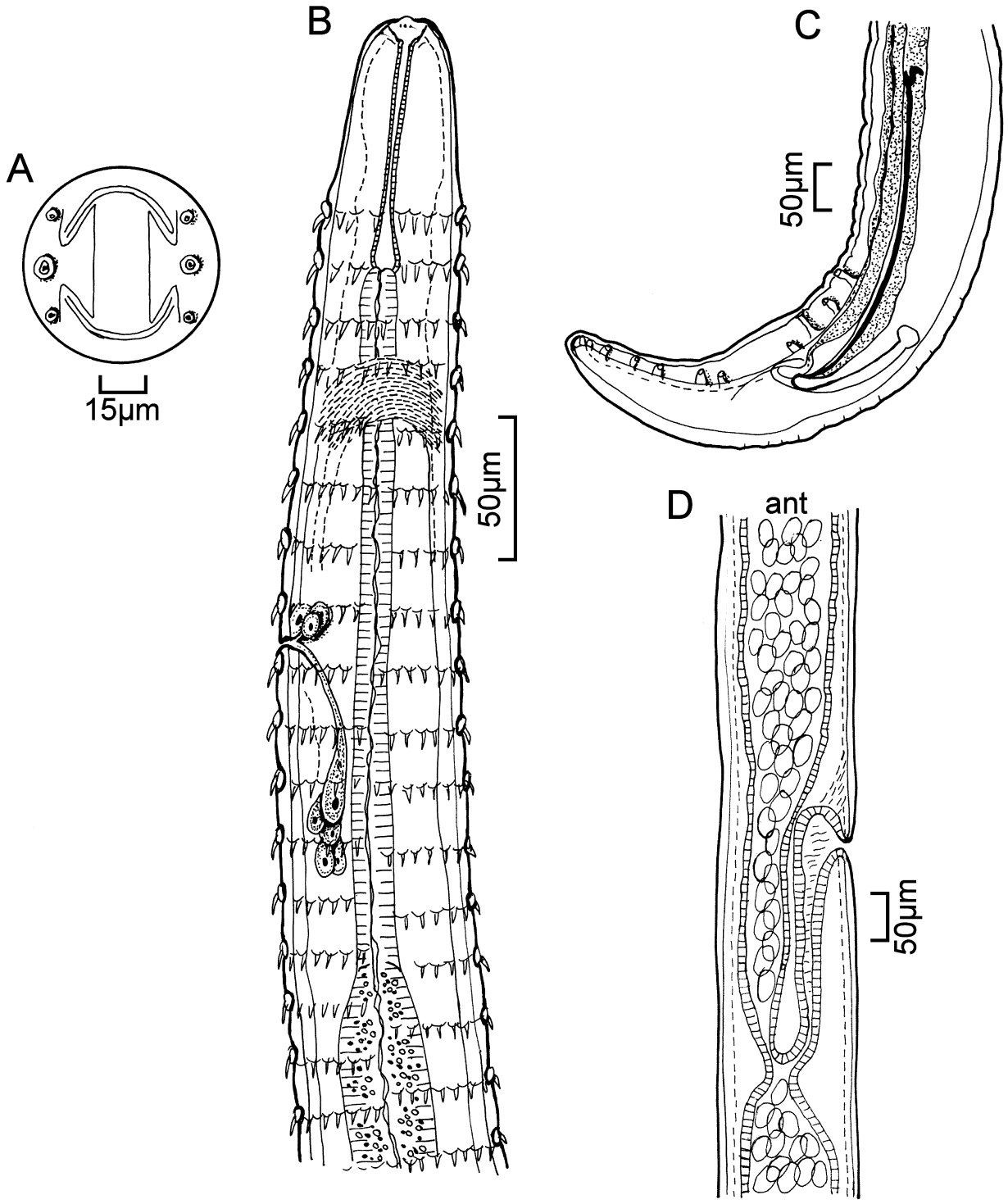

FIGURE 66. *Spinitectus carolini* Holl, 1928. A. adult, *en face* view; B. adult, anterior end, lateral view; C. adult male, posterior end, lateral view; D. adult female, mid-section, vaginal region. (A., C. and D. redrawn from Jilek & Crites 1982a; B. redrawn from Mueller & Van Cleave 1932)

openings situated laterally on pseudolabia (Fig. 66A). Deirids between 1st and 2nd spine rows. 15 to 20 sharp spines present per row; spines < 0.015 long. Anterior rows of spines arranged in 4 sectors. Spines absent over lateral lines, and decreasing in number and size posteriorly. Buccal cavity relatively long, straight and thin-walled. Muscular oesophagus begins at level of 2nd row of spines, and is about half the width of the glandular oesophagus (Fig. 66B).

Males: Body slender 3.31 (2.78–3.45) long, 0.098 (0.087–0.106) wide. Nerve ring 0.145 (0.133–0.151), and excretory pore 0.202 (0.187–0.221) from anterior end. Excretory pore between the 8th and 9th spine rows. Muscular

oesophagus 0.172–0.266 long [mean length not given]. Glandular oesophagus 1.403 (1.201–1.497) long. Narrow caudal alae. Four pairs pre-cloacal and five pairs post-cloacal pedunculate papillae present (Fig. 66C). Right spicule short, proximally expanded, distal tip with large ventral barb [length not reported]. Left spicule long, slender, evenly curved with tail, divided into shaft and flanged blade [length not reported]. *Area rugosa* present.

Females: Body slender 5.13 (4.35–5.70) long, 0.110 (0.105–0.114) wide. Nerve ring 0.152 (0.140–0.156) and excretory pore 0.212 (0.203–0.221) from anterior end. Muscular oesophagus 0.194 (0.168–0.235) long, and glandular oesophagus 1.590 (1.437–1.702) long. Vulva located just posterior to middle of body. Ovijector well developed. Vagina directed posteriorly (Fig. 66D). Amphidelphic. Eggs thick-shelled. Tail with heart-shaped mucron.

Site: intestinal lumen

Hosts: *Ambloplites rupestris* (1, 4, 6, 8); *Ameiurus nebulosus* (6); *Amia calva* (11); *Coregonus clupeaformis* (4); *Cyprinus carpio* (4); *Esox lucius* (10); *Lepomis gibbosus* (1, 2, 3, 4, 8, 9); *Lepomis macrochirus* (8, 9); *Micropterus dolomieu* (1, 2, 3, 4, 12); *Micropterus salmoides* (1, 4, 8); *Morone americana* (9); *Morone chrysops* (4, 5, 7, 11); *Osmerus mordax* (4); *Perca flavescens* (2, 10); *Pomoxis nigromaculatus* (8); *Sander vitreus* (4)

Distribution: Ontario

Records: 1. Bangham & Hunter 1939; 2. Bangham 1941; 3. Bangham & Venard 1946; 4. Bangham 1951; 5. Bangham 1955; 6. Dechtiar 1972a; 7. Anthony 1984; 8. Anthony 1985; 9. Dechtiar & Christie 1988; 10. Dechtiar & Lawrie 1988; 11. Dechtiar *et al.* 1988; 12. Dechtiar & Nepszy 1988

Spinitectus cristatus **Railliet and Henry, 1915**

This species was originally described by Linton (1901) from *Phycis tenuis* (= *Urophycis tenuis*) from the Atlantic coast of America (Nantucket) as *Filaria serrata* Linton, 1892. Various workers including Berland (1961), Rahman (1964), Scott (1987), Køie (1993) and Moravec & Klimpel (2007) concluded that the description is inadequate.

According to Linton, *S. cristatus* males show the following features: length 5.8; maximum breadth 0.1; over 100 transverse rows of spines; spines 0.01 long; four precloacal and six post-cloacal papillae; tail ends blindly, rounded extremity; cloacal aperture 0.16 from tail tip. Apart from the inadequacy of the description, there is an inconsistency in the lengths recorded for the spicules (0.06 and 0.03) and the illustrations of them.

Site: intestinal lumen

Hosts: *Phycis chesteri*; *Urophycis chuss*; *Urophycis tenuis*

Distribution: Atlantic

Record: Scott 1987

****Spinitectus gracilis*** **Ward & Magath, 1917**

Description (after Mueller & Van Cleave 1932, and Jilek & Crites 1982b). With characteristics of the genus. "Head" region without spines. Four cephalic papillae, and two amphids each with two pore-like openings situated on pseudolabia. Deirids between 1st and 2nd rows of spines. 35 to 45 short sharp spines present per row. Spines absent over lateral lines, and decreasing in number and size posteriorly. Spines < 0.015 long. Buccal cavity short, with sharp bend. Width of muscular oesophagus about half that of glandular oesophagus (Fig. 67A).

Males: body slender, 4.150 (3.852–4.390) long, 0.117 (0.102–0.130) wide. Nerve ring 0.150 (0.142–0.155) from anterior end. Excretory pore between the 4th and 5th spine rows (Fig. 67A). Muscular oesophagus 0.257 (0.203–0.303), and glandular oesophagus 1.805 (1.607–1.895) long. Alae narrow. Four pairs pre-cloacal and five pairs post-cloacal pedunculate papillae. Right spicule short and thick with 90º bend and thickened proximal portion, distal end pointed, lacks barb [length not reported]. Left spicule long, slender [length not reported]. Tail tip rounded (Fig. 67B). *Area rugosa* present.

Females: body slender 6.250 (5.648–7.390) long, 0.155 (0.147–0.163) wide. Nerve ring 0.160 (0.153–0.167) and excretory pore 0.228 (0.203–0.235) from anterior end. Muscular oesophagus 0.229 (0.184–0.243) and glandular oesophagus 1.903 (1.784–2.075) long. Vulva immediately posterior to middle of body. Ovijector well developed. Vagina directed anteriorly (Fig. 67C). Amphidelphic. Eggs thick-shelled. Tail with spine (Fig. 67D).

Comment: Choudhury & Dick (1992) discussed discrepancies in the four published descriptions of *S. gracilis* so the foregoing description should be interpreted with caution.

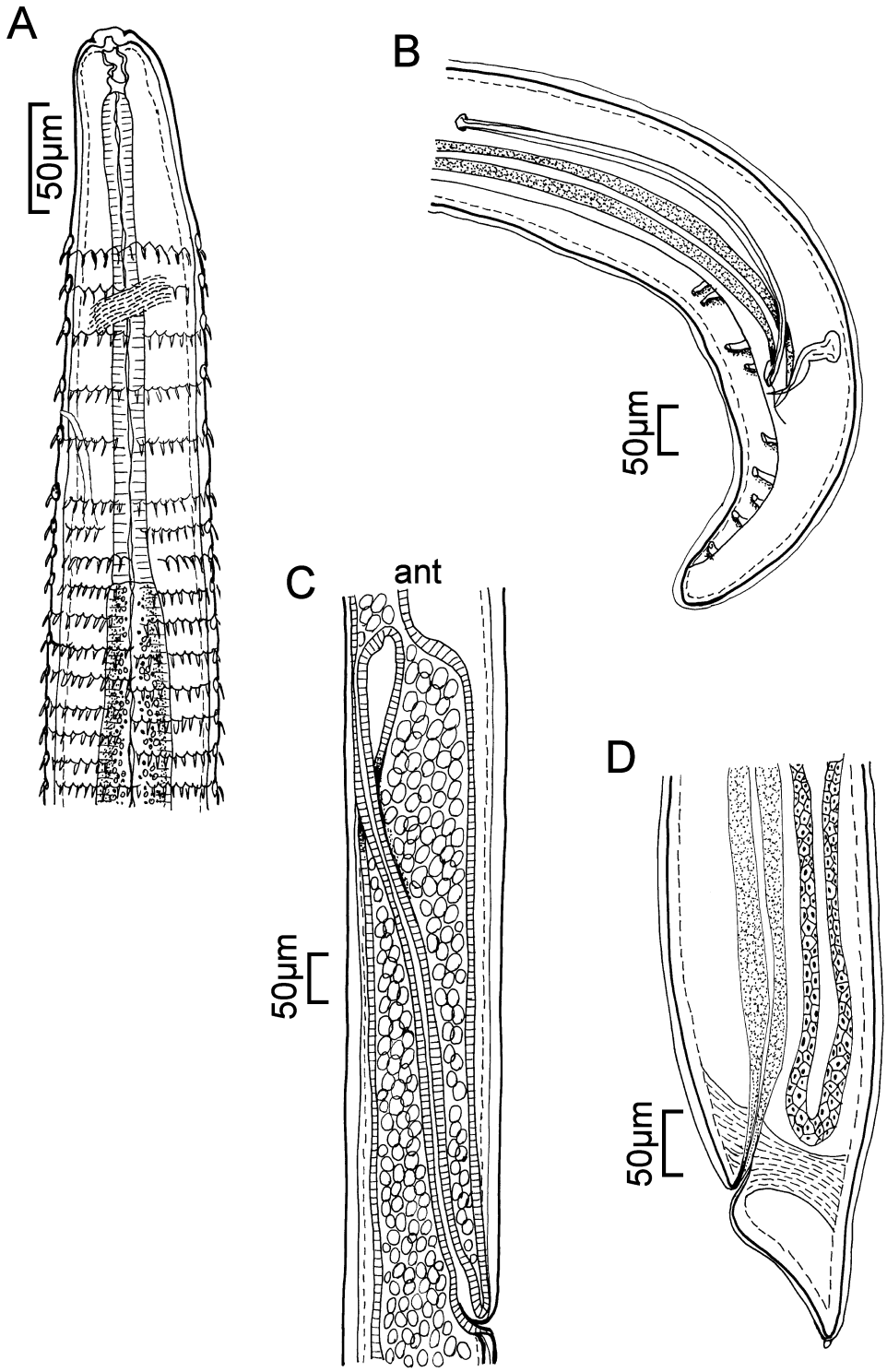

FIGURE 67. *Spinitectus gracilis* Ward & Magath, 1917. A. adult, anterior end, lateral view; B. adult male, posterior end, lateral view; C. adult female, mid-section, vaginal region; D. adult female, posterior end, lateral view. (A. redrawn from Mueller & Van Cleave 1932; B., C. and D. redrawn from Jilek & Crites 1982b)

Site: intestinal lumen

Hosts: *Acipenser fulvescens* (16, 19, 22); *Ambloplites rupestris* (16, 19, 27); *Ameiurus nebulosus* (2, 4); *Aplodinotus grunniens* (1); *Catostomus commersonii* (14); *Coregonus artedi* (7, 10, 12, 14, 20, 24); *Coregonus clupeaformis* (2, 3, 4, 5, 9, 10, 12, 14); *Cottus cognatus* (21); *Cyprinus carpio* (4, 5, 19); *Esox americanus*

vermiculatus (1, 6); *Esox lucius* (1, 10, 13, 14, 20, 24); *Ictalurus punctatus* (1); *Lepomis gibbosus* (2, 3); *Lota lota* (4, 5, 7, 19); *Luxilus cornutus* (20, 24); *Micropterus dolomieu* (4, 5, 27); *Moxostoma anisurum* (7); *Notropis hudsonius* (4, 5); *Noturus flavus* (1); *Oncorhynchus nerka* (9, 19); *Osmerus mordax* (4, 5, 16); *Perca flavescens* (3, 4, 5, 7, 8, 9, 14, 15, 16, 20, 23, 24, 25, 26); *Percina caprodes* (24); *Percopsis omiscomaycus* (5, 7, 9, 16, 17, 20, 24); *Pomoxis nigromaculatus* (4, 5, 7, 19); *Prosopium cylindraceum* (3, 17); *Salvelinus fontinalis* x *Salvelinus namaycush* (9, 11, 19); *Sander vitreus* (14, 18)

Distribution: Manitoba, Ontario, Saskatchewan

Records: 1. Bangham & Hunter 1939 (ON); 2. Bangham 1941 (ON); 3. Bangham & Venard 1946 (ON); 4. Bangham 1951 (ON); 5. Bangham 1955 (ON); 6. Crossman 1962 (ON); 7. Dechtiar 1972a (ON); 8. Cannon 1973 (ON); 9. Collins & Dechtiar 1974 (ON); 10. Watson 1977 (MB); 11. Dechtiar & Berst 1978 (ON); 12. Watson & Dick 1979 (MB); 13. Watson & Dick 1980 (MB); 14. Poole 1983 (MB); 15. Poole & Dick 1985 (MB); 16. Dechtiar & Christie 1988 (ON); 17. Dechtiar & Lawrie (ON); 18. Dechtiar & Nepszy 1988 (ON); 19. Dechtiar *et al.* 1988 (ON); 20. Szalai 1989 (MB); 21. Dechtiar *et al.* 1989 (ON); 22. Choudhury *et al.* 1990 ((MB, SK); 23. Szalai & Dick 1991 (MB); 24. Szalai *et al.* 1992a (MB); 25. Carney & Dick 1999 (MB); 26. Carney & Dick 2000 (MB); 27. Choudhury & Perryman 2003 (MB)

Spinitectus macrospinosus **Choudhury & Perryman, 2003**

Description (after Choudhury & Perryman 2003). With characteristics of the genus. "Head" region without spines, gradually widening posteriorly; transverse rows of cuticular spines prominent in the oesophageal region. Rows of spines divided into four sectors; prominent in the anterior third of body; sectors approximately on same level in anterior region of body; arrangement in sectors less well defined posterior to oesophageal region. First row with small spines; spines increasing in size posteriorly in oesophageal region before becoming narrower, then smaller; sectors of spine-rows becoming widely separated posteriorly in oesophageal region. Spines decreasing in number over first four rows (Fig. 68A). In oesophageal region mean length of spines is 0.0218 in males, and 0.0268 in females. Mouth terminal, ovoid, elongated along dorso-ventral axis, bordered by four low, submedian labia (two subdorsal, two subventral) bearing narrow, thickened sublabia, by two lateral pseudolabia, each sublabium bearing single papilla-like protuberance; inner margin of pseudolabia narrower; base widening inside oral cavity and continuous with inner wall of prostom. Short prostom followed by narrow cuticularized relatively long buccal cavity that extends beyond level of 1st row of spines; oesophagus with anterior muscular region, longer posterior glandular portion; intestine ending in short rectum surrounded by a few large gland cells; rectum leading to ventral slit-like anus. Anterior end with paired lateral amphids, and two pairs of lateral papillae. Small, simple lateral deirids between first two spine rows. Excretory pore between the 6th and 7th spine rows (Fig. 68A).

Males: 5.5–8.0 long, 0.070–0.085 maximum width. Spination begins 0.075–0.090 from anterior end; 56 to 67 rows of spines discerned in oesophageal region; spines extend to posterior 3rd of body, not discernible beyond region of seminal vesicle. Nerve ring 0.150–0.165 from anterior end. Prostom plus buccal cavity 0.120–0.132, muscular oesophagus 0.335–0.445, and glandular oesophagus 1.800–2.480 long. Testes originate in posterior 3rd of body; they extend anteriorly, loop posterior to oesophageal-intestinal junction before continuing posteriorly to form seminal vesicle occupying most of pseudocoelom width in posterior quarter of body, merging posteriorly with *vas deferens*. Posterior region of body often coiled, with an *area rugosa* in pre-cloacal region. Caudal region with alae flanking most of tail; four pairs of pre-cloacal papillae; six pairs of post-cloacal papillae, 6th pair (possibly phasmids) medial to 5th pair. Spicules unequal, left one 0.125–0.155 long, appearing ensheathed, with sclerotized and unsclerotized parts, bent near middle, blade portion narrowing to rounded end. Right spicule arcuate, 0.055–0.070 long, with narrow sclerotized portion and broad unsclerotized membranous side, distal end pointed with conspicuous recurved ventral barb (Fig. 68B).

Females: 8.70–12.65 long, 0.085–0.115 maximum width. Spination begins 0.080–0.113 from anterior end, extending to posterior 3rd of body to within short distance of anus; 59 to 69 rows of spines discerned in oesophageal region. Nerve ring 0.155–0.180 from anterior end. Prostom plus buccal cavity 0.130–0.140, muscular oesophagus 0.405–0.555, and glandular oesophagus 2.350–2.880 long. Amphidelphic, each arm of reproductive system consisting of coiled, looped ovary, followed by looping oviduct, seminal receptacle, uterus, anterior arm of system looping near oesophago-intestinal junction, loops of posterior ovary reaching near anus (Fig. 68C). Uteri

voluminous. Muscular vagina posteriorly directed, 0.225–0.290 long. Vulva inconspicuous, its opening transversely ovoid or slit-like, post-equatorial (Fig. 68D). Eggs 0.035–0.040 long, 0.018–0.025 wide, without surface ornamentation or filaments; terminal uterine eggs contain coiled larvae. Anus 0.117–0.142 from posterior end; tail apparently unspined, tapering to terminal heart-shaped mucron set off from body by narrow constriction. Phasmids ventro-lateral near tail tip (Fig. 68C).

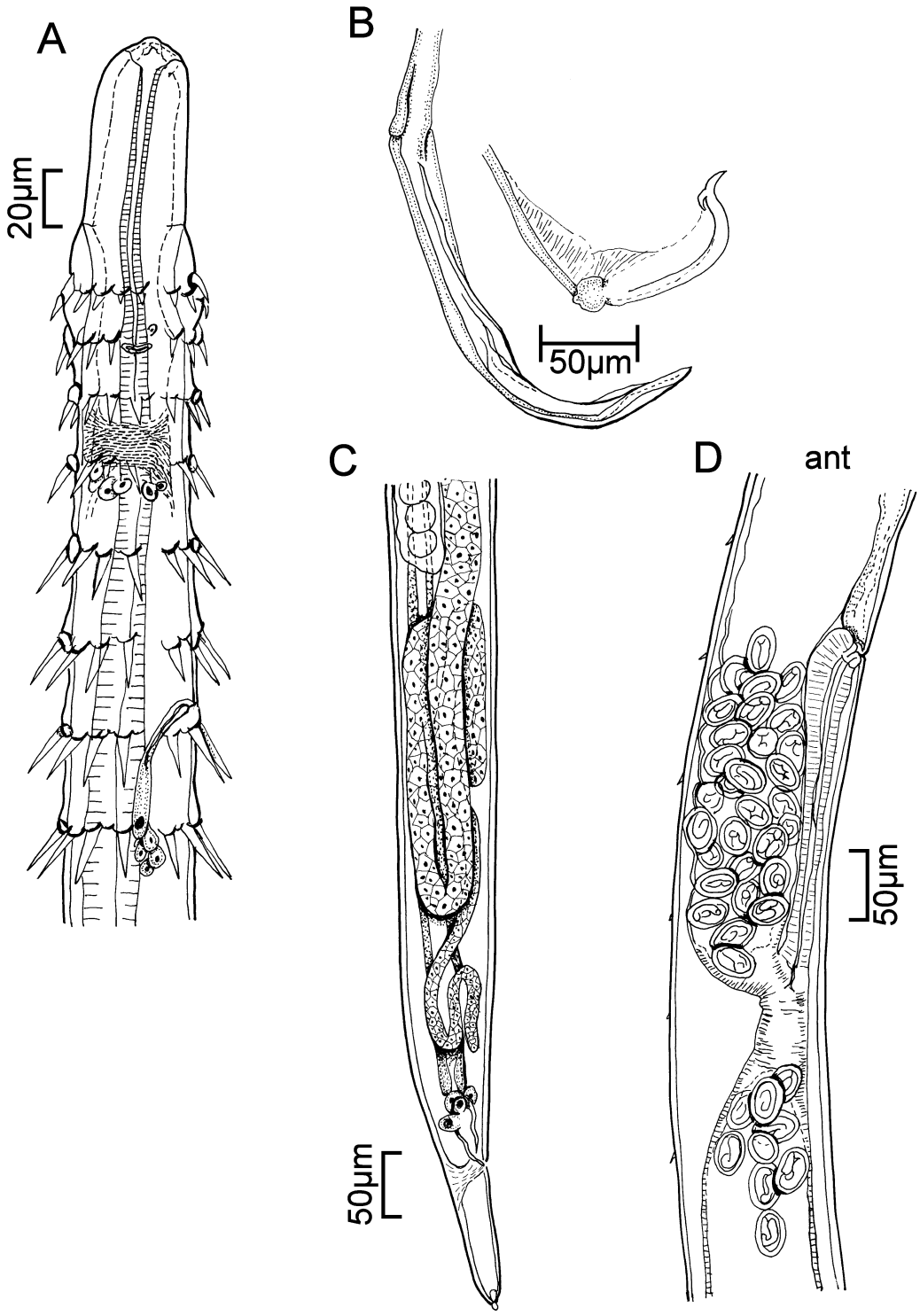

FIGURE 68. *Spinitectus macrospinosus* Choudhury & Perryman, 2003. A. female, anterior region, lateral view; B. right spicule [top], left spicule [bottom]; C. female, posterior region showing ovary and oviduct; D. female, vaginal region. (Redrawn from Choudhury & Perryman 2003)

Site: intestinal lumen
Hosts: *Ictalurus punctatus*; *Hiodon alosoides* (immature worms only); *Noturus flavus* (immature worms only)
Distribution: Manitoba
Record: Choudhury & Perryman 2003
Comment: Moravec *et al*. (2009) claimed that *Spinitectus macrospinosus* Choudhury & Perryman, 2003 is a junior synonym of *Spinitectus tabascoensis* Moravec, García-Magaña & Salgado-Maldonado, 2002. However, morphological, morphometric and geographical differences between the two species suggest that further morphological and molecular studies should be undertaken before the synonymy is accepted (A. Choudhury, pers. comm.).

***Spinitectus* sp.**

Site: alimentary tract
Hosts: *Acipenser fulvescens* (7, 9); *Anguilla rostrata* (12); *Macrourus berglax* (8, 10); *Perca flavescens* (1, 2, 4, 5, 6, 13); *Sander vitreus* (3, 4); *Urophycis tenuis* (11)
Distribution: Atlantic, Manitoba, Ontario, Saskatchewan
Records: Bangham 1941 (ON); 2. Bangham 1951 (ON); 3. Bangham 1955 (ON); 4. Dickson 1964 (MB); 5. Tedla 1969 (ON); 6. Tedla & Fernando 1972 (ON); 7. Anthony 1974 (ON); 8. Redkozubova 1976 (AT); 9. Anthony 1977 (ON); 10. Houston & Haedrich 1986 (AT); 11. Scott 1987 (AT); 12. Dechtiar & Christie 1988 (ON); 13. Carney & Dick 1999 (MB)

Family HEDRURIDAE Railliet. 1916

See Comments under Superfamily Habronematoidea above.

***Hedruris* sp.**

Site: intestinal lumen
Host: *Fundulus diaphanus*
Distribution: Nova Scotia
Record: Wiles, 1975

Family TETRAMERIDAE Travassos, 1914

See Comments under Superfamily Habronematoidea above.

***Tetrameres* sp.**

Site: ?
Host: *Chrosomus eos*
Distribution: Quebec
Record: Dubois *et al*., 1996

Superfamily ACUARIOIDEA Railliet, Henry & Sisoff, 1912

Acuariidae is the only Family recognised within the Superfamily Acuarioidea (Anderson, 2000). The Family is

represented in Canadian fishes mainly by larvae of three members of the Subfamily Acuariinae Railliet, Henry and Sisoff, 1912, namely, **Cosmocephalus obvelatus*, **Paracuaria adunca* and **Syncuaria squamata*. The only other acuariid record is that of G. A. Black (1981a) who listed a larva representing the Subfamily Seuratiinae from *Salvelinus fontinalis* in Quebec; the record is included here for the sake of completeness, although no morphological details were provided.

Adult acuariines inhabit the upper alimentary tract mainly of birds. Those that parasitize aquatic final hosts, as in the present cases, develop to L3 in the haemocoel of aquatic crustaceans (amphipods and ostracods for example). Various forage and piscivorous fish species serve as paratenic hosts of L3.

Adults of the three genera (*Cosmocephalus*, *Paracuaria*, *Syncuaria*) are distinguished by the structure of cephalic ornamentations (the cordons) and deirids. These features are not fully developed at the L3 stage so design of a key for their identification is impossible.

Family ACUARIIDAE Railliet, Henry & Sisoff, 1912

Subfamily ACUARIINAE Railliet, Henry & Sisoff, 1912

**Cosmocephalus obvelatus* (Creplin, 1825) Seurat, 1919

Description (after Wong & Anderson 1982). In the apparent absence of a description of L3 from fishes the following is based on Wong & Anderson's (1982) account of L3 from experimentally infected amphipods. L3 are 2.05 (1.63–2.40) long, and 0.071 (0.058–0.095) wide. Head with two triangular pseudolabia and four submedian cephalic papillae (Fig. 69A). Amphids small. Buccal cavity long and narrow but expanded in oral region. Pair of inconspicuous deirids immediately behind nerve ring. Excretory pore opens 0.16 (0.14–0.19) from anterior end (Fig. 69B). Total oesophagus [muscular plus glandular portions] 1.15 (0.99–1.40) long. Rectum tubular with thick cuticle. Tail tip rounded. Pair of large phasmids subventrally (Fig. 69C). Genital primordium of males a simple tube lying free in pseudocoelom; that of females a similar tube but attached to body wall by vaginal primordium (Fig. 69D).

Site: mesenteries

Hosts: *Apeltes quadracus* (2); *Carassius auratus* (1); *Cottus* sp. (1); *Fundulus heteroclitus* (3); *Gasterosteus aculeatus* (1, 2); *Notropis hudsonius* (1); *Notropis* sp. (1); *Oncorhynchus mykiss* (1); *Osmerus mordax* (1); *Pungitius pungitius* (2, 3); *Semotilus atromaculatus* (1)

Distribution: Nova Scotia, Ontario

Records: 1. Wong & Anderson 1982 (EX, ON); 2. Marcogliese 1992b (NS); 3. Marcogliese 1995b (NS)

**Paracuaria adunca* (Creplin, 1846) Anderson & Wong, 1981

Description (after Anderson & Wong 1982). In the apparent absence of a description of L3 from fishes the following is based on Anderson & Wong's (1982) account of L3 from experimentally infected amphipods. L3 slender and delicate, 2.60 (2.20–2.80) long, 0.074 (0.070–0.090) wide. Cuticle transversely striated. Head with prominent triangular pseudolabia. Interlabia each divided into two equal lobes. Two pairs cephalic papillae submedially at base of pseudolabia. Amphids inconspicuous. Buccal cavity narrow, widening at oral opening and lined with thick cuticle. Deirids small, near nerve ring. Excretory pore opens 0.162 (0.14–0.19) from anterior end (Fig. 70A). Total oesophagus [muscular plus glandular] 1.25 (1.12–1.44) long. Rectum tubular and surrounded by three oval-shaped rectal cells with prominent nuclei. Tail with slight dorsal curve, and rounded tip. Inconspicuous phasmids located subventrally (Fig. 70B). Male genital primordium lies free in pseudocoelom; female primordium attached to body wall by vaginal primordium.

Site: mesenteries

Hosts: *Apeltes quadracus* (2); *Carassius auratus* (1); *Cottus* sp. (1); *Fundulus heteroclitus* (3); *Gasterosteus aculeatus* (1, 2); *Notropis hudsonius* (1); *Pungitius pungitius* (2, 3); *Semotilus atromaculatus* (1)

Distribution: Nova Scotia, Ontario

Records: 1. Anderson & Wong 1982 (EX, ON); 2. Marcogliese 1992b (NS); 3. Marcogliese 1995 (NS)

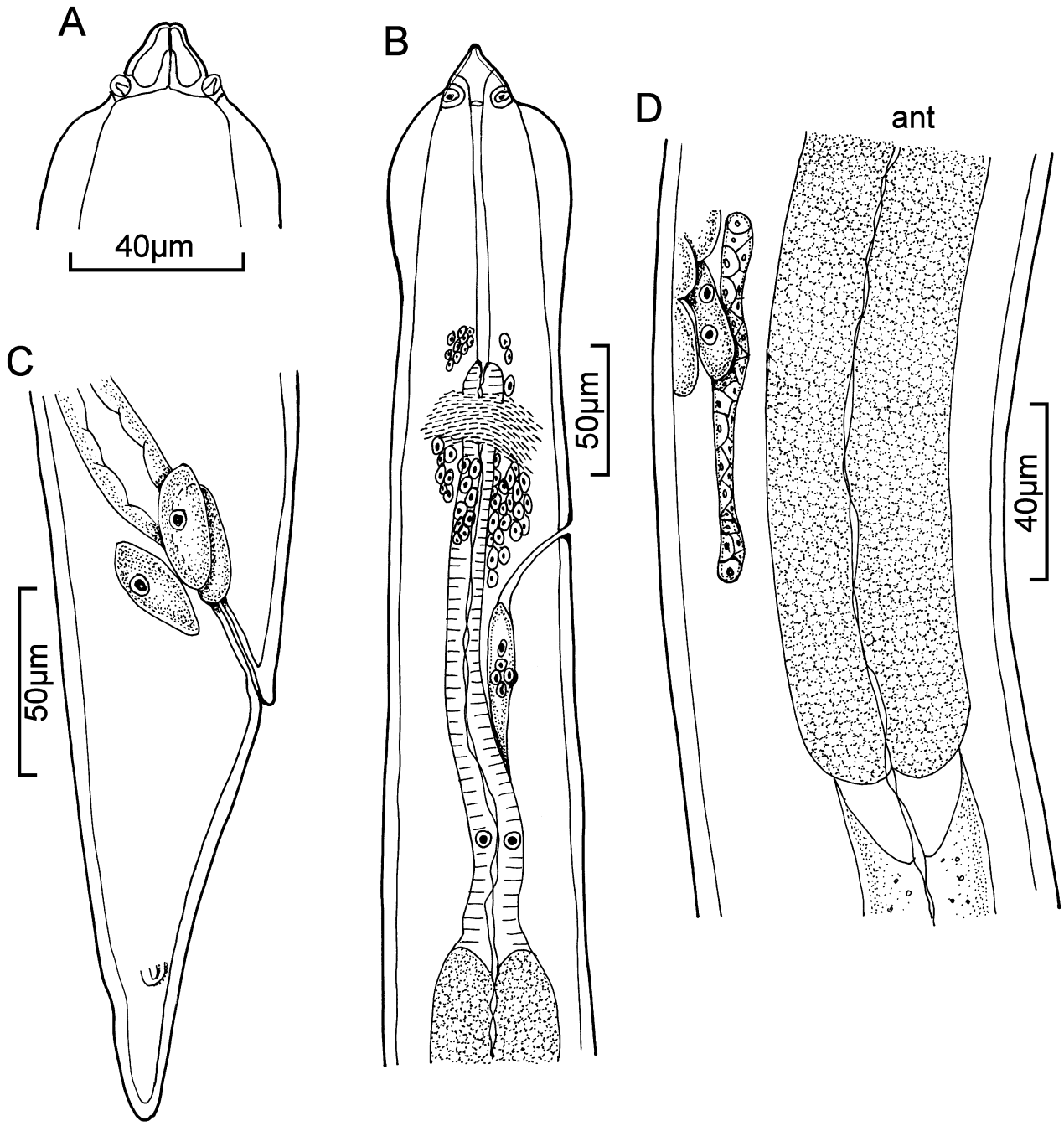

FIGURE 69. **Cosmocephalus obvelatus* (Creplin, 1825) Seurat, 1919. A. L3, head, dorso-ventral view; B. L3, anterior end, lateral view; C. L3, posterior end, lateral view; D. female L3, genital primordium, lateral view. (Redrawn from Wong & Anderson 1982)

****Syncuaria squamata* (Von Linstow, 1883) Gilbert, 1927**

Preamble: Eggs from *Syncuaria squamata* recovered by Wong & Anderson (1987) from Lake Ontarian cormorants were fed to ostracods. Granulomata containing L3 were found on the intestinal serosa of domestic goldfish *Carassius auratus* fed infected ostracods. Adult worms were recovered from a cormorant fed infected goldfish alimentary tracts. Although it appears that fish serve as paratenic hosts of *S. squamata*, no records have been traced of this nematode infecting wild fishes in Canadian waters. Because Wong & Anderson (*op. cit*.) did not describe the L3 from goldfish the following description is based on the description they provided for L3 from ostracods.

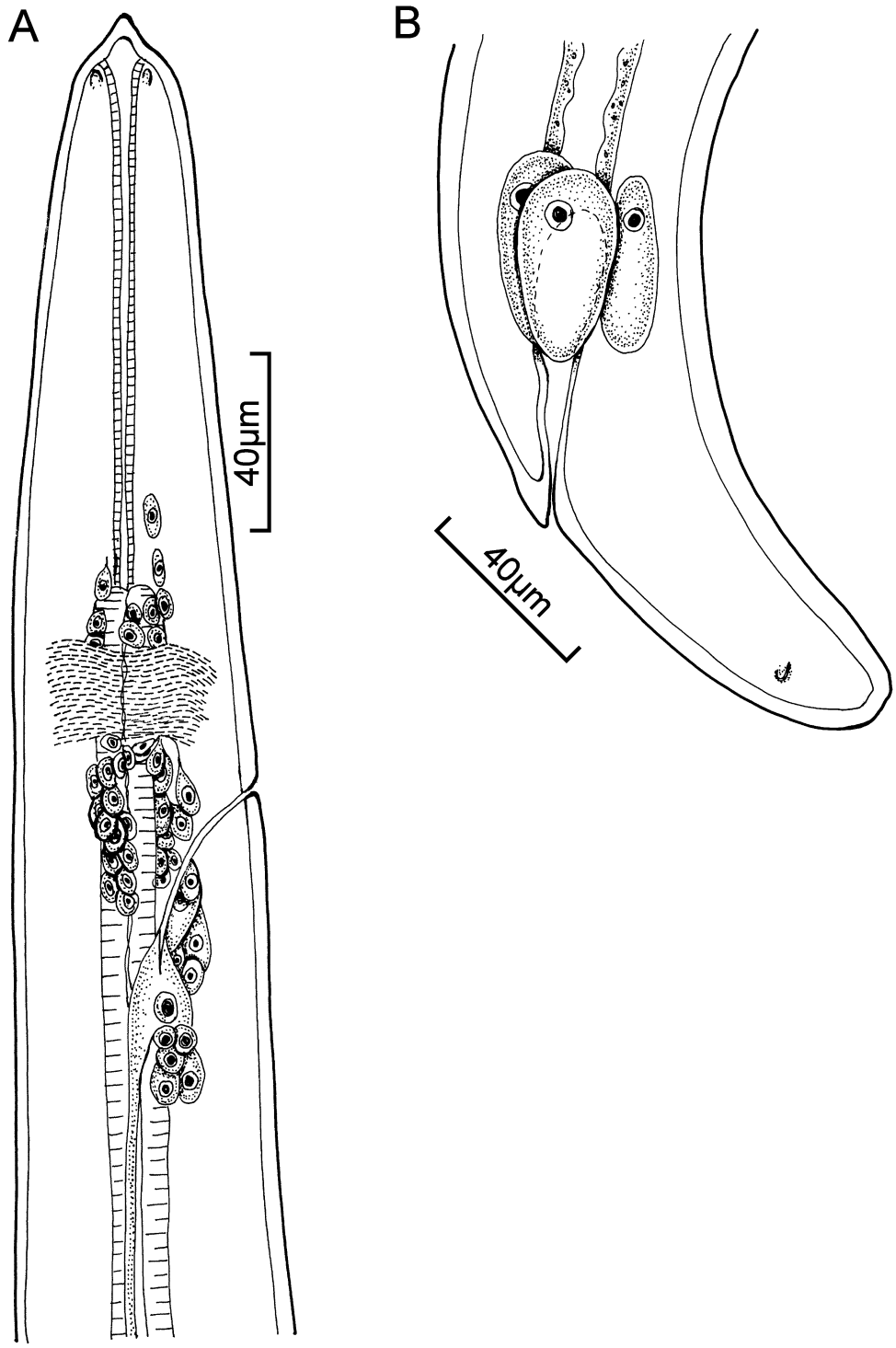

FIGURE 70. **Paracuaria adunca* (Creplin, 1846) Anderson & Wong, 1981. A. L3, anterior end, lateral view; B. L3, posterior end, lateral view. (Redrawn from Anderson & Wong 1982)

Description (after Wong & Anderson 1987). Pseudolabia well developed with prominent apices. Four interlabia originating at dorso-ventral sides of oral opening, surrounding pseudolabia and terminating at amphids. Four prominent cephalic papillae immediately behind interlabia. Buccal cavity elongated and expanded at oral opening (Fig. 71A). Deirids with pointed tips immediately behind excretory pore. Muscular oesophagus about one-fifth length of glandular oesophagus. Genital primordia present in males and females. Rectum elongated and anus patent. Tail with slight dorsal curve and rounded tip (Fig. 71B).

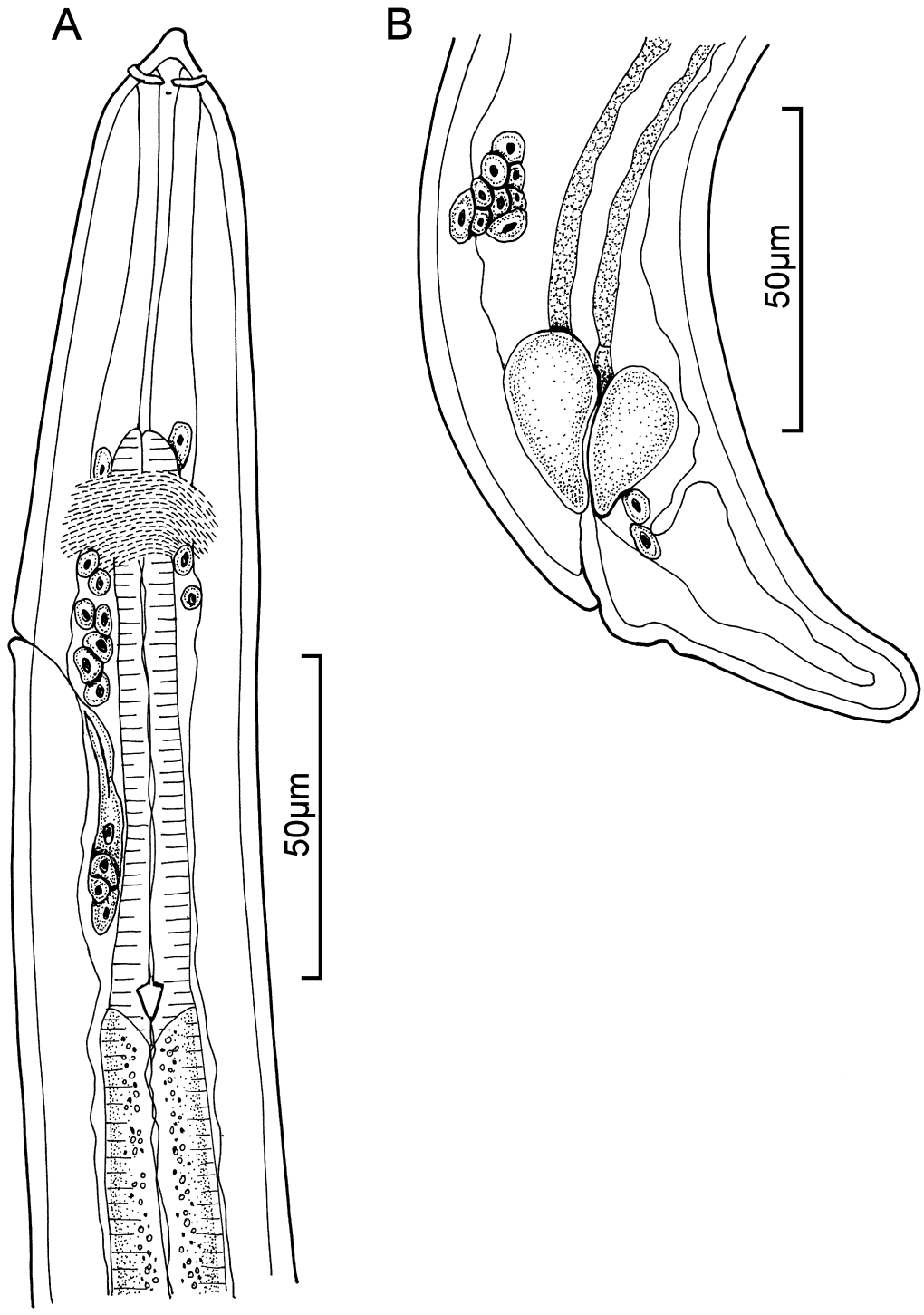

FIGURE 71. **Syncuaria squamata* (von Linstow, 1883) Gilbert, 1927. A. L3 [sex?], anterior end, lateral view ; B. female L3, posterior end showing genital primordium, lateral view. (Redrawn from Wong & Anderson 1987)

Male L3: 1.20 (0.98–1.38) long, 0.049 (0.040–0.058) wide. Excretory pore 0.102 (0.090–0.122) from anterior end. Total oesophagus (muscular plus glandular) 0.612 (0.512–0.712) long.

Female L3: 1.14 (1.04–1.38) long, 0.047 (0.040–0.065) wide. Excretory pore 0.098 (0.080–0.105) from anterior end. Total oesophagus (muscular plus glandular) 0.583 (0.485–0.726) long.

Site: intestinal serosa

Host: *Carassius auratus* (EX)

Distribution: Ontario

Record: Wong & Anderson 1987

***Seuratiinae gen. sp.**

Site: alimentary tract
Host: *Salvelinus fontinalis*
Distribution: Quebec
Record: G. A. Black 1981a

Infraorder ASCARIDOMORPHA De Ley & Blaxter, 2002

Key to Superfamilies of ASCARIDOMORPHA

1 Lips absent, or markedly reduced and variable; mouth opening sometimes elongated dorso-ventrally; oesophagus short, simple and cylindrical, or short and divided into two portions having or not having same width; pharyngeal portion of oesophagus present or absent; pre-cloacal sucker may be present in male; less than 11 pairs of genital papillae in male . . . . . Seuratoidea

\- With three well defined lips, usually large, sometimes separated by interlabia; oesophagus simple and cylindrical or terminated by swelling without valves; intestinal caeca present or absent; pre-cloacal sucker absent in male; genital papillae in male numerous . . . . . Ascaridoidea

Superfamily ASCARIDOIDEA Railliet & Henry, 1915

"Morphospecies", "cryptic species" and "sibling species" occur amongst marine ascaridoids that represent the Family Anisakidae (see also Pérez-Ponce de León & Nadler 2010). The larvae of some anisakids (species of *Anisakis* and *Pseudoterranova* in particular) have considerable public health and economic significance (J. W. Smith & Wootten 1978; Bowen 1990; Desportes & McClelland 2001).

Key to Families of ASCARIDOIDEA

1 Oesophagus comprising a preventriculus and an oblong to globular ventriculus with one dorsal and one ventral longitudinal suture-like depression, or with small globular ventriculus from which arises a posteriorly directed appendix with such depressions or rarely two appendices; excretory system asymmetrical, confined to left lateral chord; excretory pore situated between base of subventral lips or near nerve ring; intestinal caecum present or absent. Parasitic in mammals, birds, reptiles and fishes . . . . . Anisakidae

\- Oesophagus without ventriculus or with globular to ellipsoidal ventriculus without longitudinal sutures; excretory system symmetrical, the right lateral canal of which may be somewhat reduced; excretory pore near nerve ring; intestinal caecum present or absent; lips small, semicircular, not offset from anterior end; each lip provided on inner surface with two pairs of small pointed teeth, a continuous dentigerous ridge or two separate transverse dentigerous ridges; interlabia absent; oesophagus with ventriculus; intestinal caecum absent. Parasitic in elasmobranch fishes . . . . . Acanthocheilidae

Family ACANTHOCHEILIDAE Wülker, 1929

This Family appears to be represented in Canadian fishes by only one genus and species, namely *Pseudanisakis tricupola*.

Pseudanisakis Layman & Borovkova, 1926

Synonyms: *Eustoma* van Beneden, 1871; *Anacanthocheilus* Wülker, 1930; *Pseudanisakis* Yamaguti, 1941; *Metanisakis* Mozgovoi, 1950

Generic diagnosis (after Gibson 1973). Acanthocheilidae. One dorsal lip and two subventral lips (Fig. 72A), each with two papillae. Interlabia absent. Amphid present on subventral lips. Oesophagus long and narrow. Ventriculus oval or oblong, not round (Fig. 72B). Ventricular appendix and intestinal caecum absent. Excretory pore just

posterior to nerve ring. Anal glands absent. Male tail conical; normally six to nine pre-cloacal papillae on each side with five ad-cloacal or post-cloacal pairs of papillae. Spicules equal. Ejaculatory duct distinct and glandular; gubernaculum absent (Fig. 72C). Male *P. tricupola* from *Amblyraja radiata* 5.9–57.0 long. Female tail tapers to sharp point (Fig. 72D). Vulva situated in anterior half of body posterior to the ventriculus. Female *P. tricupola* from *A. radiata* are 5.9–34.5 long. Parasites of rays.

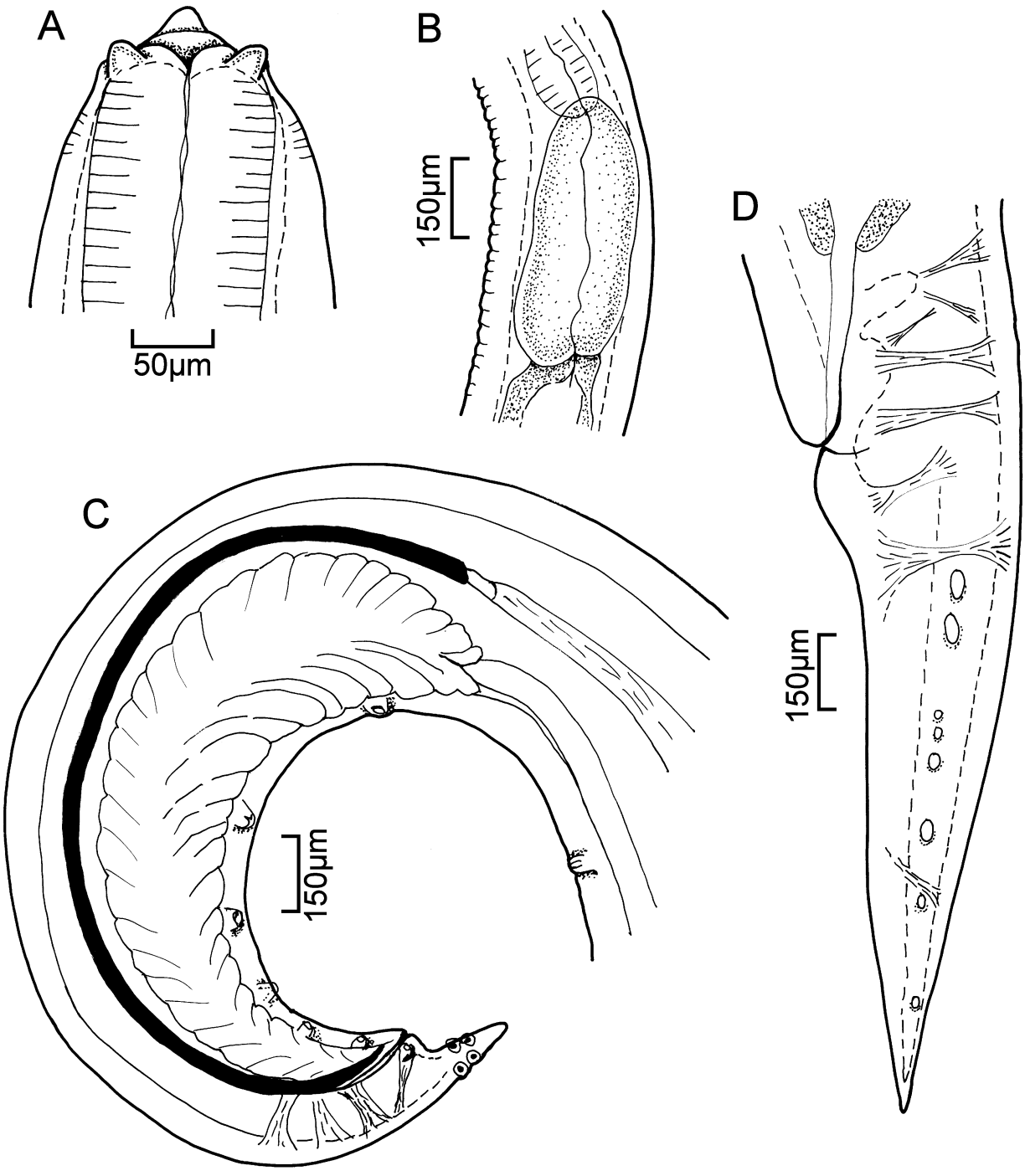

FIGURE 72. *Pseudanisakis tricupola* Gibson, 1973. A. head; B. ventriculus; C. male, posterior end, lateral view; D. female, posterior end, lateral view. (Redrawn from Gibson 1973)

***Pseudanisakis tricupola* Gibson 1973**

Sites: spiral valve, stomach

Hosts: *Amblyraja radiata* (2, 3, 4); *Dipturus laevis* (2); *Leucoraja erinacea* (1, 4); *Leucoraja ocellata* (2); *Squalus acanthias* (3)
Distribution: Atlantic
Records: 1. Heller 1949; 2. Myers 1959a; 3. Threlfall 1969; 4. Linkletter *et al.* 1977

**Pseudanisakis* sp.

Synonym: **Eustoma* sp.
Sites: stomach, intestinal lumen
Host: *Raja* sp.
Distribution: Nova Scotia
Record: Scott & Black 1960

Family ANISAKIDAE Railliet & Henry, 1912

Key to Subfamilies of ANISAKIDAE

1 Excretory system ribbon-like, extending from left lateral chord into ventral part of body-cavity; excretory pore usually between subventral lips or at base of ventral interlabium; parasitic in mammals, birds, reptiles or elasmobranch fishes; larval stages in invertebrates and vertebrates, including fishes. . . . . Anisakinae
\- Excretory system not ribbon-like; excretory pore usually near nerve ring; parasitic in fishes, occasionally birds . . . . . Raphidascaridinae

Subfamily ANISAKINAE Railliet & Henry, 1912

Synonyms: Capsulariinae Johnston & Mawson 1943; Filocapsulariinae Yamaguti, 1961 in part; Stomachinae Johnston & Mawson 1945

Key to genera and tribes of ANISAKINAE

1 Oesophagus comprising preventriculus and an oblong to globular ventriculus; ventricular appendix absent; intestinal caecum present or absent; parasitic in marine mammals, marine turtles or elasmobranch fishes; marine fishes and cephalopods harbour third-stage larvae (L3). . . . . Anisakinea Chabaud, 1965 ...2
\- Oesophagus comprising preventriculus and a reduced globular ventriculus giving off elongated ventricular appendix; intestinal caecum present; parasitic in marine, semi-aquatic or terrestrial mammals, or fish-eating birds . . . . . Contracaecinea Mozgovoi & Shakhmatova, 1971 ...3
2 Intestinal caecum absent . . . . . *Anisakis*
\- Intestinal caecum present . . . . . *Pseudoterranova*
3 Interlabia present . . . . . *Contracaecum*
\- Interlabia absent . . . . . *Phocascaris*

**Anisakis simplex* (Rudolphi, 1809) Dujardin, 1845 (*sensu lato*)

Includes **Anisakis simplex* B and C *auct*
Description (after Beverley-Burton *et al.* 1977, J. W. Smith 1983, and J. W. Smith & Wootten 1984b). With characteristics of the genus. Off-white in colour, L3 lie in capsules coiled like a watch-spring. From 8.8 to over 30 long. Cuticle usually transversely striated near anterior and posterior extremities. Mouth triangular with bilobed dorsal lip and two bilobed ventro-lateral lips, each lip with pair of indistinct papillae. Anteroventrally projecting boring tooth located ventral to mouth (Fig. 73A,B,C). Excretory pore between ventro-lateral lips with single duct passing up from excretory cell (Fig. 73A,B). Dorsal oesophageal gland extends just anterior to nerve ring. Two small ventro-lateral glands near posterior end of oesophagus. Oesophagus comprises preventriculus and

ventriculus. Ventral side of ventriculus slightly longer than dorsal side (Fig. 73A). Intestinal-rectal valve short, lined externally by four epithelial cells. Three rectal glands, two dorsal and one ventral. Tail rounded with retractable mucron (Fig. 73D). Length of preventriculus and ventriculus linearly related to total body length. Mean length of thirty L3 from one fish host was 22.6 (range 18.0–22.9), mean preventriculus length 1.94, and mean ventriculus length 0.89.

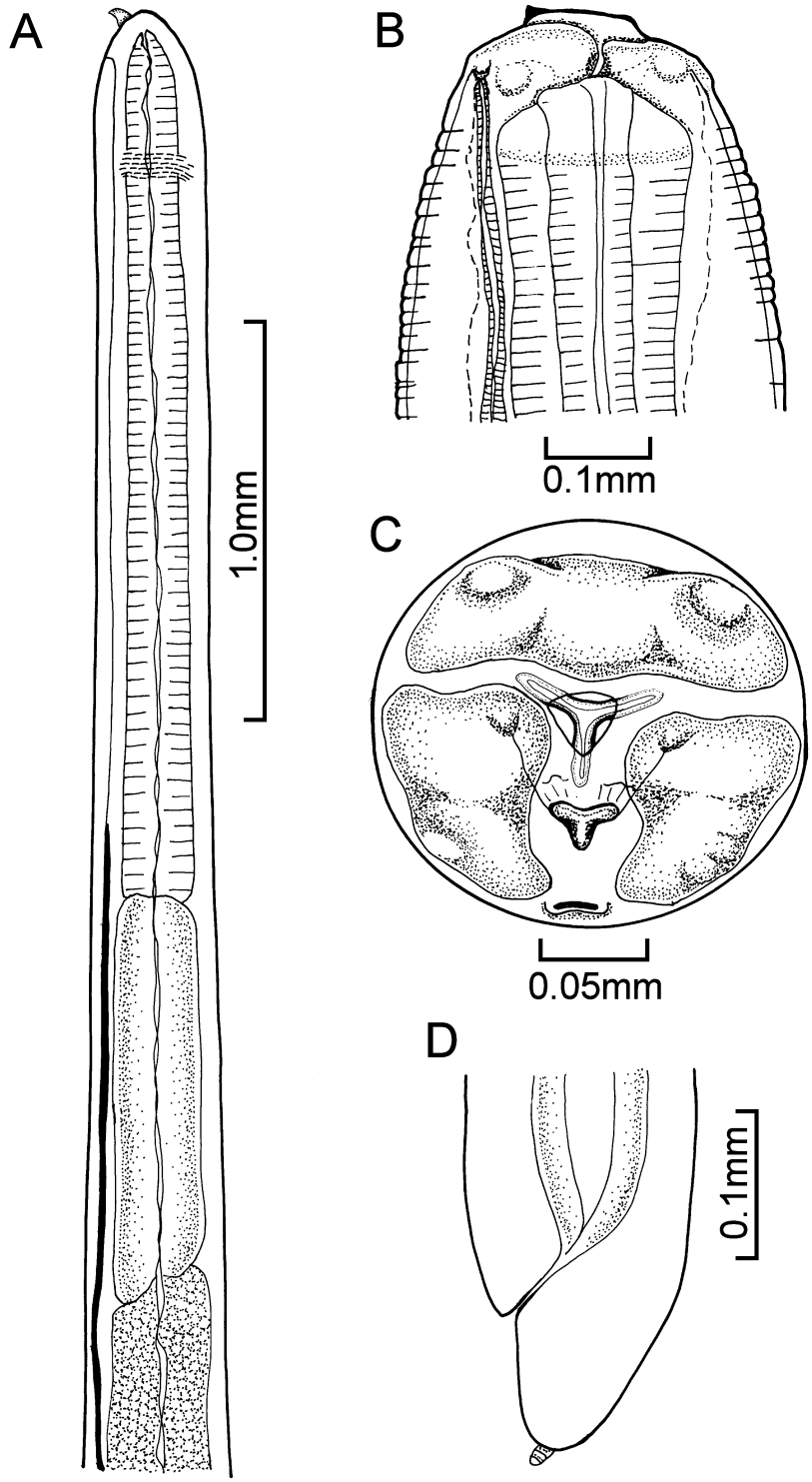

FIGURE 73. **Anisakis simplex* (Rudolphi, 1809) Dujardin, 1845 (*sensu lato*). A. L3, anterior end, lateral view; B. L3, head, sagittal view; C. L3, head, *en face* view D. L3, tail, lateral view. (A. and D. redrawn from J. W. Smith & Wootten 1984b; B. and C. redrawn from Beverley-Burton *et al*. 1977)

Sites: body cavity, alimentary tract, mesenteries, musculature

Hosts: *Acipenser transmontanus* (33); *Alosa aestivalis* (57); *Alosa pseudoharengus* (6, 57); *Amblyraja radiata* (49); *Ammodytes dubius* (28, 49); *Argentina silus* (49); *Atheresthes stomias* (76); *Boreogadus saida* (70, 73, 83); *Brosme brosme* (49); *Clupea harengus* (2, 4, 6, 7, 19, 25, 30, 32, 34, 35, 41, 54, 65, 68, 70, 72, 74); *Clupea pallasi* (8, 11, 12, 13, 73); *Coregonus huntsmani* (83); *Cyclopterus lumpus* (49); *Gadus macrocephalus* (74); *Gadus morhua* (17, 27, 28, 29, 36, 41, 42, 48, 49, 55, 60, 61, 64, 70, 73, 80, 82); *Gadus macrocephalus* (65); *Glyptocephalus cynoglossus* (28, 36, 49, 65); *Hemitripterus americanus* (49, 65); *Hippoglossoides platessoides* (28, 31, 36, 40, 63, 64); *Hippoglossus hippoglossus* (36, 49, 74); *Hippoglossus stenolepis* (67, 71, 78); *Limanda ferrugineus* (36, 49, 63, 65); *Lophius americanus* (49); *Lycodes* spp. (65); *Mallotus villosus* (26, 37, 62, 65, 72); *Melanogrammus aeglefinus* (36, 49); *Merluccius bilinearis* (6, 36, 65); *Merluccius productus* (5, 22); *Microgadus tomcod* (83); *Myoxocephalus octodecemspinosus* (65, 83); *Myoxocephalus scorpius* (65, 83); *Nezumia bairdii* (65); *Oncorhynchus gorbuscha* (74); *Oncorhynchus keta* (74); *Oncorhynchus mykiss* (24); *Oncorhynchus tshawytscha* (75); *Peprilus triacanthus* (49); *Phycis chesteri* (49); *Pollachius virens* (36, 49, 65); *Pseudopleuronectes americanus* (36, 49, 63, 65, 77, 80); *Reinhardtius hippoglossoides* (16, 43, 49, 50, 51, 52, 53, 56, 58, 59, 65, 69, 70, 73); *Salmo salar* (1, 2, 3, 4, 7, 9, 10, 14, 19, 70, 73, 83, 84); *Salvelinus alpinus* (83); *Salvelinus fontinalis* (15, 38, 39); *Scomber scombrus* (6, 19, 36, 49); *Scomberesox saurus* (70, 73); *Scophthalmus aquosus* (49); *Sebastes fasciatus* (49, 66); *Sebastes mentella* (49, 66, 79); *Sebastes* spp. (36, 65); *Squalus acanthias* (49); *Theragra chalcogramma* (18, 20, 23, 68, 70, 73, 74); *Urophycis chuss* (49); *Urophycis tenuis* (49, 65, 81); *Xiphias gladius* (21); unspecified "fish" (44, 45, 46, 47); *Zoarces americanus* (65)

Distribution: Atlantic, British Columbia, New Brunswick, Newfoundland, Nunavut, Pacific, Quebec

Records: 1. Nyman & Pippy 1972 (AT); 2. Pippy 1973a (AT); 3. Pippy 1973b (AT); 4. Beverley-Burton *et al.* 1977 (AT); 5. Margolis & Beverley-Burton 1977 (PA): 6. Gaevskaya & Umnova 1977 (AT); 7. Beverley-Burton & Pippy 1977 (AT); 8. Arthur 1978 (PA); 9. Beverley-Burton 1978b (AT); 10. Beverley-Burton & Pippy 1978 (AT); 11. Arthur & Arai 1979 (PA); 12. Arthur & Arai 1980a (PA); 13. Arthur & Arai 1980b (PA); 14. Pippy 1980 (AT); 15. G. A. Black 1981a (QC); 16. Reimer 1981 (NU); 17. Appy & Burt 1982 (AT); 18. Arthur *et al.* 1982 (PA); 19. Threlfall 1982 (AT); 20. Arthur 1983 (PA); 21. Hogans *et al.* 1983 (AT); 22. Sankurathri *et al.* 1983 (PA); 23. Arthur 1984 (PA); 24. Margolis 1984 (PA); 25. McGladdery 1984 (AT); 26. Pálsson & Beverley-Burton 1984 (AT); 27. Khan 1985 (AT); 28. McClelland *et al.* 1985 (AT); 29. Wells *et al.* 1985 (ATl); 30. McGladdery & Burt 1985 (AT); 31. Zubchenko 1985a (AT); 32. Chenoweth *et al.* 1986 (AT); 33. Margolis & McDonald 1986 (PA); 34. McGladdery 1986a (AT); 35. McGladdery 1986b (AT); 36. Morrison *et al.* 1986 (AT); 37. Pálsson 1986 (AT); 38. Frimeth 1987a (NB); 39. Frimeth 1987b (NB); 40. McClelland *et al.* 1987 (AT); 41. Brattey 1988 (AT); 42. Chandra & Khan 1988 (AT); 43. Wierzbicka 1988 (AT); 44. Berland *et al.* 1989 (AT); 45. Burt *et al.* 1989a (AT); 46. Mattiucci & Paggi 1989 (AT); 47. Burt *et al.* 1989b (AT); 48. Brattey *et al.* 1990 (AT); 49. McClelland *et al.* 1990 (AT); 50. Wierzbicka 1991a (AT); 51. Wierzbicka 1991b (AT); 52. Arthur & Albert 1992a (AT); 53. Arthur & Albert 1992b (AT); 54. Bradford & Iles 1992 (AT); 55. Brattey & Bishop 1992 (AT); 56. Krzykawski & Wierzbicka 1992 (AT); 57. Landry *et al.* 1992 (AT); 58. Arthur & Albert 1993 (AT); 59. Arthur & Albert 1994 (AT); 60. Marcogliese & Boily 1994 (AT); 61. McClelland & Marcogliese 1994 (AT); 62. Arthur *et al.* 1995 (AT); 63. Martell & McClelland 1995 (AT); 64. Boily & Marcogliese 1995 (AT); 65. Marcogliese 1995a (AT); 66. Moran *et al.* 1996 (AT); 67. Blaycock 1996 (PA); 68. Mattiucci *et al*. 1996 (PA); 69. Boje *et al.* 1997 (AT); 70. Mattiucci *et al.* 1997 (AT, PA); 71. Blaycock *et al.* 1998a (PA); 72. Hays *et al.* 1998 (AT); 73. Paggi *et al.* 1998a (AT, PA); 74. Paggi *et al.* 1998b (PA); 75. Urawa *et al.* 1998 (PA); 76. Wierzbicka & Piasecki 1998 (PA); 77. Khan 1999 (AT); 78. Blaycock *et al.* 2003 (PA); 79. Marcogliese *et al.* 2003 (AT); 80. McClelland *et al.* 2005 (AT); 81. Melendy *et al.* 2005 (AT); 82. McClelland & Melendy 2011 (AT); 83. Pufall *et al.* 2012 (NU); 84. Larrat *et al*. 2013 (QC).

****Anisakis* sp.**

Includes "*Anisakis*-type larva" *auct*.; "herringworm"; "whaleworm"

Sites: alimentary tract, body cavity, mesenteries, musculature, viscera

Hosts: *Acipenser transmontanus* (3); *Alepocephalus agassizii* (67); *Alosa aestivalis* (70); *Alosa pseudoharengus* (70); *Amblyraja radiata* (9, 28); *Ammodytes hexapterus* (23); *Anoplarchus purpurescens* (23); *Anoplopoma*

fimbria (3); *Apodichthys flavidus* (23); *Atheresthes stomias* (2, 3, 24, 65, 81); *Aulorhynchus flavidus* (23); *Blepsias cirrhosus* (23); *Citharichthys sordidus* (3); *Citharichthys stigmaeus* (2, 18, 23); *Clupea harengus* (1, 4, 11, 12, 22, 25, 30, 33, 34, 37, 38, 39, 40, 42, 56); *Clupea pallasi* (3, 5, 18, 23, 45); *Coryphaenoides rupestris* (48, 53, 58, 59, 69); *Cryptacanthodes giganteus* (3); *Cyclopterus lumpus* (77); *Cymatogaster aggregata* (17, 19, 73); *Dipturus laevis* (9); *Eopsetta jordani* (2, 3, 16); *Gadus macrocephalus* (1, 16, 23); *Gadus morhua* (1, 8, 10, 13, 14, 52, 60, 61, 66, 80); *Gasterosteus aculeatus* (18, 23); *Glyptocephalus cynoglossus* (8, 54, 60); *Glyptocephalus zachirus* (3); *Hexagrammos lagocephalus* (18, 23); *Hippoglossoides elassodon* (3); *Hippoglossoides platessoides* (8, 54, 60, 61); *Hippoglossus hippoglossus* (50, 54); *Icosteus aenigmaticus* (3); *Isopsetta isolepis* (3); *Leptocottus armatus* (23); *Leucoraja ocellata* (9); *Lycodes brevipes* (3); *Lyopsetta exilis* (2, 3); *Macrourus berglax* (44, 58); *Mallotus villosus* (3, 8); *Melanogrammus aeglefinus* (8); *Merluccius albidus* (72); *Merluccius bilinearis* (72); *Merluccius productus* (3); *Microgadus tomcod* (1); *Microstomus pacificus* (2, 3, 65); *Myoxocephalus octodecemspinosus* (78); *Myoxocephalus polyacanthocephalus* (23); *Oligocottus maculosus* (23); *Oncorhynchus gorbuscha* (3, 6, 7, 18, 23, 45, 49, 55, 62); *Oncorhynchus keta* (3, 18, 23, 55, 62, 68, 75); *Oncorhynchus kisutch* (3, 45, 55, 62); *Oncorhynchus nerka* (3, 6, 7, 23, 55, 62); *Oncorhynchus tshawytscha* (3); *Ophiodon elongatus* (3, 23); *Osmerus mordax* (1, 57); *Parophrys vetulus* (2, 3, 65); *Pholis laeta* (23); *Pholis ornata* (18, 23); *Platichthys stellatus* (23); *Paraplagusia bilineata* (2, 3, 23); *Pollachius virens* (8); *Psettichthys melanostictus* (3); *Psychrolutes sigalutes* (23); *Raja rhina* (3); *Reinhardtius hippoglossoides* (50, 54); *Ronquilus jordani* (23); *Salmo salar* (1, 20, 21, 26, 27, 31, 41, 43); *Salvelinus alpinus* (43); *Salvelinus fontinalis* (43); *Scomber scombrus* (1); *Sebastes alutus* (18, 23); *Sebastes brevispinis* (3, 51); *Sebastes fasciatus* (64, 74); *Sebastes flavidus* (76, 79); *Sebastes mentella* (15, 64); *Sebastes norvegicus* (8, 15, 64); *Sebastes paucispinis* (3, 51); *Sebastes pinniger* (51); *Squalus acanthias* (3, 9, 28); *Syngnathus leptorhynchus* (18, 23); *Tautogolabrus adspersus* (32); *Theragra chalcogramma* (3, 23, 63, 65, 71); *Thunnus alalunga* (3); *Triglops pingelii* (18, 23); *Urophycis chuss* (1); *Urophycis tenuis* (72); unspecified "fish" (46); unspecified "herring" (29, 35, 36, 47)

Distribution: Atlantic, British Columbia, Labrador, New Brunswick, Nova Scotia, Pacific, Quebec

Records: 1. Heller 1949 (AT); 2. Margolis 1952a (PA); 3. Margolis 1952b (PA); 4. Scott 1953 (AT); 5. Bishop & Margolis 1955 (BC, PA); 6. Margolis 1956 (PA); 7. Margolis 1957 (BC, PA); 8. Templeman *et al.* 1957 (AT); 9. Myers 1959a (AT); 10. Scott & Martin 1959 (AT); 11. Sindermann 1959a (AT); 12. Sindermann 1959b (AT); 13. Fleming 1960 (AT); 14. Postolaki 1962 (AT); 15. Yanulov 1962 (AT); 16. Myers 1963 (AT); 17. Arai 1964 (PA); 18. Arai 1967a (PC); 19. Arai 1967b (PC); 20. Pippy 1967 (NB); 21. Templeman 1967 (AT); 22. Parsons 1968 (AT); 23. Arai 1969 (PA); 24. Kovalenko 1969 (PA); 25. Parsons 1969 (AT); 26. Pippy 1969 (AT, NB, NS, QC); 27. Power 1969 (QC); 28. Threlfall 1969 (AT); 29. Hodder & Parsons 1970 (AT); 30. Parsons 1970 (AT); 31. Pippy 1970 (AT); 32. Sekhar S. [*sic*] & Threlfall 1970 (AT); 33. Boyar & Perkins 1971 (AT); 34. Hodder & Parsons 1971a (AT); 35. Hodder & Parsons 1971b (AT); 36. Hodder & Parsons 1971c (AT); 37. Parsons 1971 (AT); 38. Parsons and Hodder 1971a (AT); 39. Parsons & Hodder 1971b (AT); 40. Parsons 1972 (AT); 41. Pippy 1972 (AT); 42. Dornheim 1973 (AT); 43. Hicks & Threlfall 1973 (LB); 44. Noble 1973 (PA); 45. Hoskins *et al.* 1976 (PA); 46. Redkozubova 1976 (AT); 47. Zenkin & Umnova 1976 (AT); 48. Zubchenko 1976 (AT); 49. Hoskins & Hulstein 1977 (BC); 50. Redkozubova 1978 (AT); 51. Cain & Raj 1980 (PA); 52. McClelland 1980c (AT); 53. Szuks 1980 (AT); 54. Zubchenko 1980 (AT); 55. Anon. 1981 (AT); 56. McGladdery 1981 (AT); 57. Threlfall 1981 (AT); 58. Zubchenko 1981a (AT); 59. Zubchenko 1981b (AT); 60. McClelland *et al.* 1983a (AT); 61. McClelland *et al.* 1983b (AT); 62. Anon. 1984 (BC); 63. Arthur 1984 (PA); 64. Bourgeois & Ni 1984 (AT); 65. Kabata & Whitaker 1984 (PA); 66. McClelland *et al.* 1984 (AT); 67. Zubchenko 1984 (AT); 68. Whitaker 1985 (PA); 69. Zubchenko 1985b (AT); 70. Landry *et al.* 1986 (AT); 71. Priebe 1986 (PA); 72. Scott 1987 (AT); 73. Arai *et al.* 1988 (PA); 74. Scott 1988 (AT); 75. Gardiner 1990 (PA); 76. Lee *et al.* 1990 (PA); 77. McClelland *et al.* 1990 (AT); 78. Khan 1991 (AT); 79. Stanley *et al.* 1992 (PA); 80. Lee & Khan 2000 (AT); 81. Adams *et al*. 2005 (PA)

***Pseudoterranova bulbosa* (Cobb, 1888) Mattiucci, Paggi, Nascetti, Ishikura, Kikuchi, Sato, Cianchi & Bullini, 1998**

Includes *P. decipiens* C *auct*.

Description: see that for *P. decipiens* below.

Site: ?

Hosts: *Gadus macrocephalus* (5); *Hippoglossus hippoglossus* (5); *Myoxocephalus quadricornis* (5); *Reinhardtius hippoglossoides* (3, 4); unspecified "fish" (1, 2)

Distribution: Atlantic, Labrador, Pacific

Records: 1. Berland *et al.* 1989 (LB); 2. Mattiucci & Paggi 1989 (LB); 3. Paggi *et al.* 1991 (AT); 4. Mattiucci *et al.* 1998 (AT); 5. Paggi *et al.* 1998b (AT, PA).

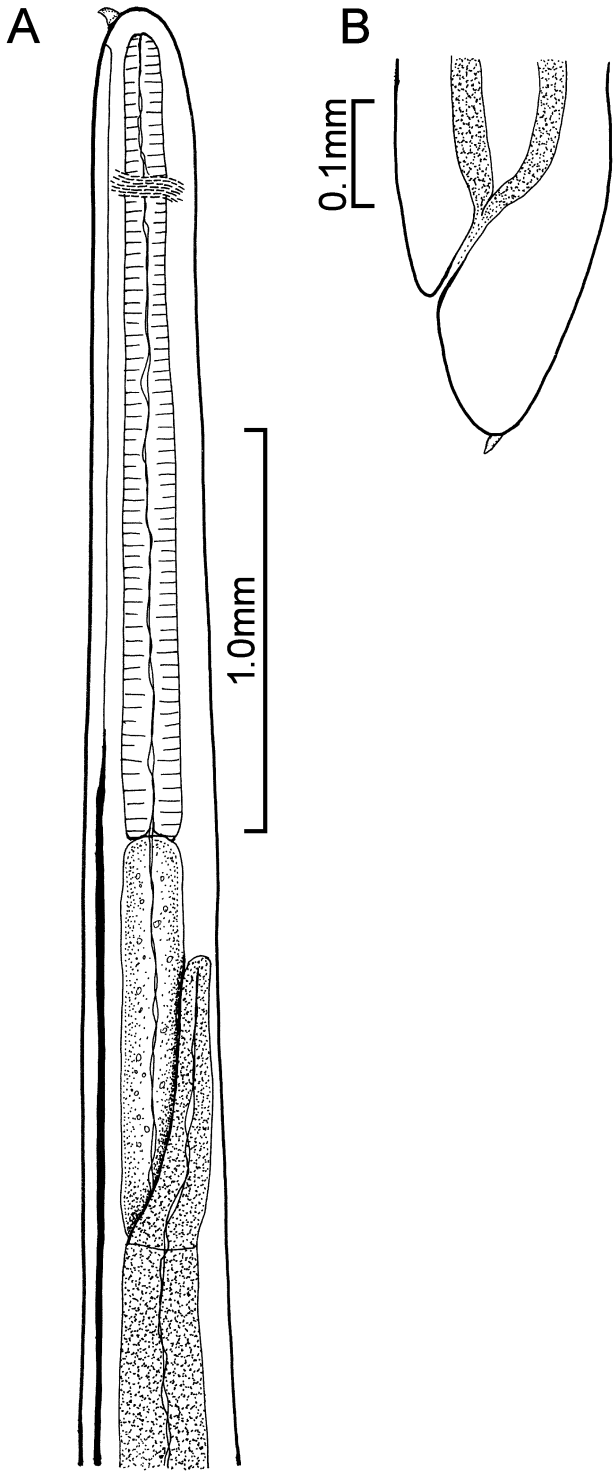

FIGURE 74. **Pseudoterranova decipiens* (Krabbe, 1878) Gibson, 1983 (*sensu lato*). A. L3, anterior end, lateral view; B. L3, tail, lateral view. (Redrawn from J. W. Smith & Wootten 1984a)

******Pseudoterranova decipiens* **(Krabbe, 1878) Gibson, 1983 (*sensu lato*)**

Synonyms: *Terranova decipiens* (Krabbe, 1878) Mozgovoi, 1953; *Phocanema decipiens* (Krabbe, 1878) Myers 1959

Includes *P. decipiens* B *auct*.

Description (after McClelland & Ronald 1974, McClelland *et al*. 1983, Hurst 1984, J. W. Smith & Wootten 1984a, McClelland 1995, and Martell & McClelland 1995). With characteristics of the genus. Creamy white, yellow, brown, red, or reddish brown in colour, L3 lie coiled in capsules of irregular shape. About 1.5 to 60 long. Cuticular striations transverse and irregular. Anterior and posterior ends of an L3 shown diagrammatically in Fig.74A,B. Mouth, lips, boring tooth, and excretory pore similar to those of *Anisakis simplex* L3 (see Fig. 73A,B,C). L3 from cod musculature 15–60 long, from cod viscera, mesenteries and peritoneum 8–42 long. The largest of five relatively small L3 found free in a flatfish stomach (from Canadian waters) was 8.078 long; length of preventriculus, ventriculus, intestinal caecum and tail 0.871, 0.533, 0.194, and 0.105 respectively. The smallest of these L3 was 1.592 long; corresponding measurements 0.290, 0.158, not stated, and 0.066. Mean length of ten L3 from barracouta (from New Zealand waters) was 29.8 (range 25.0–36.0); corresponding measurements 2.03 (1.54–2.65), 0.90 (0.71–1.14), 1.11 (0.87–1.29), and 0.12 (0.10–0.13). Tail bluntly rounded with small mucron.

Sites: body cavity, mesenteries, musculature

Hosts: *Alosa aestivalis* (110); *Alosa pseudoharengus* (110, 127); *Amblyraja radiata* (99); *Ammodytes* sp. (99); *Anarhichas lupus* (55, 138); *Anoplopoma fimbria* (69); *Apeltes quadracus* (112, 113); *Artediellus atlanticus* (138); *Aspidophoroides monopterygius* (99, 138); *Atheresthes stomias* (69, 134); *Boreogadus saida* (106, 145); *Brosme brosme* (99); *Clupea harengus* (56, 79); *Clupea pallasi* (43); *Coregonus huntsmani* (145); *Cryptacanthodes maculatus* (138); *Cyclopterus lumpus* (99, 138); *Enchelyopus cimbrius* (138); *Eumesogrammus praecisus* (138); *Eumicrotremus spinosus* (99, 138); *Fundulus heteroclitus* (127); *Gadus morhua* (1, 2, 3, 5, 6, 7, 8, 11, 14, 15, 17, 19, 21, 27, 28, 29, 30, 31, 32, 34, 35, 36, 37, 40, 44, 46, 49, 50, 51, 52, 53, 54, 58, 62, 63, 68, 71, 73, 74, 77, 79, 80, 81, 87, 89, 90, 92, 93, 99, 100, 101, 103, 104, 105, 106, 107, 111, 114, 116, 117, 118, 119, 121, 122, 124, 127, 129, 136, 138, 143, 144); *Gadus macrocephalus* (1, 6, 21, 106, 125); *Gasterosteus aculeatus* (113, 127); *Glyptocephalus cynoglossus* (1, 6, 10, 19, 46, 62, 63, 71, 73, 77, 99, 125, 138); *Hemitripterus americanus* (1, 6, 21, 46, 89, 92, 93, 99, 103, 105, 114, 125, 129, 138); *Hippoglossoides platessoides* (1, 5, 6, 10, 19, 21, 46, 55, 62, 63, 71, 73, 75, 77, 86, 99, 105, 114, 124, 126, 129, 136, 137, 138, 139); *Hippoglossus hippoglossus* (77, 99, 129); *Hippoglossus stenolepis* (43, 128, 133, 140); *Limanda ferrugineus* (6, 21, 45, 63, 71, 73, 77, 99, 105, 114, 125, 126, 138); *Lophius americanus* (99, 125, 138); *Lumpenus lumpretaeformis* (138); *Leptoclinus maculatu*s (138); *Lycodes reticulatus* (138); *Lycodes vahlii* (99, 138); *Lycodes* spp. (125); *Mallotus villosus* (123); *Melanogrammus aeglefinus* (99, 105, 114, 138); *Menidia menidia* (127); *Merluccius bilinearis* (1, 99, 138); *Merluccius productus* (64); *Microgadus tomcod* (145); *Microstomus pacificus* (69); *Myoxocephalus aenaeus* (127); *Myoxocephalus octodecemspinosus* (6, 21, 99, 105, 114, 125, 138, 145); *Myoxocephalus scorpius* (6, 21, 65, 106, 125, 129, 145); *Myoxocephalus* sp. (19); *Nezumia bairdii* (57); *Oncorhynchus mykiss* (70, 101, 102, 107); *Ophiodon elongatus* (43); *Osmerus mordax* (1, 5, 6, 21, 61, 85, 86, 89, 92, 95, 96, 97, 103, 127); *Peprilus triacanthus* (99, 138); *Phycis chesteri* (99); *Pollachius virens* (99, 106, 127); *Pseudopleuronectes americanus* (6, 77, 99, 105, 125, 126, 127, 135, 138, 141); *Raja* sp. (21); *Reinhardtius hippoglossoides* (60, 99, 108, 109, 115, 120, 125, 129, 132, 138); *Salmo salar* (127, 145); *Salvelinus alpinus* (145); *Salvelinus fontinalis* (93, 127); *Scophthalmus aquosus* (99, 105, 114, 138); *Sebastes alutus* (18, 24); *Sebastes fasciatus* (1, 99, 131, 138); *Sebastes flavidus* (98); *Sebastes mentella* (99, 131); *Sebastes norvegicus* (6, 45); *Tautogolabrus adspersus* (125, 127); *Theregra chalcogramma* (59, 67, 69, 78); *Triglops murrayi* (6, 138); *Triglops pingelii* (21); *Urophycis chuss* (99); *Urophycis tenuis* (6, 99, 125, 138, 142); unspecified “cod” (5, 9, 12, 13, 16, 20, 25, 33, 38, 39, 41, 42, 47, 48, 66, 72, 84, 94); unspecified “fish” (22, 23, 26, 76, 82, 83, 88, 91); unspecified “hake” (1); *Zoarces americanus* (1, 5, 6, 21, 46, 92, 99, 125, 138)

Distribution: Atlantic, Newfoundland, Nova Scotia, Nunavut, Pacific

Records: 1. Scott 1950 (AT); 2. Baer 1953 (AT); 3. Martin 1953 (AT); 4. Reed 1953 (AT); 5. Scott 1953 (AT); 6. Scott 1954 (AT); 7. Ronald 1956 (AT); 8. Scott 1956 (AT); 9. W. F. Black 1957 (AT); 10. Homans & MacFarlane 1957 (AT); 11. Scott & Martin 1957 (AT); 12. Fairbairn 1958 (AT); 13. Power 1958 (AT); 14. Scott & Fisher 1958 (AT); 15. Kohler 1959 (AT); 16. Myers 1959b (AT); 17. Scott & Martin 1959 (AT); 18. Liston *et al.* 1960 (PA); 19. Myers 1960 (EX, AT); 20. Ronald 1960 (AT); 21. Scott & Black 1960 (AT); 22. Bradley 1961a (AT); 23. Bradley 1961b (AT); 24. Liston & Hitz 1961 (PA); 25. Power 1961 (AT); 26. Ronald

1962 (AT); 27. Freeman *et al.* 1963 (AT); 28. Townsley *et al.* 1963 (AT); 29. McCracken & Fitzgerald 1964 (AT); 30. Davey 1965 (AT); 31. Davey 1966 (AT); 32. Wiles 1968 (AT); 33. Kan & Davey 1968a (AT); 34. Kan & Davey 1968b (AT); 35. Davey 1969 (AT); 36. Pippy 1970 (AT); 37. Davey 1971 (AT); 38. Davey & Sommerville 1974 (AT); 39. McClelland & Ronald 1974 (AT); 40. Ackman & Gjelstad 1975 (AT); 41. Boghen & Davey 1975 (AT); 42. Ackman 1976 (AT); 43. Hoskins *et al.* 1976 (PA); 44. McClelland 1976 (AT); 45. Gaevskaya & Umnova 1977 (AT); 46. Linkletter *et al.* 1977 (AT); 47. Goil & Harpur 1978 (AT); 48. Davey 1979 (AT); 49. Goil & Harpur 1979 (AT); 50. Cain & Raj 1980 (AT); 51. Croll *et al.* 1980 (AT); 52. McClelland 1980a (AT); 53. McClelland 1980b (AT); 54. McClelland 1980c (AT); 55. Zubchenko 1980 (AT); 56. McGladdery 1981 (AT); 57. Zubchenko 1981a (AT); 58. Appy & Burt 1982 (AT); 59. Arthur *et al.* 1982 (PA); 60. Khan *et al.* 1982 (AT); 61. Fréchet *et al.* 1983 (AT); 62. McClelland *et al.* 1983a (AT); 63. McClelland *et al.* 1983b (AT); 64. Sankurathri *et al.* 1983 (PA); 65. Stewart & Bernier 1983 (NT); 66. Apold *et al.* 1984 (AT); 67. Arthur 1984 (PA); 68. Davey & Goh 1984 (AT); 69. Kabata & Whitaker 1984 (PA); 70. Margolis 1984 (PA); 71. McClelland *et al.* 1984 (AT); 72. Goh & Davey 1985 (AT); 73. McClelland *et al.* 1985 (AT); 74. Wells *et al.* 1985 (AT); 75. Zubchenko 1985a (AT); 76. Davey 1986 (AT); 77. Morrison *et al.* 1986 (AT); 78. Priebe 1986 (PA); 79. Brattey 1988 (AT); 80. Chandra & Khan 1988 (AT); 81. Lee 1988 (AT); 82. Berland *et al.* 1989 (AT); 83. Burt *et al.* 1989a (AT); 84. des Clers 1989 (AT); 85. Landry 1989a (AT); 86. Landry 1989b (AT); 87. Likely & Burt 1989 (AT); 88. Mattiucci & Paggi 1989 (AT); 89. Appleton & Burt 1990 (AT); 90. Brattey *et al.* 1990 (AT); 91. Burt *et al.* 1990a (AT); 92. Burt *et al.* 1990b (AT); 93. Burt *et al.* 1990c (EX, AT); 94. Burt *et al.* 1990d (AT); 95. Landry 1990a (AT); 96. Landry 1990b (AT); 97. Landry & Hare 1990 (AT); 98. Lee *et al.* 1990 (PA); 99. McClelland *et al.* 1990 (AT); 100. Myers & Brattey 1990 (AT); 101. Ramakrishna & Burt 1990 (EX, AT); 102. J. W. Smith *et al.* 1990 (EX, AT); 103. Appleton & Burt 1991 (AT); 104. des Clers 1991 (AT); 105. Marcogliese 1991 (AT); 106. Paggi *et al.* 1991 (AT); 107. Ramakrishna & Burt 1991 (EX, AT); 108. Arthur & Albert 1992a (AT); 109. Arthur & Albert 1992b (AT); 110. Landry *et al.* 1992 (AT); 111. MacKinnon & Burt 1992 (AT); 112. Marcogliese 1992a (NS); 113. Marcogliese 1992b (NS); 114. Marcogliese & McClelland 1992 (AT); 115. Arthur & Albert 1993 (AT); 116. Dixon *et al.* 1993 (AT); 117. Fusé *et al.* 1993a (AT); 118. Fusé *et al.* 1993b (AT); 119. Ramakrishna *et al.* 1993 (AT); 120. Arthur & Albert 1994 (AT); 121. Marcogliese & Boily 1994 (AT); 122. McClelland & Marcogliese 1994 (AT); 123. Arthur *et al.* 1995 (AT); 124. Boily & Marcogliese 1995 (AT); 125. Marcogliese 1995a (AT); 126. Martell & McClelland 1995 (AT); 127. McClelland 1995 (EX, AT); 128. Blaycock 1996 (PA); 129. Brattey & Davidson 1996 (AT); 130. Marcogliese 1996 (NS); 131. Moran *et al.* 1996 (AT); 132. Boje *et al.* 1997 (AT); 133. Blaycock *et al.* 1998a (PA); 134. Wierzbicka & Piasecki 1998 (PA); 135. Khan 1999 (AT); 136. McClelland 2000 (AT); 137. McClelland *et al.* 2000 (AT); 138. McClelland & Martell 2001a (AT); 139. McClelland & Martell 2001b (AT); 140. Blaycock *et al.* 2003 (PA); 141. McClelland *et al*. 2005 (AT); 142. Melendy *et al*. 2005 (AT); 143. Khan *et al*. 2011 (NF); 144. McClelland & Melendy 2011 (AT); 145. Pufall *et al.* 2012 (NU)

***Pseudoterranova* sp.**

Synonyms: "*Porrocaecum*-type" sp. *auct*.; *Phocanema* sp. *auct*.; "codworm"; "sealworm"

Sites: alimentary tract, body cavity, mesenteries, musculature, viscera

Hosts: *Amblyraja radiata* (15); *Anoplarchus purpurescens* (13); *Anoplopoma fimbria* (4); *Atheresthes stomias* (14); *Gadus macrocephalus* (4); *Gadus morhua* (1, 3, 6, 8, 12, 18); *Gadus macrocephalus* (6); *Glyptocephalus cynoglossus* (6, 11); *Hippoglossoides platessoides* (6, 11); *Hippoglossus hippoglossus* (11); *Leucoraja ocellata* (9); *Limanda ferrugineus* (6, 11); *Lophius americanus* (6); *Melanogrammus aeglefinus* (6); *Microgadus tomcod* (6); *Myoxocephalus octodecemspinosus* (6); *Myoxocephalus polyacanthocephalus* (13); *Oncorhynchus nerka* (5); *Ophiodon elongatus* (4, 13); *Osmerus mordax* (6, 20); *Pleuronectes putnami* (11); *Pseudopleuronectes americanus* (11); *Raja* sp. (10); *Rhamphocottus richardsonii* (13); *Scophthalmus aquosus* (11); *Sebastes flavidus* (21); *Sebastes norvegicus* (6); *Squalus acanthias* (15); *Tautogolabrus adspersus* (17); *Theragra chalcogramma* (13); unspecified "cod" (2, 7, 16); unspecified "fish" (19)

Distribution: Atlantic, British Columbia, Canada, Pacific

Records: 1. Smedley 1934 (AT); 2. Needler 1947 (AT); 3. Heller 1949 (AT); 4. Margolis 1952b (PA); 5. Margolis 1957 (BC); 6. Templeman *et al.* 1957 (AT); 7. Crampton *et al.* 1960 (AT); 8. Fleming 1960 (AT); 9. Myers 1959a (AT); 10. Myers 1960 (AT); 11. Ronald 1963 (AT); 12. Wiles 1968 (AT); 13. Arai 1969 (PA); 14.

Kovalenko 1969 (PA); 15. Threlfall 1969 (AT); 16. Chitwood 1970 (CA); 17. Sekhar S. [*sic*] & Threlfall 1970 (AT); 18. Kates *et al.* 1973 (AT); 19. Redkozubova 1976 (AT); 20. Threlfall 1981 (AT); 21. Stanley *et al.* 1992 (PA)

***Anisakidae gen. sp.**

Sites: body cavity, intestinal lumen, mesenteries, peritoneum
Hosts: *Gadus morhua* (1); *Hippoglossus hippoglossus* (5); *Pollachius virens* (3); *Prosopium williamsoni* (2); *Pseudopleuronectes americanus* (6, 7); *Reinhardtius hippoglossoides* (5); *Salmo salar* (8); *Sebastes fasciatus* (4)
Distribution: Atlantic, British Columbia
Records: 1. Appy & Burt 1982 (AT); 2. Anon. 1984 (BC); 3. Scott 1985 (AT); 4. Scott 1988 (AT); 5. Scott & Bray 1989 (AT); 6. Khan *et al.* 1992 (AT); 7. Barker *et al.* 1994 (AT); 8. Marty 2008 (BC)

***Anisakinae gen. sp.**

Sites: mesenteries, musculature, stomach, viscera
Hosts: *Clupea harengus* (1, 2); *Glyptocephalus cynoglossus* (4); *Hippoglossoides platessoides* (4); *Hippoglossus hippoglossus* (4); *Limanda ferrugineus* (4); *Pleuronectes putnami* (4); *Pseudopleuronectes americanus* (4); *Scophthalmus aquosus* (4); *Sebastes fasciatus* (5); *Sebastes mentella* (5); *Sebastes norvegicus* (3)
Distribution: Atlantic
Records: 1. Sindermann 1957; 2. Sindermann 1961a; 3. Sindermann 1961b; 4. Ronald 1963; 5. Moran *et al.* 1996
Tribe CONTRACAECINEA: genera *Contracaecum* and *Phocascaris*
The species of these two genera are defined by characteristics of the adults. It is difficult therefore to assign larvae to any one species, and impossible to design a key for their reliable identification (Moravec 2013). Feeding experiments to rear larvae to adults and/or the application of molecular markers to aid identification of species may help solve these problems. Brattey (1995) used discriminant function analysis to reveal differences in shape among larvae of *Contracaecum* and *Phocascaris*. He reported that larvae of *Phocascaris* sp. and *C. osculatum* B can generally be distinguished by the use of three measurements (body length, and widths at mid-length and at the base of the intestinal caecum) although larvae of *C. osculatum* A could not be reliably distinguished from the other two species. The following taxa are included as their names have appeared in the relevant Canadian literature.

******Contracaecum osculatum* **(Rudolphi, 1802) Baylis, 1920 (*sensu lato*)**

Includes: **C. osculatum* A *auct*.; **C. osculatum* B *auct*.; and **C. osculatum* C *auct*.
Description (after J. W. Smith & Wootten 1984c, and Moravec 2013). NB: the following description applies also to **Phocascaris* sp. and/or **Contracaecum* sp. (see below). Greenish brown in colour, sometimes tinged with red, L3 about 7 to 30 long, lying coiled in capsules of irregular shape (J. W. Smith & Wootten 1984c). Mouth, lips, boring tooth, and excretory pore similar to those of *Anisakis simplex* L3 (see Fig. 73A,B,C).
According to Moravec (2013), L3 are 3.81–22.00 long, maximum width 0.15–0.53. Oesophagus 0.55–1.71 long, ventricular appendix 0.54–1.58, and intestinal caecum 0.20–0.89. Single excretory cell extends posteriorly to mid-body region. Tail 0.09–0.21 long, narrows rapidly to a point lacking a mucron. Anterior and posterior ends of an L3 shown diagrammatically in Fig. 75A,B.
Sites: intestinal lumen, mesenteries, musculature, viscera
Hosts: *Boreogadus saida* (13); *Gadus macrocephalus* (11); *Gadus morhua* (1, 4, 5, 7, 8, 9, 10, 14, 16); *Glyptocephalus cynoglossus* (1); *Hippoglossoides platessoides* (10); *Hippoglossus hippoglossus* (11); *Mallotus villosus* (10); *Myoxocephalus scorpius* (10); *Oncorhynchus mykiss* (6); *Oncorhynchus tshawytscha* (12); *Pseudopleuronectes americanus* (10); *Theragra chalcogramma* (11); *Urophycis tenuis* (5, 15); unspecified “fish” (2, 3)
Distribution: Atlantic, Nunavut, Pacific
Records: 1. McClelland *et al.* 1985 (AT); 2. Berland *et al.* 1989 (AT); 3. Burt *et al.* 1989a (AT); 4. Brattey *et al.*

1990 (AT); 5. McClelland *et al.* 1990 (AT); 6. J. W. Smith *et al.* 1990 (EX, AT); 7. Likely & Burt 1992 (AT); 8. Marcogliese & Boily 1994 (AT); 9. McClelland & Marcogliese 1994 (AT); 10. Brattey 1995 (AT); 11. Paggi *et al.* 1998 (PA); 12. Urawa *et al.* 1998 (PA); 13. Køie 2009 (NU); 14. Khan *et al.* 2011 (AT); 15. Melendy *et al*. 2005 (AT); 16. McClelland & Melendy 2011 (AT)

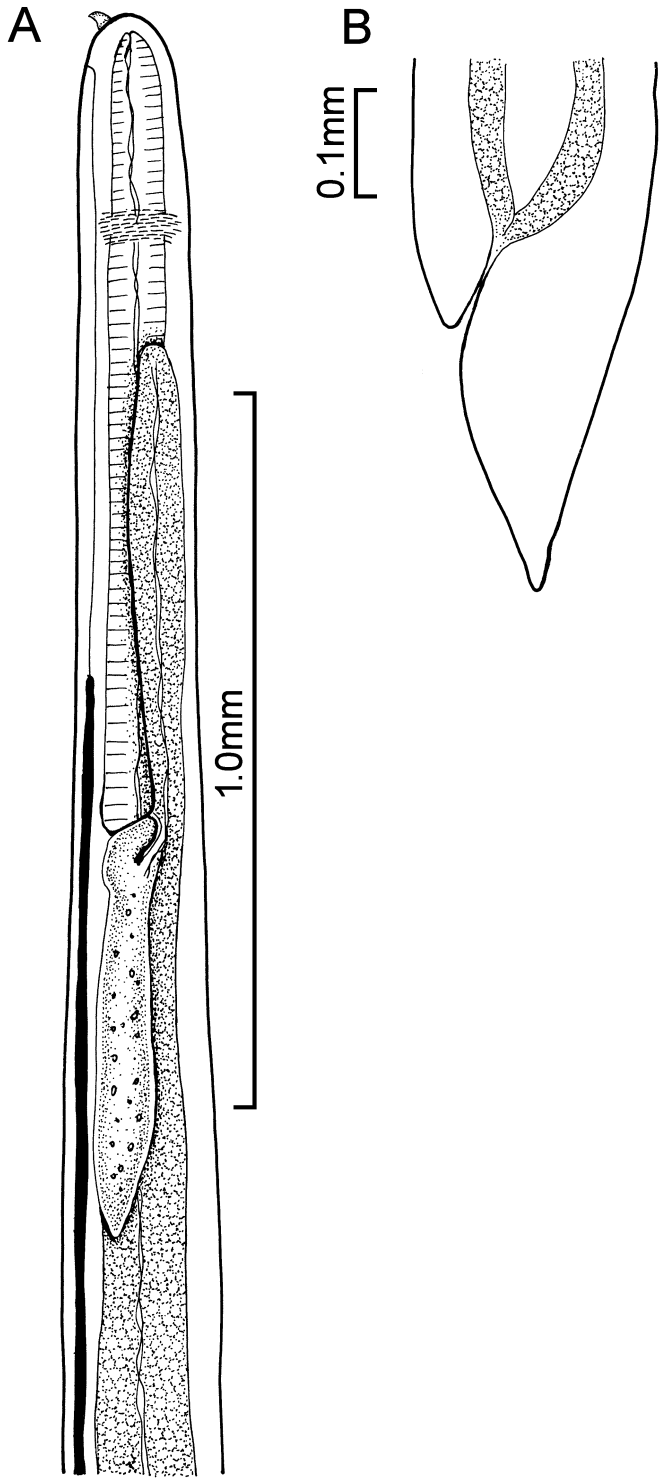

FIGURE 75. **Contracaecum osculatum* (Rudolphi, 1802) Baylis, 1920 (*sensu lato*). A. L3, anterior end, lateral view; B. L3, tail, lateral view. (Redrawn from J. W. Smith & Wootten 1984c)

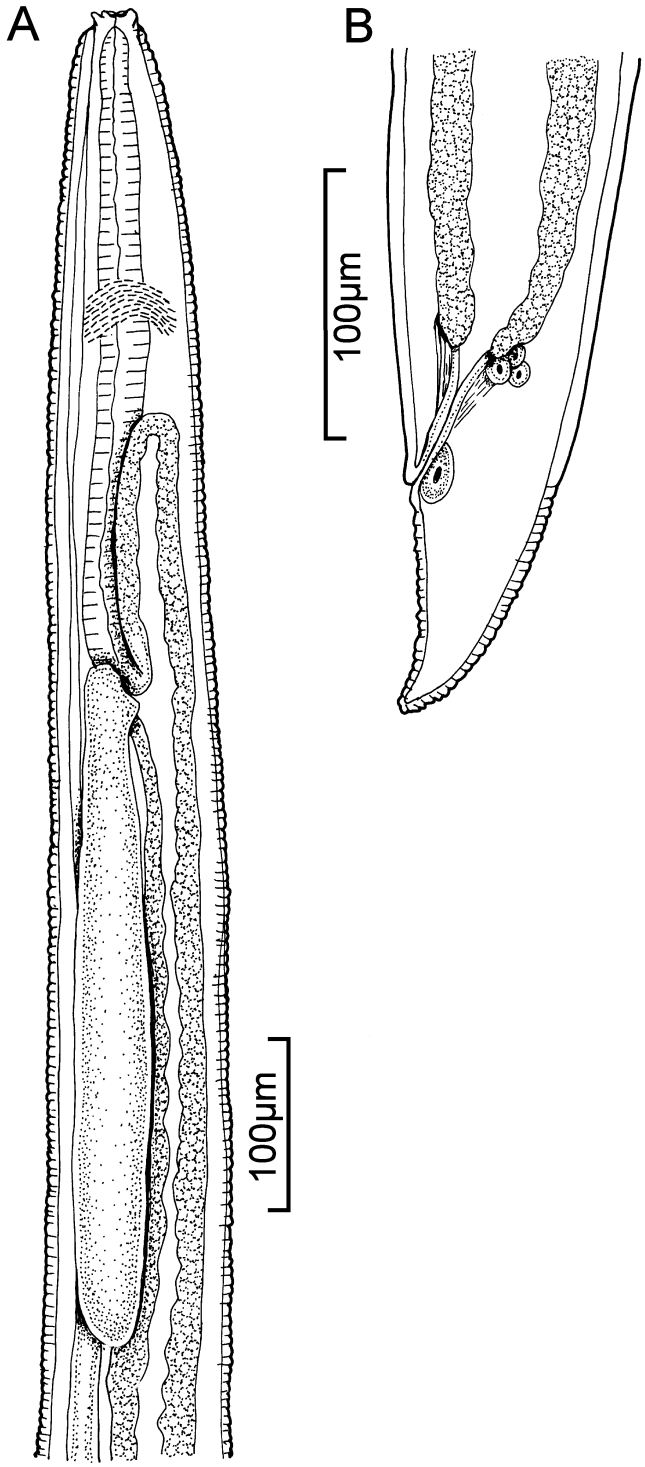

FIGURE 76. **Contracaecum rudolphii* Hartwich, 1964. A. L3, anterior end, lateral view; B. L3, posterior end, lateral view. (Redrawn from Bartlett 1996)

****Contracaecum rudolphii*** **Hartwich, 1964**

Synonym: *Contracaecum spiculigerum auct. nec* Rudolphi, 1809

Description (after Bartlett 1996, and Moravec 2013). Ten 87-day-old L3 from experimentally infected guppies *Poecilia reticulata* were 0.8–2.9 long, and 0.030–0.090 maximum width. Five 152-day-old L3 were 3.1–3.9 (mean 3.5) long, and 0.110–0.120 (0.114) maximum width. Older larvae were 15.0–24.0 long, and 0.9–2.1 wide. Mouth,

lips, boring tooth, and excretory pore similar to those of *Anisakis simplex* L3 (see Fig. 76A,B,C). Nerve ring 0.150–0.200 (0.167) from anterior end. Length of preventriculus 0.370–0.415 (0.391), ventriculus 0.025–0.030 (0.029), ventricular appendix 0.320–0.380 (0.359), intestinal caecum 0.170–0.225 (0.191) [Fig. 76A], and tail 0.085–0.090 (0.088) [Fig. 76B].
Sites: body cavity, intestinal lumen, musculature
Hosts: *Fundulus heteroclitus*; *Poecilia reticulata* (EX)
Distribution: Nova Scotia
Record: Bartlett 1996

**Contracaecum spiculigerum* (Rudolphi, 1809) Railliet & Henry, 1912

Description (after Huizinga 1966). Huizinga's tabulated data indicate that seventeen 18-day-old L3 from experimentally infected mummichog *Fundulus heteroclitus* were 0.202–1.902 (mean 1.263) long, and 0.016–0.071 (0.041) wide at ventriculus; however, the mean length is given as 1.236 in the text. [Older larvae are presumably longer and wider (see *C. rudolphii* above).] Nerve ring 0.059–0.128 (0.105) from anterior end. Length of preventriculus 0.109–0.257 (0.197), ventriculus 0.007–0.037 (0.019), ventricular appendix 0.016–0.287 (0.179), intestinal caecum 0.029–0.095 (0.066) [Fig. 77A], and tail 0.031–0.099 (0.061) [Fig. 77B].
Sites: liver, mesenteries
Hosts: *Morone americana* (4); *Oncorhynchus nerka* (1); *Perca flavescens* (2, 3, 5, 6); *Ptychocheilus oregonensis* (1)
Distribution: Alberta, British Columbia, Ontario
Records: 1. Bangham & Adams 1954 (BC); 2. Tedla 1969 (ON); 3. Tedla & Fernando 1969a (ON); 4. Tedla & Fernando 1969b (ON); 5. Tedla & Fernando 1972 (ON); 6. Zelmer 1994 (AB)

**Contracaecum* sp.

Comments: larvae from fresh-water fishes probably represent either **C. rudolphii* or **C. spiculigerum*, whilst those from marine fishes probably represent **C. osculatum*, or **Contracaecum* and/or **Phocascaris*.
Sites: alimentary tract, body cavity, mesenteries, musculature
Hosts: *Ambloplites rupestris* (4, 52); *Amblyraja radiata* (24); *Ameiurus nebulosus* (30); *Ammodytes hexapterus* (8, 17); *Anguilla rostrata* (26); *Anoplarchus purpurescens* (21); *Apeltes quadracus* (59); *Artedius harringtoni* (17, 21); *Aulorhynchus flavidus* (17); *Blepsias cirrhosus* (17); *Catostomus commersoni* (28, 30, 31, 61, 63); *Chitonotus pugetensis* (21); *Chrosomus eos* (63); *Citharichthys stigmaeus* (2); *Clupea pallasi* (2, 8, 17, 21, 38, 40, 41); *Coregonus clupeaformis* (46, 48); *Coryphaenoides rupestris* (53); *Cottus bairdii* (30); *Culaea inconstans* (54, 55); *Cymatogaster aggregata* (21); *Eopsetta jordani* (7); *Esox lucius* (61); *Etheostoma microperca* (31); *Etheostoma nigrum* (30); *Gadus morhua* (1, 44, 67); *Gasterosteus aculeatus* (17, 25, 59); *Glyptocephalus cynoglossus* (14); *Hexagrammos lagocephalus* (17, 21); *Hippoglossoides elassodon* (7); *Hippoglossoides platessoides* (14); *Hippoglossus hippoglossus* (39); *Hippoglossus stenolepis* (62, 65, 66); *Hydrolagus colliei* (2): *Hypomesus pretiosus* (8); *Icelinus filamentosus* (17, 21); *Jordania zonope* (21); *Lepomis gibbosus* (30); *Leptocottus armatus* (17, 21); *Limanda ferrugineus* (14); *Luxilus cornutus* (31); *Lycodes cortezianus* (17, 21); *Lyopsetta exilis* (7); *Malacocottus kincaidi* (21); *Mallotus villosus* (5, 20, 29, 34); *Melanogrammus aeglefinus* (3); *Merluccius productus* (2); *Micropterus dolomieu* (30, 52, 61); *Micropterus salmoides* (56); *Moxostoma anisurum* (61); *Myoxocephalus octodecemspinosus* (57); *Myoxocephalus polyacanthocephalus* (17, 21); *Notropis atherinoides* (61); *Notropis hudsonius* (30, 61); *Oligocottus maculosus* (17, 21); *Oncorhynchus clarkii* (9); *Oncorhynchus gorbuscha* (10, 11, 16, 21); *Oncorhynchus keta* (17, 19, 21); *Oncorhynchus kisutch* (17, 19, 21); *Oncorhynchus mykiss* (55); *Oncorhynchus nerka* (10, 11, 13, 17, 21); *Oncorhynchus tshawytscha* (17, 19, 21); *Ophiodon elongatus* (2, 17); *Parophrys vetulus* (7); *Perca flavescens* (6, 30, 58, 61); *Percina caprodes* (30); *Pholis laeta* (21); *Pholis ornata* (17); *Pimephales promelas* (48, 54, 55); *Platichthys stellatus* (17, 21); *Pleuronectes putnami* (14); *Podothecus accipenserinus* (17); *Pseudopleuronectes americanus* (1, 14); *Pungitius pungitius* (54, 55, 59); *Reinhardtius hippoglossoides* (39, 64); *Rhinichthys atratulus* (31); *Rhinogobiopsis nicholsii* (21); *Salmo salar* (18, 23, 42); *Salvelinus alpinus* (32, 43, 51); *Salvelinus fontinalis* (32, 63); *Salvelinus malma* (9, 17, 21); *Sander vitreus* (6); *Scomber* sp. (2); *Scophthalmus aquosus* (14); *Sebastes aleutianus* (37); *Sebastes alutus* (33, 37); *Sebastes*

babcocki (37); *Sebastes borealis* (37); *Sebastes brevispinis* (37); *Sebastes caurinus* (21, 37); *Sebastes ciliatus* (37); *Sebastes crameri* (37); *Sebastes diploproa* (37); *Sebastes elongatus* (37); *Sebastes entomelas* (37); *Sebastes fasciatus* (50); *Sebastes flavidus* (37, 60); *Sebastes goodei* (37); *Sebastes helvomaculatus* (37); *Sebastes maliger* (37); *Sebastes mentella* (12, 50); *Sebastes nebulosus* (37); *Sebastes nigrocinctus* (37); *Sebastes norvegicus* (12, 50); *Sebastes paucispinis* (37); *Sebastes pinniger* (37); *Sebastes polyspinis* (37); *Sebastes proriger* (37); *Sebastes reedi* (37); *Sebastes ruberrimus* (37); *Sebastes variegatus* (37); *Sebastes wilsoni* (37); *Sebastes zacentrus* (37); *Sebastes* sp. (2); *Squalus acanthias* (2, 24); *Synaphobranchus kaupii* (53); *Syngnathus leptorhynchus* (17, 21); *Tautogolabrus adspersus* (27); *Thaleichthys pacificus* (17, 21); *Theragra chalcogramma* (17, 21, 45, 47, 49); *Triglops pingelii* (17, 21); unspecified "fish" (35); unspecified "herring" (36); *Zoarces americanus* (1).

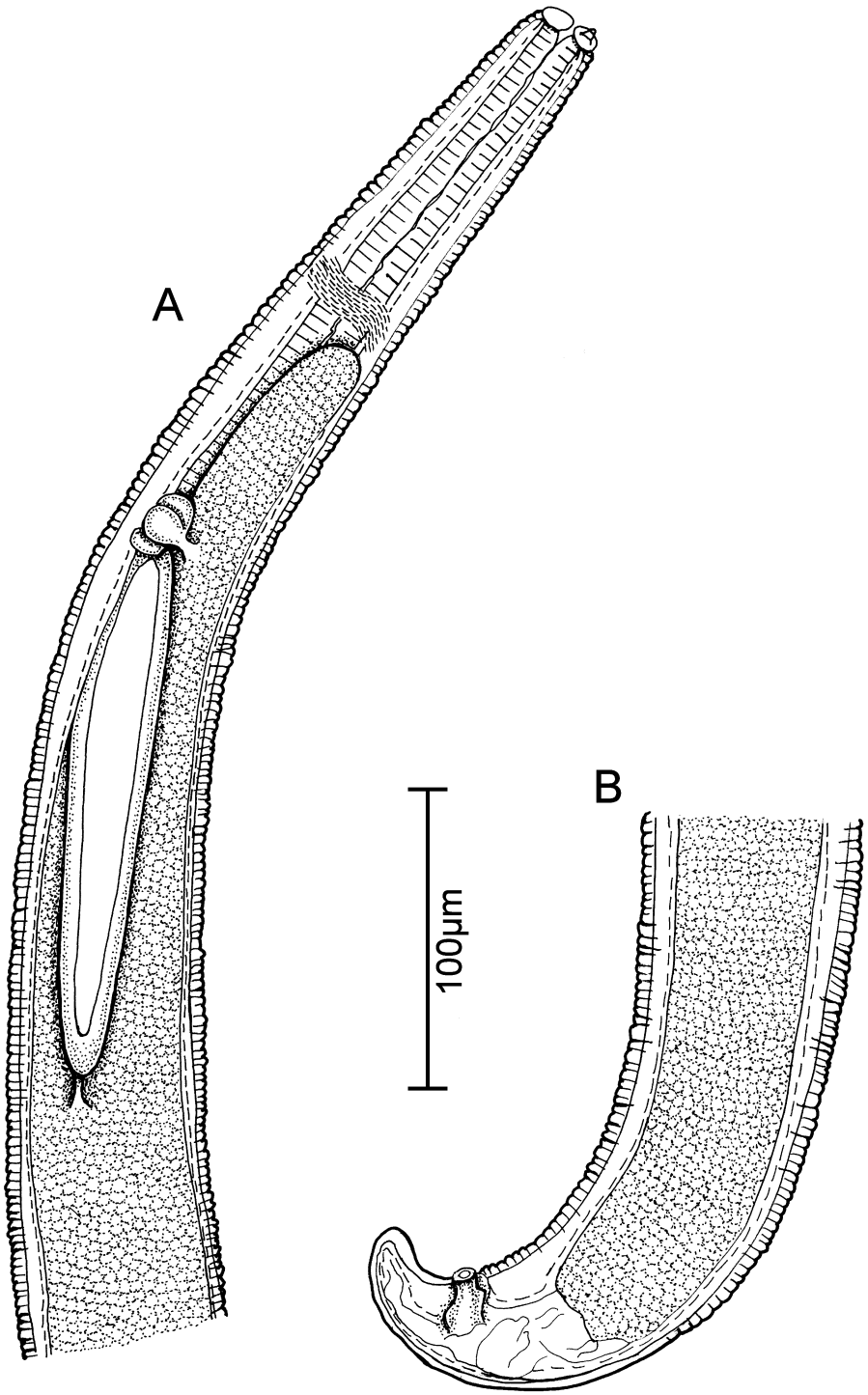

FIGURE 77. **Contracaecum spiculigerum* (Rudolphi, 1809) Railliet & Henry, 1912. A. L3, anterior end, lateral view; B. L3, posterior end, lateral view. (Redrawn from Huizinga 1966).

Distribution: Alberta, Atlantic, British Columbia, Labrador, Manitoba, New Brunswick, Newfoundland, Nova Scotia, NorthwestTerritories, Ontario, Prince Edward Island, Quebec, Saskatchewan

Records: 1. Clemens & Clemens 1921 (AT); 2. Smedley 1934 (PA); 3. Kuitunen-Ekbaum 1937b (AT); 4. Bangham & Hunter 1939 (ON); 5. Templeman 1948 (AT); 6. Worley & Bangham 1952 (QC); 7. Margolis 1952a (PA); 8. Margolis 1952b (PA); 9. Bangham & Adams 1954 (BC); 10. Margolis 1956 (PA); 11. Margolis 1957 (BC, PAQ); 12. Yanulov 1962 (AT); 13. Margolis 1963 (BC, PA): 14. Ronald 1963 (AT); 15. Wood 1965 (BC); 16. Boyce 1966 (PA); 17. Arai 1967a (PA); 18. Pippy 1967 (PE); 19. Godfrey 1968 (PA); 20. Templeman 1968 (NF); 21. Arai 1969 (PA); 22. Boyce 1969 (PA); 23. Pippy 1969 (AT); 24. Threlfall 1969 (AT); 25. Hanek & Threlfall 1970a (LB, NL); 26. Hanek & Threlfall 1970b (LB, NL); 27. Sekhar S.[*sic*] & Threlfall 1970 (AT); 28. Threlfall & Hanek 1970a (AT); 29. Winters 1970 (AT); 30. Dechtiar 1972a (ON); 31. Kakonge 1972 (ON); 32. Hicks & Threlfall 1973 (LB); 33. Sekerak & Arai 1973 (PA); 34. Winters & Campbell 1974 (AT); 35. Redkozubova 1976 (AT); 36. Zenkin & Umnova 1976 (AT); 37. Sekerak & Arai 1977 (PA); 38. Arthur 1978 (PA); 39. Redkozubova 1978 (AT); 40. Arthur & Arai 1980a (PA); 41. Arthur & Arai 1980b (PA); 42. Pippy 1980 (AT); 43. Dick & Belosevic 1981 (NT): 44. Appy & Burt 1982 (AT); 45. Arthur *et al.* 1982 (PA); 46. Drouin 1982 (AB); 47. Arthur 1983 (PA); 48. McAllister & Mudry 1983 (AB); 49. Arthur 1984 (PA); 50. Bourgeois & Ni 1984 (AT); 51. Dick 1984 (NT); 52. Anthony 1985 (ON); 53. Houston & Haedrich 1986 (AT); 54. Dick 1987 (MB; 55. Dick *et al.* 1987 (MB); 56. Szalai & Dick 1990 (SK); 57. Khan 1991 (AT); 58. Szalai & Dick 1991 (MB); 59. Marcogliese 1992b (NS); 60. Stanley *et al.* 1992 (PA); 61. Szalai *et al.* 1992a (MB); 62. Blaycock 1996 (PA); 63. Dubois *et al.* 1996 (QC); 64. Boje *et al.* 1997 (AT); 65. Blaycock *et al.* 1998a (PA); 66. Blaycock *et al.* 1998b (PA); 67. Lee & Khan 2000 (AT)

****Contracaecum*** **sp. and/or** ****Phocascaris*** **sp.**

Description: see that for **Contracaecum osculatum* above.

Sites: alimentary tract , body cavity, mesenteries

Hosts: *Cyclopterus lumpus* (7); *Gadus morhua* (2, 3, 4); *Gadus macrocephalus* (7); *Glyptocephalus cynoglossus* (7); *Hippoglossoides platessoides* (2); *Limanda ferrugineus* (7); *Mallotus villosus* (5, 6, 7); *Melanogrammus aeglefinus* (7); *Myoxocephalus octodecemspinosus* (7); *Myoxocephalus scorpius* (7); *Nezumia bairdii* (7); *Pseudopleuronectes americanus* (7); *Raja* spp. (7); *Reinhardtius hippoglossoides* (7); *Theragra chalcogramma* (1); *Urophycis tenuis* (7)

Distribution: Atlantic, Pacific

Records: 1. Berland 1981 (PA); 2. McClelland *et al.* 1983 (AT); 3. McClelland *et al.* 1983b (AT); 4. McClelland *et al.* 1984 (AT); 5. Pálsson & Beverley-Burton 1984 (AT); 6. Pálsson 1986 (AT); 7. Marcogliese 1995a (AT)

****Phocascaris*** **sp.**

Description: see that for **Contracaecum osculatum* above.

Sites: alimentary tract, musculature, viscera

Hosts: *Gadus morhua* (3, 4, 5); *Hippoglossoides platessoides* (4); *Mallotus villosus* (4); *Myoxocephalus scorpius* (4); *Pseudopleuronectes americanus* (4); *Reinhardtius hippoglossoides* (2); *Tautogolabrus adspersus* (1)

Distribution: Atlantic

Records: 1. Sekhar S. [*sic*] & Threlfall 1970 ; 2. Reimer 1981; 3. Marcogliese & Boily 1994; 4. Brattey 1995; 5. Lee & Khan 2000

Contracaecinea gen. sp.

Sites: body cavity, intestinal lumen, mesenteries, musculature, stomach

Hosts: *Gadus morhua* (5); *Fundulus heteroclitus* (6); *Hippoglossoides platessoides* (5); *Mallotus villosus* (4); *Pungitius pungitius* (6); *Reinhardtius platessoides* (1, 2, 3); *Salvelinus alpinus* (8); *Sebastes fasciatus* (7); *Sebastes mentella* (7, 9)

Distribution: Atlantic, Nova Scotia, Quebec

Records: 1. Arthur & Albert 1992b (AT); 2. Arthur & Albert 1993 (AT); 3. Arthur & Albert 1994 (AT); 4. Arthur *et al.* 1995 (AT); 5. Boily & Marcogliese 1995 (AT); 6. Marcogliese 1995b (NS); 7. Moran *et al.* 1996 (AT); 8. Desdevises *et al.* 1998 (QC); 9. Marcogliese *et al.* 2003 (AT)

Subfamily RAPHIDASCARIDINAE Hartwich, 1954

Of the four tribes of this Subfamily recognised by Hartwich (1975) only one, the Raphidascaridinea, represented by two genera, namely, *Hysterothylacium* and *Raphidascaris*, is known from various fish species in Canada.

Key to genera of the Tribe RAPHIDASCARIDINEA Chabaud, 1965

1 Intestinal caecum absent; ventricular appendix present; interlabia absent; lips usually not longer than wide; parasitic in teleost fishes . . . . . *Raphidascaris*

- Intestinal caecum present; ventricular appendix present; interlabia present; lips large, with anterior region forming distally broadened process internally supported by pair of longitudinal thickenings; parasitic in teleost fishes . . . . . *Hysterothylacium*

Hysterothylacium Ward and Magath, 1917

Synonyms: *Thynnascaris* Dollfus, 1933; *Contracaecum* (*Thynnascaris*) Dollfus 1935; *Contracaecum* (*Erschovicaecum*) Mozgovoi, 1951; *Contracaecum* (*Simplexonema*) Kreis, 1952 *nom. nud.*; *Iheringascaris* Pereira, 1935; *Contracaecum* (*Acollaris*) Araujo, 1970

Generic diagnosis (after Deardorff & Overstreet 1981). Raphidascaridinae. Body elongate, reaching greatest width near midbody. Cuticle with annulations moderately or weakly defined or lacking (presumably unreported). Cuticular alae distinct or indistinct. Lips approximately equal in size, usually wider than long, bearing transparent cuticular flanges on lateral margins: flanges with or without indentations; internal pulp usually pedunculated; dorsal lip with two lateral doubled papillae; subventral lips with amphid, adjacent mediolateral doubled papilla, and single lateral papilla. Dentigerous ridges absent. Interlabia present. Interlabial grooves present or absent. Ventriculus almost spherical; ventricular appendix sac-like or cylindrical, with septum dividing structure into two equal longitudinal pouches; intestinal caecum usually shorter than ventricular appendix. Excretory system with excretory pore at or near nerve ring level, with duct extending to at least left lateral cord. Rectal glands present or absent (presumably unreported). Spicules similar, alate, equal or slightly unequal in length. Gubernaculum absent. Vulva anterior to midbody. Uterus didelphic, opisthodelphic. Tail conical, tip with or without spines. Medioventral pre-cloacal organ usually distinct on pre-cloacal fold. Phasmids usually distinct. Parasites of marine, estuarine and fresh-water fishes.

Comments: Gopar-Merino *et al*. (2005) claimed that 61 species of *Hysterothylacium* have been recognized; however, there are more than 61species if "morphospecies", "sibling species" and "cryptic species" are taken into account. According to Rye & Baker (1992) most *Hysterothylacium* species occur in the alimentary tract of marine fishes rather than fresh-water ones. In common with some other aquatic ascaridoids, species of *Hysterothylacium* have evolved remarkable flexibility in completing the life-cycle. For example, Luque *et al*. (2007) reported L4 of *Hysterothylacium* sp. in the haemocoel of amphipods, *Paracorophium excavatum*, from New Zealand waters. Furthermore, several of the adult males showed precocious sexual development, having undergone the 3rd and 4th (final) moults in the amphipod host. Moreover, *H. haze* also departs from the life-cycle known for many other species. Yoshinaga *et al.* (1989) studied natural and experimental infections of *H. haze* in gobies *Acanthogobius flavimanus* from Tokyo Bay, concluding that the life-cycle may be direct and involve invertebrates as paratenic hosts; this life-cycle might represent an example of extreme precocity in which the fish intermediate host has also become a final host (Anderson 1998).

Like *Contracaecum* and *Phocascaris* (see above) the genus *Hysterothylacium* is defined by characteristics of the adults, and agreeing again with Moravec (2013) it is difficult to assign larvae to any one species. It is not

possible to design a key for their reliable identification, and the following keys are for the identification of the adults only. Feeding experiments to rear larvae to adults and the application of molecular markers to identify species may be solutions to this and similar problems. Several taxa are considered and, where possible, described, their names having appeared in the relevant Canadian literature. Only two *Hysterothylacium* species (***H. analarum* and ***H. brachyurum*) are known from Canadian fresh-water fishes. While four species (***H. aduncum, H. corrugatum, H. incurvum* and *H. reliquens*) have been reported from Canadian marine fishes, only ***H. aduncum* is abundant, having been recorded from a wide variety of fish species. In contrast, there is only one report, that of Hogans *et al.* (1983), for each of the other three *Hysterothylacium* species. All of the specimens were recovered from the stomachs of swordfish, *Xiphias gladius*, collected from the "northwest Atlantic Ocean". The coordinates for the collection site(s) are not given but it may be assumed that these were within Canadian waters, so the descriptions are given below. Swordfish are oceanic travellers that enter Canadian waters usually about June and leave in October and November. They move through a great range of depths, feeding on various fish species and shortfin squid, *Illex illecebrosus* (Scott and Scott 1988). It is possible, therefore, that infections with the three species of *Hysterothylacium* were acquired by swordfish at locations remote from Canadian waters. It is worth noting that Hogans *et al.* (1983) deposited representative specimens of each nematode species (and of the other helminths collected) at a public museum and provided catalogue numbers; details may be found in the original paper. While two other species of *Hysterothylacium*, *H. magnum* and *H. melanogrammi*, have been recorded from Canadian marine fishes the species are of doubtful validity, as discussed below.

Key to species of *Hysterothylacium* from Canadian fresh-water fishes

1 Broad lateral alae present; tail tip with few sharply pointed spines . . . . . .***H. brachyurum***
\- Lateral alae absent; tail tip with numerous blunt spines . . . . . .***H. analarum***

***Hysterothylacium analarum* Rye & Baker, 1984**

Description (after Rye & Baker 1984, 1992). With characteristics of the genus. Body cuticle with narrow transverse striations and wide, irregularly spaced transverse folds. Lateral alae absent. Narrow caudal alae present. Cephalic lips equal in length and width. Dorsal lip with two double papillae, subventral lips each with one double papilla, one single papilla and one amphid. Interlabia prominent (Fig. 78A). Intestinal caecum and ventricular appendix present. Excretory pore at level of nerve ring (Fig. 78B). Tail tip of both sexes covered with numerous blunt spines (Fig. 78D).

Males: 18.1 (13.5–19.1) long. Intestinal caecum 1.19 (0.54–2.30) and ventricular appendix 0.300 (0.225–0.325) long. Excretory pore 0.390 (0.325–0.475) and nerve ring 0.390 (0.325–0.440) from anterior end (Fig. 78B). Tail conical 0.240 (0.160–0.190) long. Posterior half of tail with four pairs of papillae: two pairs lateral and two pairs subventral (one or more may be missing). Anterior half of tail with three pairs of subventral papillae. Anterior lip of anus with one unpaired papilla. Pre-cloacal region with 18 (13 to 21) pairs of subventral caudal papillae extending anteriorly. Pre-cloacal subventral region with numerous caudal muscles. Spicules equal, 0.580 (0.450–0.625) long, alate, rounded distally, with blunt capitulum (Fig. 78C). Gubernaculum absent.

Females: 22.05 (19.82–25.55) long. Preventriculus 2.1 (2.45–3.87) long. Intestinal caecum 1.11 (1.55–1.93) and ventricular appendix 0.375 (0.350–0.480) long. Excretory pore 0.390 (0.345–0.410), nerve ring 0.390 (0.345–0.460) and vulva 7.10 (6.96–8.80) from anterior end. Eggs oval, 0.080 in diameter, thin walled, embryos at 1- or 2-cell stage. Tail conical, 0.370 (0.380–0.440) long. One pair post-cloacal lateral papillae present.

L4: 3.367–5.863 long (male); 3.582–5.755 (female). Mouth opening triangular. Lips well developed. Dorsal lip with two double papillae, subventral lips each with one double papilla, one single papilla, and an amphid. Each lip with two single inner papillae. Interlabia triangular, apically pointed, height about one-third at base, similar to those of adult. Narrow lateral alae extending length of body. Vulva at middle of body, nonpatent. Posterior end of tail with numerous blunt projections.

L3: 1.355–4.172 long. Lips absent. Mouth opening triangular, boring tooth absent. Two subdorsal and two subventral double papillae and two single sublateral papillae present. Lateral alae extend length of body. Genital primordium in early 3rd stage similar to that of 2nd-stage larvae. In late 3rd-stage larvae genital primordium Y-shaped

with undifferentiated vagina in females and an elongate column of cells in males. Tail conical with six to eight blunt projections.

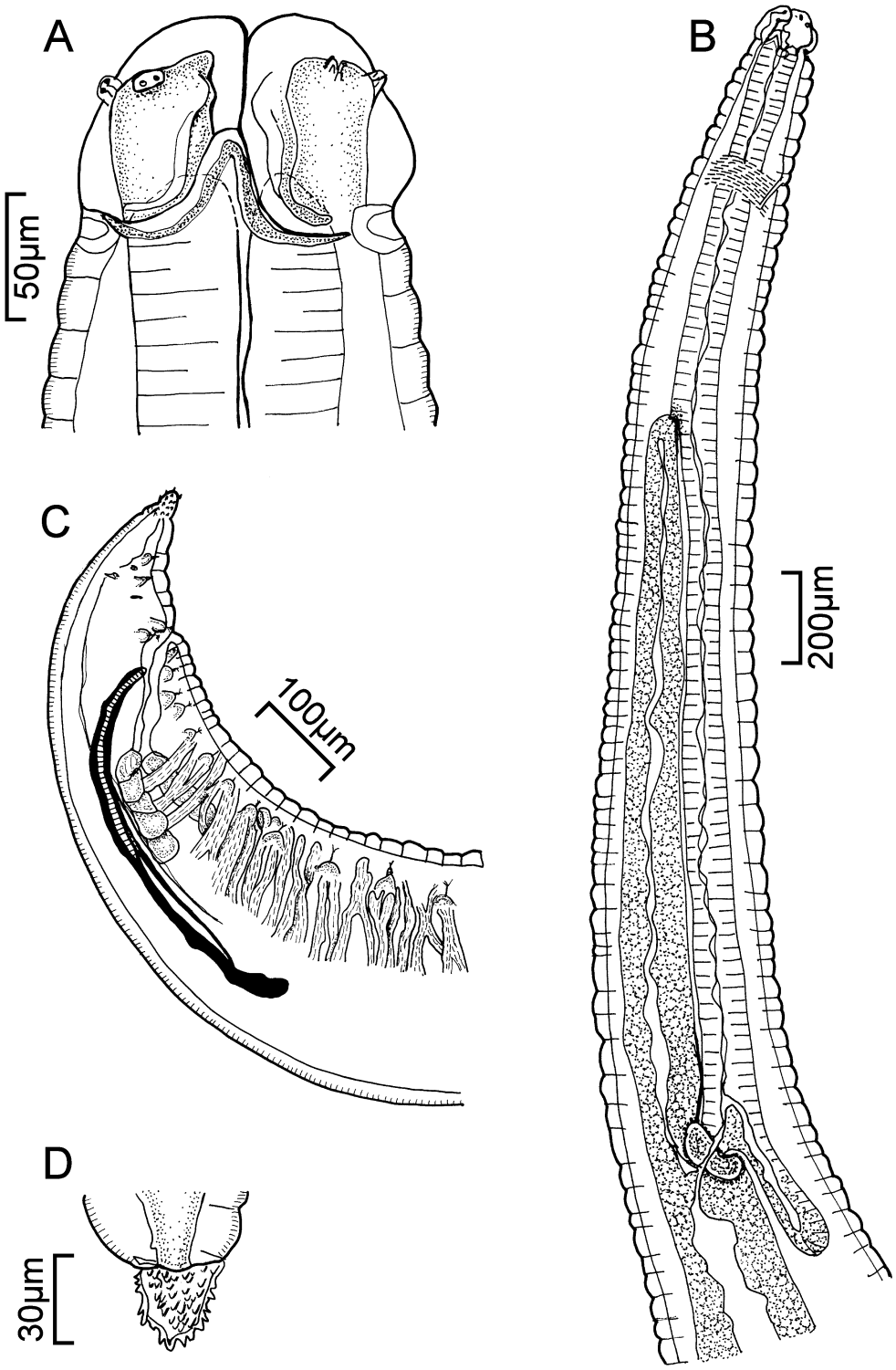

FIGURE 78. ***Hysterothylacium analarum* Rye & Baker, 1984. A. head, dorso-lateral view; B. anterior end, lateral view; C. male, posterior end, lateral view, D. male, tail tip, lateral view. (Redrawn from Rye & Baker 1984)

L2: 0.190–0.249 long (freshly hatched); 0.312–0.587 (recovered from various sites in fishes). Mouth opening triangular, lips absent. Head end with large ventral boring tooth. Two subdorsal and two subventral cephalic papillae present. Lateral alae extend length of body. Genital primordium oval, comprising four to eight cells. Tail conical with six to eight spiny protuberances.

Sites: intestinal lumen, mesenteries, serosal nodules
Host: *Lepomis gibbosus*
Distribution: Ontario
Records: Rye & Baker 1984; Rye & Baker 1987; Rye & Baker 1992

***Hysterothylacium brachyurum* Ward & Magath, 1917

Synonyms: *Contracaecum brachyurum* (Ward & Magath, 1917) Van Cleave & Mueller, 1934; *Thynnascaris brachyura* (Ward & Magath, 1917) Margolis & Arthur, 1979

Description (after Van Cleave & Mueller 1934, and Rye & Baker 1984). With characteristics of the genus. Lips large and prominent with well developed interlabia. Lateral alae arise from the interlabia between the subventral and dorsal lips and extend posteriorly to about the level of the posterior end of the preventriculus. A pair of minute, blind-ending deirids are located within the alae at nerve ring level. Nerve ring about 0.5 behind anterior end (Fig. 79A). Preventriculus 6.0–7.0 long, with "a clearly defined ventriculus". Intestinal caecum 5.6 long, ventricular appendix relatively short, about 1.0 long. Tail tip of both sexes with few relatively large spines, sharply pointed (Fig. 79B).

Males: about 60 long and 0.9 wide. Spicules equal, about 0.84 long. Arrangement of male caudal papillae not clear.

Females: about 80 to 90 long and 1.0 wide. Vulva "some distance" anterior to middle of body. Eggs *in utero* 0.060 x 0.050.

Comments: *Hysterothylacium brachyurum* should be redescribed, especially as it is the type species of the genus. Moreover, an account of the life-history of *H. brachyurum*—like that provided by Rye & Baker (1992) for *H. analarum*—does not appear to be available. In view of the possibility that larvae of *H. brachyurum* occur in the organs and tissues of Canadian fishes the taxon is adorned with a double asterisk. *H. brachyurum* has been reported frequently from a variety of fresh-water hosts throughout North America but, as Rye & Baker (1984) pointed out, in most surveys no voucher specimens were deposited in permanent collections so identifications cannot be confirmed; there is evidence that *H. brachyurum* has been confused in the past with *H. analarum* and *Raphidascaris acus* (Rye & Baker 1984).

Sites: intestinal lumen, liver, mesenteries, pyloric caeca

Hosts: *Ambloplites rupestris* (4, 7, 8, 18, 19); *Anguilla rostrata* (3); *Coregonus artedi* (10, 14); *Culaea inconstans* (22); *Esox lucius* (4, 5, 7, 8, 10, 15, 16, 18, 19, 20, 21); *Esox masquinongy* (4, 7, 8, 18); *Etheostoma exile* (4, 7); *Lepomis gibbosus* (2, 18); *Lota lota* (3, 6, 8, 9, 11, 17, 19, 21); *Micropterus dolomieu* (2, 4, 7, 18, 20, 21); *Micropterus salmoides* (1, 2, 4, 7); *Moxostoma anisurum* (8); *Notemigonus crysoleucas* (4, 7); *Notropis atherinoides* (4, 8); *Noturus flavus* (21); *Perca flavescens* (12, 18, 19, 20, 22); *Percopsis omiscomaycus* (4, 7, 8, 21); *Salvelinus fontinalis* (3, 19, 22); *Salvelinus fontinalis* x *Salvelinus namaycush* (9, 13, 21, 22); *Salvelinus malma* (9, 11, 17); *Salvelinus namaycush* (9); *Sander canadensis* (8); *Sander vitreus* (4, 7, 8, 12, 18, 21)

Distribution: Alberta, British Columbia, Manitoba, Ontario, Quebec

Records: Bangham & Hunter 1939 (ON); 2. Bangham 1941 (ON); 3. Bangham &Venard 1946 (ON); 4. Bangham 1951 (ON); 5. Worley & Bangham 1952 (QC); 6. Bangham & Adams 1954 (BC); 7. Bangham 1955 (ON); 8. Dechtiar 1972a (ON); 9. Mudry & Anderson 1977 (AB); 10. Watson 1977 (MB); 11. Anon. 1978 (BC); 12. Anthony 1978b (ON); 13. Dechtiar & Berst 1978 (ON); 14. Watson & Dick 1979 (MB); 15. Watson & Dick 1980 (MB); 16. Anthony 1983 (ON); 17. Arai & Mudry 1983 (BC); 18. Dechtiar & Christie 1988 (ON); 19. Dechtiar & Lawrie 1988 (ON); 20. Dechtiar & Nepszy 1988 (ON); 21. Dechtiar *et al.* 1988 (ON); 22. Dechtiar *et al.* 1989 (ON)

Key to species of *Hysterothylacium* from marine fishes

1 Deep interlabial grooves present; spicules 2.6–8.7 long, ratio 1: 0.9–1.0; cuticle with enlarged and modified annules on ventral surface of males near cloaca; tail tip usually lacking spines . . . . . *H. incurvum*
- Interlabial grooves absent 2

2	Tail tip lacking spines; spicules 1.2–2.6 long, ratio about equal	*H. corrugatum*
-	Tail tip with spines	3
3	Tail tip multispinous; spicules 1.7–2.4 long, ratio variable	*H. reliquens*
-	Tail tip with few spines; spicules 2.0–4.65, ratio equal	*H. aduncum*

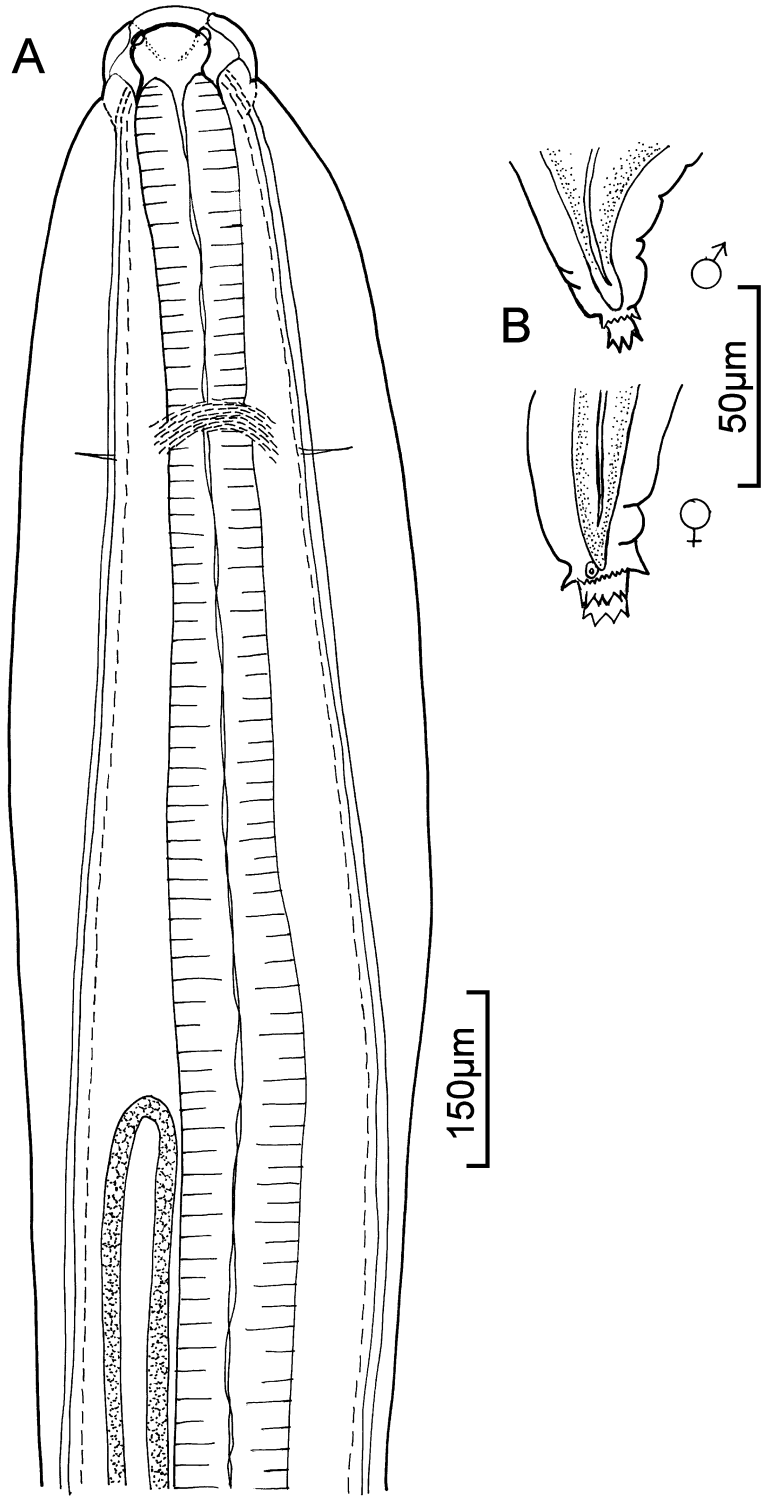

FIGURE 79. ***Hysterothylacium brachyurum* Ward & Magath, 1917. A. male, anterior end, dorso-ventral view; B. male and female tail tips. (Redrawn from Rye & Baker 1984)

***Hysterothylacium aduncum* (Rudolphi, 1802) Deardorff & Overstreet, 1981

Synonyms: *Thynnascaris adunca* (Rudolphi, 1802) Hartwich, 1957; *Contracaecum aduncum* (Rudolphi, 1802) Baylis, 1920; *Contracaecum gadi* (O. F. Müller, 1777) Johnston & Mawson, 1945; *Contracaecum clavatum* (Rudolphi, 1809) Baylis, 1920

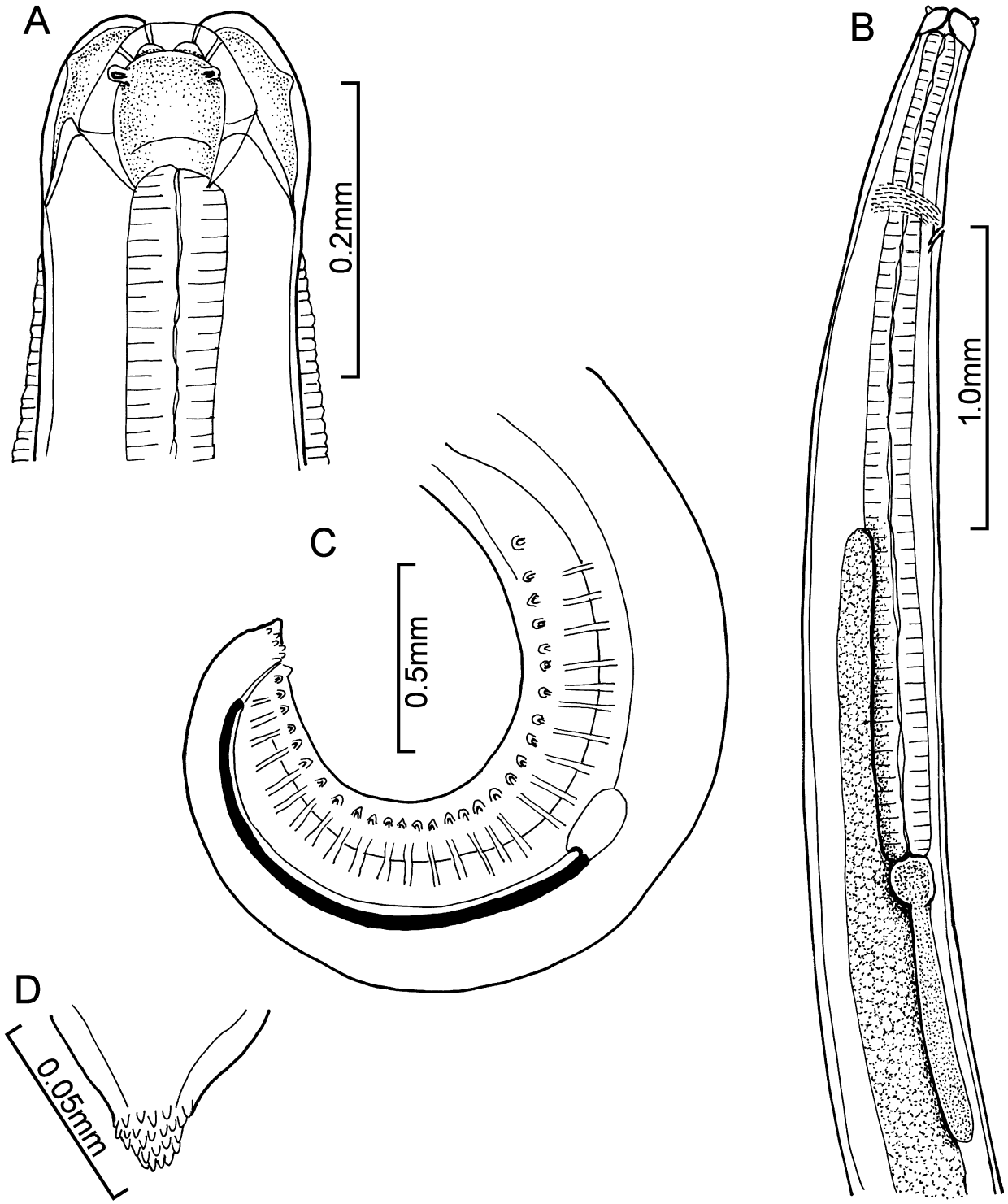

FIGURE 80. ***Hysterothylacium aduncum* (Rudolphi, 1802) Deardorff & Overstreet, 1981. A. male, head; B. female, anterior end; C. male, posterior end; D. male, tail tip showing spiny process. (Redrawn from Moravec 2013)

Description (after Moravec 2013). With characteristics of the genus. Females larger than males. Lips of approximately equal size, with wide membranous flanges broadest near their base; dorsal lip with two subdorsal papillae; each subventral lip with one double subventral papilla and small simple papilla and amphid situated laterally; pulp of lips with at either side small rounded lobe at its anterior margin. Interlabia triangular, broad, with distinct cuticular margin. Interlabial grooves absent. Cervical alae starting short distance below level of base of subventral lips, gradually becoming wider (maximum width 0.04–0.05) and extending posteriorly to posterior limit of preventriculus. Preventriculus narrow, small ventriculus globular; ventricular appendix narrow, about as long as intestinal caecum; intestinal caecum represents about 30–40% of preventricular length. Nerve ring encircling preventriculus at border of first and second fifths of its length; excretory pore just below nerve ring level. Intestine dark, straight. Rectum short, hyaline, surrounded by three unicellular rectal glands. Tail of both sexes conical, ending in small process covered with fine spines.

Males: 18.0–35.0 long, maximum width 0.430–0.800. Dorsal lip 0.151–0.153 long, 0.144 wide; ventro-lateral lips 0.138–0.150 long, 0.131–0.138 wide (Fig. 80A). Preventriculus 1.94–3.23 long, ventriculus 0.154–0.170 x 0.124–0.144, ventricular appendix 0.54–0.64 long, and intestinal caecum 0.65–0.93 long. Nerve ring and deirids 0.530–0.540 and 0.590–0.600 from anterior end. Tail conical, 0.108–0.139 long, ending in small process covered with fine spines (Fig. 80D). Twenty three pairs pre-cloacal papillae, two pairs ad-cloacal papillae, and four to five pairs post-cloacal papillae—last pair lateral, remaining pairs subventral. Anterior cloacal lip with one unpaired papilla. Spicules equal, 2.00–4.65 long, with narrow membranous wings; distal tip of spicules rounded (Fig. 80C).

Females: 24.0–48.0 long, maximum width 0.72–1.40. Dorsal lip 0.143–0.155 long, 0.149–0.181 wide; ventro-lateral lips 0.153 long, 0.159–0.163 wide. Preventriculus 2.25–4.12 long, ventriculus 0.171–0.180 x 0.155–0.165, ventricular appendix 0.62–0.69 long, and intestinal caecum 0.91–1.08 long. Nerve ring and deirids 0.66–0.90 and 1.08 from anterior end (Fig. 80B). Tail conical 0.270–0.420 long, ending in small process covered with fine spines. Vulva at end of first third of body length, 9.0–16.5 from anterior end. Vagina narrow, long, directed posteriorly and dividing into two posteriorly directed uterine branches filled with eggs; ovaries situated in posterior part of body. Eggs almost spherical, 0.062–0.070 x 0.046–0.047.

L4: 12.0–31.0 long, maximum width 0.22–0.47. Mouth surrounded by three lips comparatively narrow, lacking the large flanges of adults. Preventriculus 1.85–3.85 long, ventricular appendix 0.61–0.98, intestinal caecum 0.65–1.23. Nerve ring and excretory pore 0.34–0.61 and 0.42–0.66 from anterior end. Tail conical, 0.11–0.29 long, tail tip covered with numerous minute projections.

L3: 6.6–21.6 long, maximum width 0.16–0.33. Mouth opening usually T-shaped, two basal projections of ventral boring tooth extending along its margin. No distinct lips present. Two subventral and two subdorsal papillae at anterior end as well as one dorsal antero-median papilla. Cuticle transversely striated. Preventriculus 1.00–2.00 long, ventriculus small. Ventricular appendix 0.40–0.68 long, intestinal caecum 0.33–0.92 long. Nerve ring and excretory pore 0.28–0.45 and 0.31–0.50 from anterior end. Tail conical, 0.12–0.21 long, with pointed tip.

Comments: *Hysterothylacium aduncum* appears to be the most abundant species of the genus known from marine fishes in Canadian waters. According to Klimpel & Ruckert (2005) it is also the most abundant anisakid nematode of North Sea fishes. *Hysterothylacium aduncum* may be carried into Canadian fresh waters by anadromous or catadromous fishes but is not able to reproduce there.

Sites: alimentary tract, body cavity, intestinal lumen, mesenteries, musculature, stomach, stomach wall, viscera

Hosts: *Alosa pseudoharengus* (13); *Alosa sapidissima* (28, 58); *Ammodytes dubius* (10); *Anarhichas lupus* (47); *Atheresthes stomias* (36, 66); *Aulorhynchus flavidus* (5); *Clupea harengus* (38, 40, 44); *Clupea pallasi* (16, 17, 18, 19); *Coryphaenoides rupestris* (11, 12, 23, 24, 43); *Cryptacanthodes giganteus* (3); *Eopsetta jordani* (2, 3); *Gadus macrocephalus* (3); *Gadus morhua* (1, 13, 14, 25, 29, 53, 68, 72, 73); *Glyptocephalus cynoglossus* (4, 21, 29); *Glyptocephalus zachirus* (2, 3); *Hippoglossoides elassodon* (2, 3); *Hippoglossoides platessoides* (4, 21, 29, 42, 61); *Hippoglossus hippoglossus* (4, 21); *Hippoglossus stenolepis* (62, 65); *Hypomesus pretiosus* (3); *Limanda ferrugineus* (4, 61); *Macrourus berglax* (23); *Mallotus villosus* (46, 60); *Melanogrammus aeglefinus* (13, 14, 22); *Merluccius albidus* (50); *Merluccius bilinearis* (50); *Merluccius productus* (30); *Microgadus tomcod* (1); *Microstomus pacificus* (36); *Myoxocephalus scorpius* (1); *Nezumia bairdii* (23); *Oncorhynchus gorbuscha* (27, 32); *Oncorhynchus keta* (32, 41); *Oncorhynchus kisutch* (3, 32); *Oncorhynchus mykiss* (37); *Oncorhynchus nerka* (3, 32); *Ophiodon elongatus* (3); *Parophrys vetulus* (2, 3, 36); *Phycis chesteri* (50); *Podothecus accipenserinus* (5); *Pseudopleuronectes americanus* (1, 4, 61, 67, 70); *Reinhardtius hippoglossoides* (21, 51, 55, 56, 57, 59, 64); *Rhinochimaera atlantica* (35); *Salmo salar* (1, 6, 7, 9, 20);

Salvelinus alpinus (9, 31, 39, 52); *Salvelinus fontinalis* (45, 48, 49); *Salvelinus namaycush* (9, 31); *Scomber scombrus* (1, 13); *Sebastes aleutianus* (15); *Sebastes alutus* (3, 15); *Sebastes babcocki* (15); *Sebastes brevispinis* (15); *Sebastes caurinus* (15); *Sebastes crameri* (15); *Sebastes diploproa* (15); *Sebastes entomelas* (15); *Sebastes fasciatus* (34, 63); *Sebastes flavidus* (15); *Sebastes helvomaculatus* (15); *Sebastes maliger* (15); *Sebastes mentella* (34, 63, 69); *Sebastes nebulosus* (15, 54); *Sebastes norvegicus* (34); *Sebastes paucispinis* (15); *Sebastes pinniger* (15); *Sebastes polyspinis* (15); *Sebastes proriger* (15); *Sebastes reedi* (15); *Sebastes ruberrimus* (3, 15); *Sebastes variegatus* (15); *Sebastes zacentrus* (15); *Tautogolabrus adspersus* (1); *Theragra chalcogramma* (3, 26, 33, 36); *Urophycis chuss* (50); *Urophycis tenuis* (50, 71); *Xiphias gladius* (28)

Distribution: Atlantic, British Columbia, Labrador, New Bruswick, Newfoundland, Nova Scotia, Northwest Territories, Pacific

Records: 1. Heller 1949 (AT); 2. Margolis 1952a (PA); 3. Margolis 1952b (PA); 4. Ronald 1963 (AT); 5. Arai 1969 (PA); 6. Pippy 1969 (AT, NS); 7. Pippy 1970 (AT); 8. Sekhar S. [*sic*] & Threlfall 1970 (AT); 9. Hicks & Threlfall 1973 (LB); 10. Scott 1973 (AT); 11. Zubchenko 1975 (AT); 12. Zubchenko 1976 (AT); 13. Gaevskaya & Umnova 1977 (AT); 14. Linkletter *et al.* 1977 (AT); 15. Sekerak & Arai 1977 (PA); 16. Arthur 1978 (PA); 17. Arthur & Arai 1979 (PA); 18. Arthur & Arai 1980a (PA); 19. Arthur & Arai 1980b (PA); 20. Pippy 1980 (AT); 21. Zubchenko 1980 (AT); 22. Scott 1981 (AT); 23. Zubchenko 1981a (AT); 24. Zubchenko 1981b (AT); 25. Appy & Burt 1982 (AT); 26. Arthur *et al.* 1982 (PA); 27. Margolis 1982 (NF); 28. Hogans *et al.* 1983 (AT); 29. McClelland *et al.* 1983a (AT); 30. Sankurathri *et al.* (PA); 31. Stewart & Bernier 1983 (NT); 32. Anon. 1984 (BC); 33. Arthur 1984 (PA); 34. Bourgeois & Ni 1984 (AT); 35. Hogans & Hurlbut (AT); 36. Kabata & Whitaker 1984 (PA); 37. Margolis 1984 (PA); 38. McGladdery 1984 (AT); 39. Stewart & Bernier 1984 (NT); 40. McGladdery & Burt 1985 (AT); 41. Whitaker 1985 (PA); 42. Zubchenko 1985a (AT); 43. Zubchenko 1985b (AT); 44. Chenoweth *et al.* 1986 (AT); 45. Frimeth 1986 (NB); 46. Pálsson 1986 (AT); 47. Bray 1987 (AT); 48. Frimeth 1987a (NB); 49. Frimeth 1987b (NB); 50. Scott 1987 (AT); 51. Wierzbicka 1988 (AT); 52. Bouillon & Dempson 1989 (LB); 53. Brattey *et al.* 1990 (AT); 54. Holmes 1990 (PA); 55. Wierzbicka 1991a (AT); 56. Wierzbicka 1991b (AT); 57. Krzykawski & Wierzbicka 1992 (AT); 58. Hogans *et al.* 1993 (AT); 59. Arthur & Albert 1994 (AT); 60. Arthur *et al.* 1995 (AT); 61. Martell & McClelland 1995 (AT); 62. Blaycock 1996 (PA); 63. Moran *et al.* 1996 (AT); 64. Boje *et al.* 1997 (AT); 65. Blaycock *et al.* 1998a (PA); 66. Wierzbicka & Piasecki 1998 (PA); 67. Khan 1999 (AT); 68. Lee & Khan 2000 (AT); 69. Marcogliese *et al.* 2003 (AT); 70. McClelland *et al*. 2005 (AT); 71. Melendy *et al.* 2005 (AT); 71. Khan *et al.* 2011 (NF); 73. McClelland & Melendy 2011 (AT)

Hysterothylacium corrugatum Deardorff & Overstreet, 1981

Description (after Deardorff & Overstreet 1981). With characteristics of the genus. Body reaching greatest width near midbody. Cuticle with inconspicuous annulations except ventrally on male's posterior. Cervical alae not flaring. Lips about equal in size, occasionally wider than long; flanges widest near base, indented at anterior 2/5. Pulp for each lip not narrowed at base, each with two to four lobular projections often a few times longer than wide. Interlabia with height equal to or slightly less than width at base, with rounded tips. Interlabial grooves absent (Fig. 81A). Preventriculus clavate, 5–13% of body length. Ventriculus narrower than widest level of preventriculus, generally longer than broad; ventricular appendix descending without angulation from posterior portion of ventriculus. Nerve ring located between anterior 6–12% of preventriculus. Excretory pore immediately behind level of nerve ring. Tail gradually tapering, ending without spines.

Males: body 26–50 long by 0.4–1.0 wide. Preventriculus 3.0–5.6, ventriculus 0.036–0.154, ventricular appendix 2.4–3.8, and intestinal caecum 2.3–4.6 long. Spicules similar length: left one 1.2–2.5, right one 1.2–2.6. Caudal papillae 29 to 31 pairs, 24 to 26 pre–cloacal pairs, four post–cloacal pairs, one para-anal pair, doubled. Distinct medioventral pre-cloacal organ, papillated. Modified annules on ventral surface, beginning near anus, extending anteriorly1.0–4.1. Tail flexed ventrad, lacking spines (Fig. 81B).

Females: body 100–142 long by 1.7–2.6 wide. Preventriculus 5.5–8.5, ventriculus 0.154–0.472, ventricular appendix 3.5–4.3, and intestinal caecum 5.3–7.2 long. Vulva opening 35 to 40 from anterior end. Ovaries rarely extending anteriad beyond level of vulva. Eggs 0.040–0.080 in diameter. Tail tapered, lacking spines.

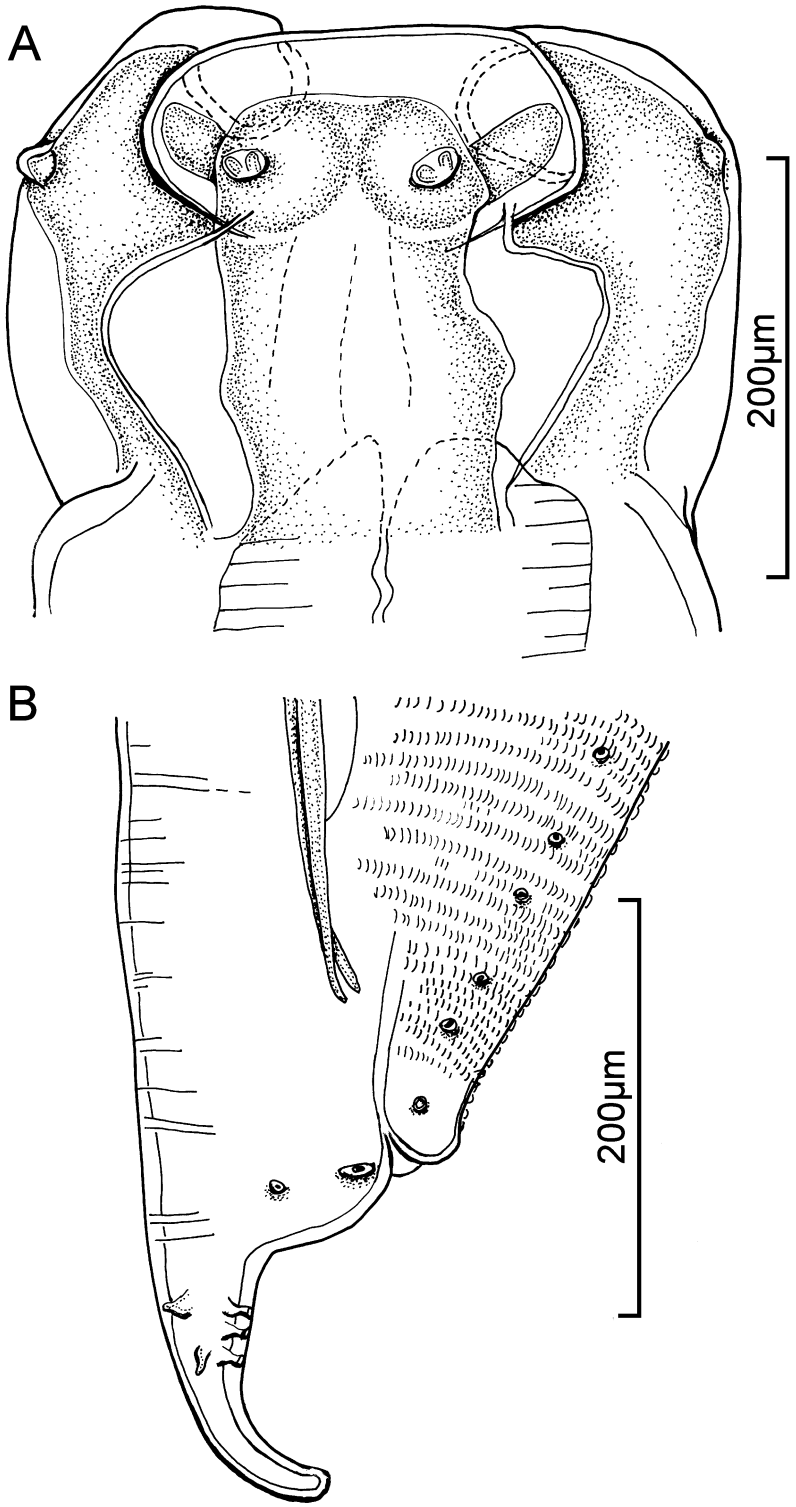

FIGURE 81. *Hysterothylacium corrugatum* Deardorff & Overstreet, 1981. A. head, lips, dorsal view; B. male, posterior end showing post-cloacal and pre-cloacal papillae, and modified annules. (Redrawn from Deardorff & Overstreet 1981)

Site: stomach
Host: *Xiphias gladius*
Distribution: Atlantic
Record: Hogans *et al.* 1983

***Hysterothylacium incurvum* (Rudolphi, 1819) Deardorff & Overstreet, 1981**

Synonyms: *Thynnascaris incurva* (Rudolphi, 1819) Dollfus, 1935; *Contracaecum incurvum* (Rudolphi, 1819) Baylis & Daubney, 1922

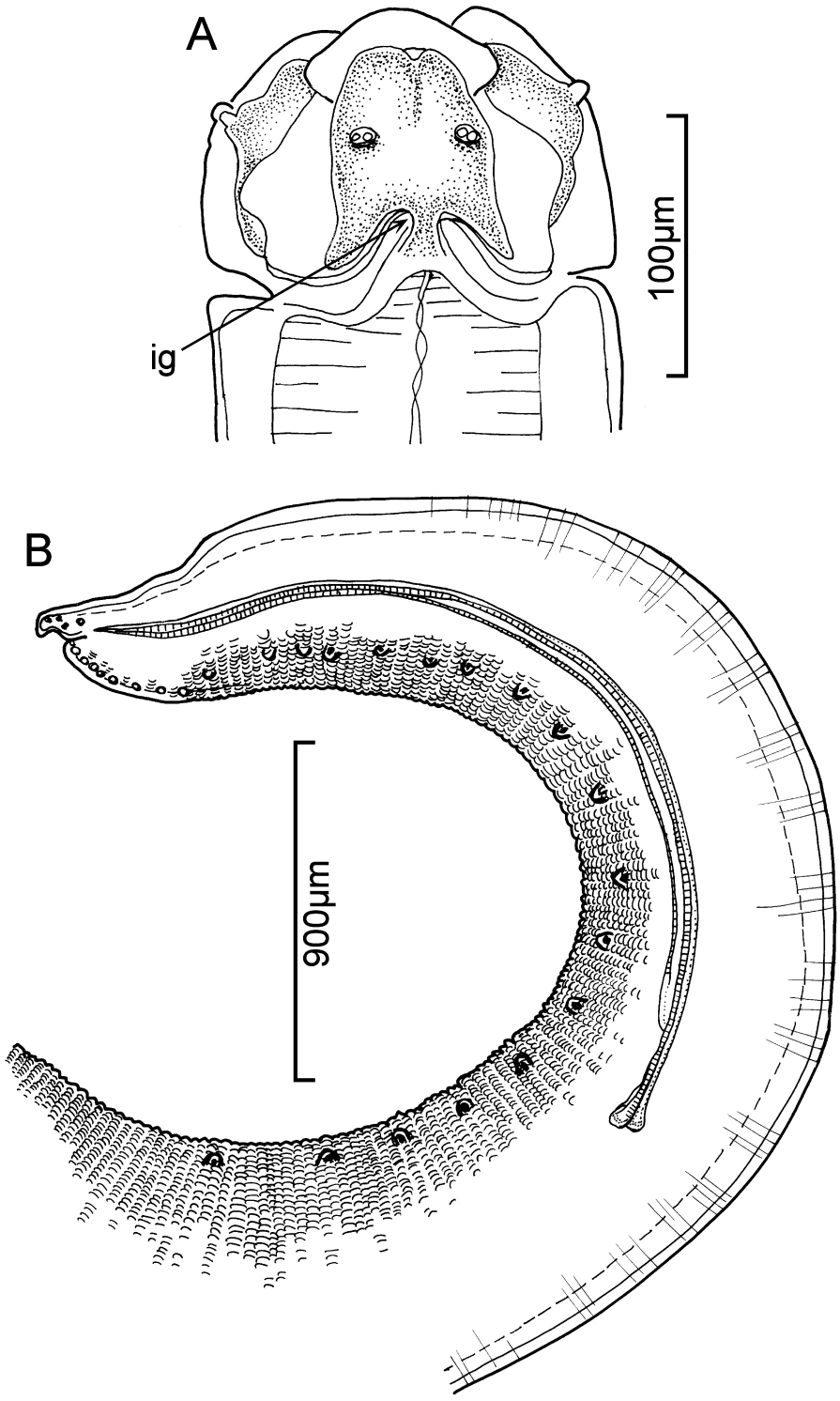

FIGURE 82. *Hysterothylacium incurvum* (Rudolphi, 1809) Deardorff & Overstreet, 1981. A. head, lips, dorsal view, showing interlabial groove (ig); B. male, posterior end, showing caudal papillae and annules on ventral surface, lateral view. (Redrawn from Deardorff & Overstreet 1981)

Description (after Deardorff & Overstreet 1981). With characteristics of the genus. Body reaching greatest width near midbody. Cuticle with inconspicuous annulations except ventrally on male's posterior. Lateral alae bifurcate at their tips throughout worm. Cervical alae not flaring. Lips approximately equal in size, all wider than long; flanges widest near base, indented at anterior 1/3. Pulp conspicuously narrow near base. Interlabia with height two times greater than width at base, with rounded tips. Interlabial grooves deep, adjacent grooves nearly merging at base of each lip (Fig. 82A). Preventriculus clavate, 7–16% of body length. Ventriculus narrower than widest level of preventriculus. Nerve ring located between anterior 7–19% of preventriculus. Excretory pore immediately posterior to nerve ring level. Tail gradually tapering, usually without spines.

Males: body 17–34 long by 0.606–0.772 wide. Preventriculus 2.3–5.2, ventriculus 0.117–0.166, ventricular appendix 1.7–2.6, and intestinal caecum 1.9–4.5 long. Spicules 2.6–8.7 long, equal in eight specimens, left one longer in two specimens: spicule ratio 1:0.9–1.0, Caudal papillae 31 to 32 pairs: 27 to 28 pre-cloacal pairs, four post-cloacal pairs, one para-anal papilla, doubled. Distinct medioventral pre-cloacal organ, papillated. Modified annules on ventral surface, beginning near anus, extending anteriorly 2.0–6.1 (Fig. 82B). Tail flexed ventrad, without spines.

Females: body 25–69 long by 0.5–1.7 wide. Preventriculus 2.6–7.2, ventriculus 0.173–0.362, ventricular appendix 0.6–4.0, and intestinal caecum 1.5–5.1 long. Vulva opening 7.3–35.1 from anterior end. Ovaries rarely extending anteriad to vulva level. Eggs 0.018–0.063 in diameter. Tail usually without spines.

Site: stomach

Host: *Xiphias gladius*

Distribution: Atlantic

Records: Nigrelli 1938; Tibbo *et al.* 1961; Iles 1971; Hogans *et al.* 1983

Hysterothylacium magnum **(Smedley, 1934) Deardorff & Overstreet, 1981**

Synonyms: *Contracaecum magnum* Smedley, 1934; *Thynnascaris magnum* (Smedley, 1934) Margolis & Arthur, 1979

Comments: as noted by McDonald & Margolis (1995), Margolis & Arthur (1979) listed a previous Canadian record as *Thynnascaris magna*. Deardorff & Overstreet (1981) considered the genus *Thynnascaris* to be a junior synonym of *Hysterothylacium* and listed the species as *H. magnum* n. comb. In agreement with McDonald & Margolis (1995) the validity of this species requires re-assessment (see also Comments on *H. melanogrammi* below).

Site: ?

Hosts: *Apodichthys flavidus*; *Leptocottus armatus*; *Ophiodon elongatus*

Distribution: Pacific

Record: Smedley 1934

Hysterothylacium melanogrammi **(Smedley, 1934) Deardorff & Overstreet, 1981**

Synonyms: *Contracaecum melanogrammi* Smedley, 1934; *Thynnascaris melanogrammi* (Smedley, 1934) Margolis & Arthur, 1979

Comments: as noted by McDonald & Margolis (1995), Margolis & Arthur (1979) listed a previous Canadian record as *Thynnascaris melanogrammi*. Deardorff & Overstreet (1981) considered the genus *Thynnascaris* to be a junior synonym of *Hysterothylacium* and listed the species as *H. melanogrammi* n. comb. In agreement with McDonald & Margolis (*op. cit.*) the validity of this species requires re-assessment (see also Comments on *H. magnum* above).

Site: intestinal lumen

Host: *Melanogrammus aeglefinus*

Distribution: Atlantic

Record: Smedley 1934

Hysterothylacium reliquens (Norris & Overstreet, 1975) Deardorff & Overstreet, 1981

Synonym: *Thynnascaris reliquens* Norris & Overstreet, 1975

Description (after Deardorff & Overstreet 1981). With characteristics of the genus. Body reaching greatest width near midbody. Cuticle with inconspicuous annulations and minute lateral alae. Alae become more apparent at levels behind rectum. Lips approximately equal in size, all longer than wide; flanges constricted near middle of lip; pulp pedunculated. Interlabia with height equal to or slightly greater than width at base. Interlabial grooves absent (Fig. 83A). Preventriculus 11–13% of body length. Ventriculus narrower than widest level of preventriculus. Usually longer than broad; ventricular appendix departing without angulation from posterior portion of ventriculus. Nerve ring located at anterior 16–28% of preventriculus. Excretory pore at or immediately posterior to level of nerve ring. Tail with spined conical mucron.

Males: body 25–40 long by 0.5–0.9 wide. Preventriculus 3.3–4.5, ventriculus 0.141–300, ventricular appendix 1.2–1.7, and intestinal caecum 0.315–598 long. Spicules 1.7–2.4 long, relative length varies: spicule ratio 1:0.6–1.3. Caudal papillae 27 to 33 pairs: 23 to 29 pre–cloacal pairs, four to five post–cloacal pairs with 3rd pair from tail end doubled; para-anal papillae lacking. Distinct medio-ventral organ, papillated. Tail reflexed ventrad, 0.123–0.185 long, including multispinous process (Fig. 83B).

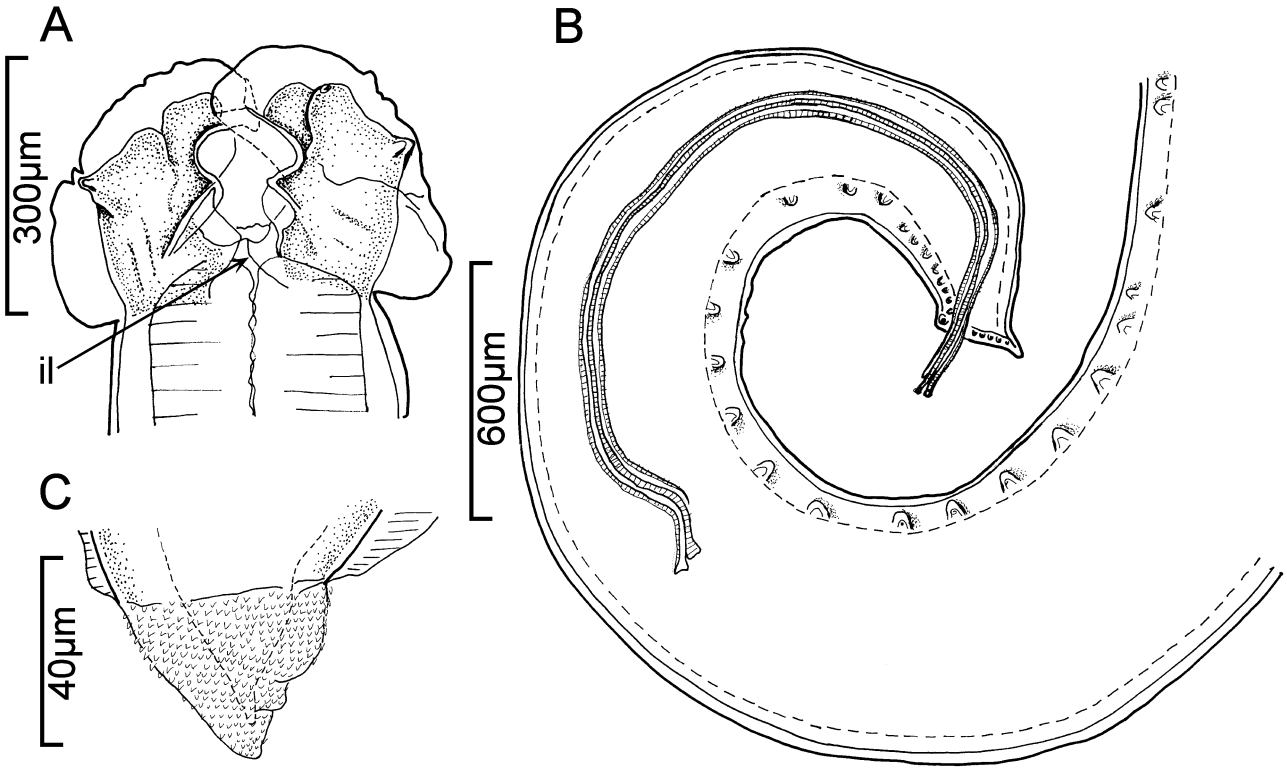

FIGURE 83. *Hysterothylacium reliquens* (Norris & Overstreet, 1975) Deardorff & Overstreet, 1981. A. head, lips, ventral view showing interlabium (il); B. male, posterior end showing caudal papillae, lateral view; C. multispinous process on tail tip, lateral view. (Redrawn from Deardorff & Overstreet 1981)

Females: body 21–44 long by 0.5–1.1 wide. Preventriculus 2.9–5.0, ventriculus 0.142–0.286, ventricular appendix 1.0–2.9, and intestinal caecum 0.394–0.788 long. Vulva without protruding lips, opens 6.5–17.0 from anterior end. Ovaries rarely extend beyond anterior level of vulva. Tail 0.370–0.574 long, including multispinous process (Fig. 83C).

Site: stomach

Host: *Xiphias gladius*

Distribution: Atlantic

Record: Hogans *et al.* 1983

***Hysterothylacium* sp.**

Synonym: *Thynnascaris* sp.

Sites: alimentary tract, body cavity, mesenteries

Hosts: *Alosa aestivalis* (8, 14); *Alosa pseudoharengus* (8, 14); *Ambloplites rupestris* (1); *Boreogadus saida* (6); *Catostomus columbianus* (4); *Coregonus clupeaformis* (4); *Cottunculus microps* (7); *Cottus aleuticus* (4); *Culaea inconstans* (11); *Fundulus diaphanus* (10); *Gadus morhua* (3, 9); *Gasterosteus aculeatus* (10); *Lepomis macrochirus* (10); *Lycodes esmarkii* (7); *Lycodonus mirabilis* (7); *Macrourus berglax* (7); *Mallotus villosus* (5); *Melanogrammus aeglefinus* (9); *Merluccius bilinearis* (9); *Morone americana* (10); *Nezumia bairdii* (7); *Oncorhynchus mykiss* (4); *Oncorhynchus nerka* (4); *Osmerus mordax* (12); Pleuronectidae gen. sp. (9); *Pollachius virens* (9); *Prosopium williamsoni* (4); *Ptychocheilus oregonensis* (4); *Salvelinus fontinalis* (2, 13); *Salvelinus malma* (4); *Scomber scombrus* (9); *Sebastes* sp. (9); *Synaphobranchus kaupii* (7)

Distribution: Atlantic, British Columbia, Labrador, New Brunswick, Nunavut, Ontario, Quebec

Records: 1. Szuks 1980 (AT); 2. G. A. Black 1981a (QC); 3. Appy & Burt 1982 (AT); 4. Anon. 1984 (BC); 5. Pálsson & Beverley-Burton 1984 (AT); 6. Bradstreet *et al.* 1986 (NU); 7. Houston & Haedrich 1986 (AT); 8. Landry *et al.* 1986 (NB); 9. Morrison *et al.* 1986 (AT); 10. Dechtiar & Christie 1988 (ON); 11. Dechtiar *et al.* 1988 (ON); 12. Landry & Hare 1990 (AT); 13. Marcogliese & Cone (LB); 14. Landry *et al.* 1992 (AT)

Raphidascaris Railliet & Henry, 1915

Synonyms: *Hysterothylacium* Ward & Magath, 1917; *Ichthyascaris* Wu, 1949; ?*Neogoezia* Kreis, 1937

Preamble: *Raphidascaris acus* is the only species of the genus known from Canadian fishes. The life cycle of *R. acus* was discussed by J. D. Smith (1984b) and Moravec (2013) and involves predatory fishes as final hosts, and various invertebrates and fishes as paratenic or intermediate hosts. Adult and larval stages of *R. acus* are described below.

Generic diagnosis (after Moravec 2013). Raphidascaridinae. Large nematodes, widest in midbody. Cuticle with distinct striations. Lips well developed, of complex structure. Interlabia rudimentary or absent. Excretory pore slightly behind nerve ring level. Narrow lateral alae may be present. Preventriculus muscular; ventriculus almost spherical; posteriorly directed ventricular appendix present. Intestinal caecum absent. Spicules subequal, arcuate, alate. Caudal papillae numerous. Vulva anterior to mid-length of body. Oviparous. Parasites of marine and freshwater fishes.

Raphidascaris acus (Bloch, 1779) Railliet & Henry, 1915

Synonyms: *Raphidascaris canadensis* Smedley 1933; *Raphidascaris laurentianus* Richardson, 1937; *Raphidascaris alius* Lyster, 1940

Description (after J. D. Smith 1984a). With characteristics of the genus.

Males: 31.5–39.5 (mean 35.3) long, 0.063–0.83 (0.69) maximum width. Lips 0.092–0.118 (0.102) long. Small triangular elevation present between bases of subventral lips (Fig. 84A). Nerve ring 0.63–0.83 (0.69) and excretory pore 0.73–0.88 (0.80) from anterior end. Preventriculus 3.45–4.11 (3.73) long. Ventriculus and ventricular appendix 1.44–2.07 (1.80) long (Fig. 84B). Testis tightly coiled, anterior end 6.05–7.84 (6.91) from anterior end of worm. *Vas efferens* short. Seminal vesicle broad and thin-walled. Ejaculatory duct 1.70–2.57 (2.19) long. Left spicule 0.586–0.802 (0.686) and right spicule 0.544–0.773 (0.681) long. Gubernaculum absent. Caudal papillae extending 3.10–4.27 (3.70) anterior to anus: 16–21 (18) pre-cloacal pairs, two pairs or one pair doubled ad-cloacal, and four pairs post-cloacal. Tail conical, 0.235–0.291 (0.250) long (Fig. 84C). Phasmids lateral, 0.067–0.140 (100) from tip of tail.

Females: 40.5–49.2 (44.5) long, 0.81–1.07 (0.93) maximum width. Lips 0.93–0.132 (0.117) long. Nerve ring 0.60–0.74 (0.68) and excretory pore 0.75–0.84 (0.78) from anterior end. Preventriculus 3.51–4.62 (4.18) long.

Ventriculus and ventricular appendix 1.37–2.23 (1.83) long. Vulva 9.83–11.65 (10.85) from anterior end. Didelphic, opisthodelphic, with many eggs, 0.092–0.111 (0.101) x 0.083–0.101 (0.092). Oviducts ascending and descending, not extending anterior to vulva. Ovaries long, much folded, mainly posterior to uterus. Tail conical, 0.50–0.73 (0.61) long. Phasmids 0.18–0.26 (0.22) from tip of tail.
Site: intestinal lumen

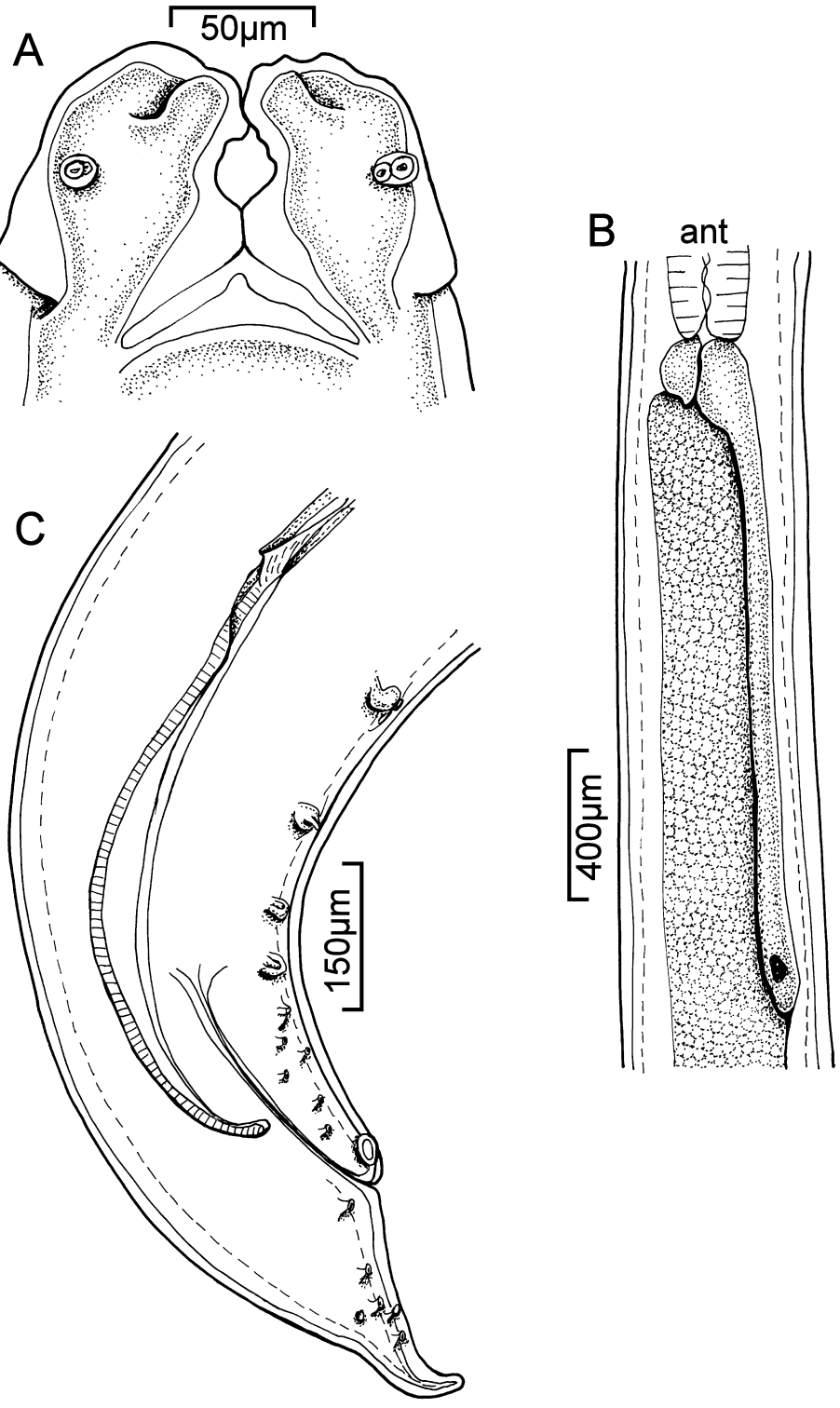

FIGURE 84. *Raphidascaris acus* (Bloch, 1779) Railliet & Henry, 1915. A. head showing cuticular elevation, ventral view; B. ventriculus and ventricular appendix, lateral view; C. male, posterior end, lateral view. (Redrawn from J. D. Smith 1984a)

Hosts: *Catostomus catostomus* (25); *Catostomus commersonii* (24, 44); *Chrosomus eos* (44); *Coregonus artedi* (24); *Coregonus clupeaformis* (15, 23, 24, 25, 36); *Esox lucius* (1, 4, 5, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 28, 30, 31, 32, 35, 37, 38, 39, 40, 43); *Esox masquinongy* (6, 22, 34); *Hiodon alosoides* (39, 43); *Lota lota* (25, 33, 45); *Micropterus dolomieu* (25); *Oncorhynchus gorbuscha* (29); *Oncorhynchus mykiss* (26); *Perca flavescens* (12, 23, 24, 27, 28, 32, 39, 42, 43); *Salvelinus fontinalis* (2, 3, 25, 26, 41, 44); *Sander vitreus* (24, 25, 27, 30, 39, 43, 45)

Distribution: Alberta, Labrador, Manitoba, Northwest Territories, Ontario, Quebec, Saskatchewan, Yukon Territory

Records: 1. Smedley 1933 (MB, SK); 2. Richardson 1937 (QC); 3. Lyster 1940 (QC); 4. Miller 1945 (AB); 5. Rawson 1951 (NT); 6. Choquette 1951c (QC); 7. Stewart-Hay 1951a (MB); 8. Stewart-Hay 1951b (MB); 9. Stewart-Hay 1952a (MB); 10. Stewart-Hay 1952b (MB); 11. Stewart-Hay 1953a (MB); 12. Dickson 1964 (MB); 13. Chinniah & Threlfall 1978 (LB); 14. Gordon *et al.* 1978 (QC); 15. Pybus & Samuel 1978 (AB); 16. Thompson & Threlfall 1978 (QC); 17. Kinnis & Curtis 1981 (QC); 18. Leong & Holmes 1981 (AB); 19. Samuel 1981 (AB); 20. J. D. Smith & Anderson 1981 (ON); 21. J. D. Smith & Anderson 1982 (ON); 22. Anthony 1983 (ON); 23. McAllister & Mudry 1983 (AB); 24. Poole 1983 (MB); 25. J. D. Smith 1984a (ON); 26. J. D. Smith 1984b (ON); 27. Poole & Dick 1985 (MB); 28. Samuel 1985 (AB); 29. Anthony 1986 (ON); 30. Poole & Dick 1986 (MB); 31. Shostak & Dick 1986 (MB); 32. J. D. Smith 1986 (ON); 33. Anthony 1987 (ON); 34. Dechtiar & Christie 1988 (ON); 35. Dechtiar *et al.* 1988 (ON); 36. Stock 1988 (AB); 37. Szalai & Dick 1988 (MB); 38. Shostak & Dick 1989 (MB); 39. Szalai 1989 (MB); 40. Szalai & Dick 1989 (MB); 41. Marcogliese & Cone 1991a (LB, QC); 42. Szalai & Dick 1991 (MB); 43. Szalai *et al.* 1992a (MB); 44. Dubois *et al.* 1996 (QC); 45. Baldwin & Goater 2003 (AB)

****Raphidascaris acus*** **(Bloch, 1779) Railliet & Henry, 1915**

Synonyms: *Raphidascaris canadensis* Smedley 1933; *Raphidascaris laurentianus* Richardson, 1937; *Raphidascaris alius* Lyster, 1940

Description (after J. D. Smith 1984b).

L4 males: mean 2.777 (range 2.522–3.197) long; L4 females: 2.961 (2.348–3.393) long. Three lips present, equal in length. Single interlabium between subventral lips, much reduced in adults. Lateral interlabia absent. Four double papillae, two on dorsal lip, one on each subventral lip. Lateral amphid and single papilla on each subventral lip. Cuticle with distinct striations. Lateral alae from base of lips to tail. Deirids small, at level of excretory pore. Tail long, conical, pointed (Fig. 85A). Phasmids in midregion of tail. Male gonad from slightly anterior of midpoint of larva to rectum. Testis thin-walled. Posterior portion of gonad with walls of low cuboidal cells. Spicule pouches extending dorsally and anteriorly from dorsal wall of rectum. Developing spicules narrow, not cuticularized (Fig. 85A). Female gonad 20–25% of length of larva. Vagina slightly anterior to midpoint of larva (Fig. 85B). Uterus dividing into two posteriorly directed branches, slightly posterior from vagina. Oviduct proximal to uterus, short. Ovaries straight, thin-walled, filled with large germinal cells.

L3: males 1.682 (1.444–2.056) long; females 1.925 (1.690–2.248) long. Anterior end with ventral boring tooth, four large papillae subdorsally and subventrally, pair of single papillae, and pair of amphids laterally. Lips absent. Lateral alae from anterior end to tail, widest in anterior third. Cuticle with fine transverse striations. Deirids small, at level of excretory pore. Tail conical, pointed. Phasmids in midregion of tail. Three rectal cells around anterior part of rectum. Sexes distinct. Vaginal primordium an ovoid mass of cuboidal cells, embedded in ventral body wall, near midpoint of larva. Two ovaries extending posteriorly from vagina. Gonad in male straight, elongate, ventral to intestine in posterior quarter of body.

L2: body 0.899 (0.787–1.009) long. Anterior end bluntly rounded with 4 large papillae subdorsally and subventrally. Mouth opening approximately triangular in outline. Conical boring tooth at ventral apex of mouth opening. Lips absent. Lateral alae narrow. Cuticular striations not seen. Deirids small, at level of excretory pore which is slightly posterior to nerve ring. Preventriculus claviform. Ventriculus about as long as wide, with posteriorly directed ventricular appendix. Genital primordium ovoid, comprising four to eight cells. Tail conical, pointed.

For detailed dimensions and disposition of the various organs in L4, L3 and L2 see J. D. Smith (1984b).

Site: viscera

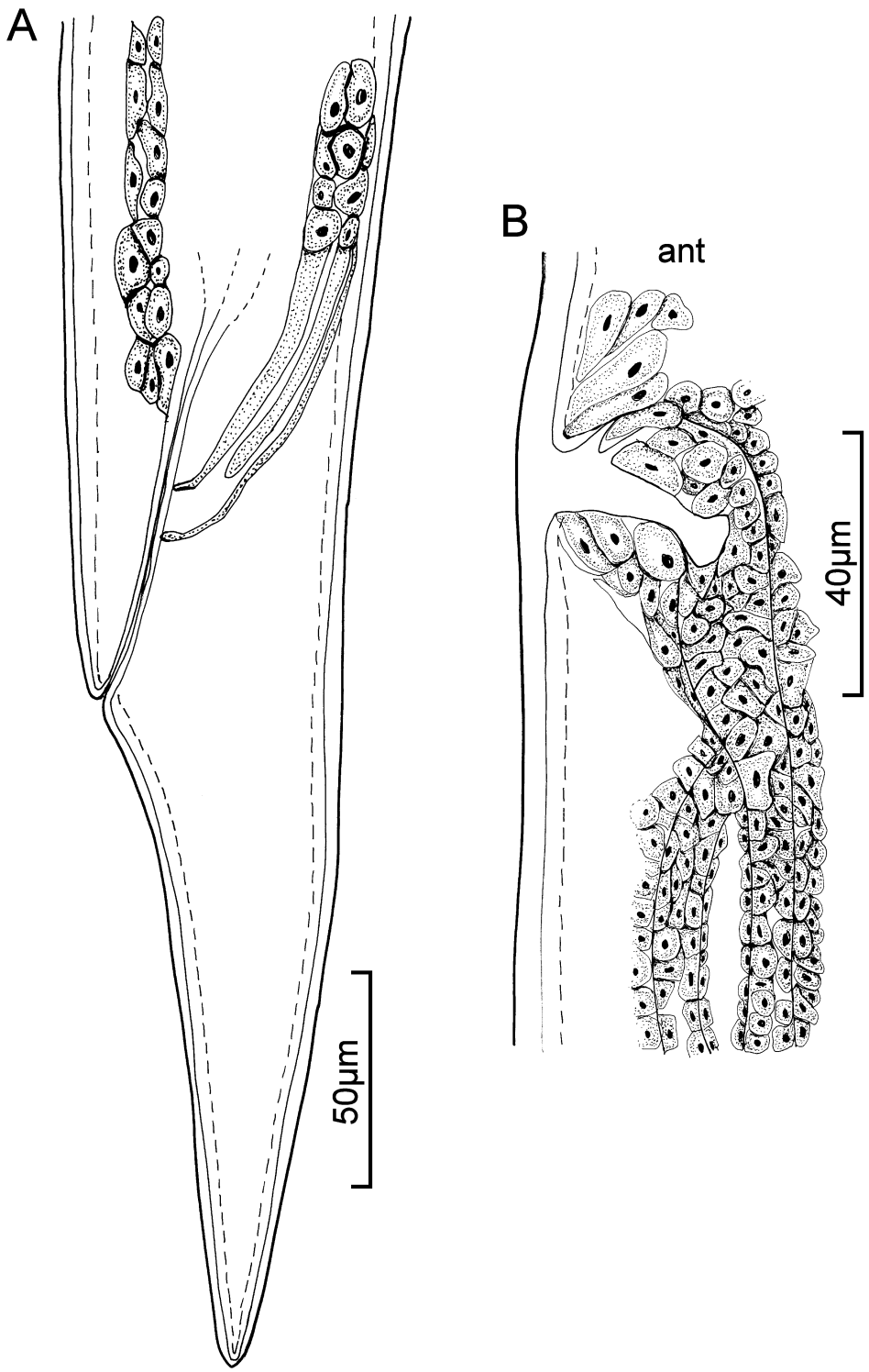

FIGURE 85. **Raphidascaris acus* (Bloch, 1779) Railliet & Henry, 1915. A. male L4, posterior end showing developing spicules and *vas deferens*, lateral view; B. female L4, vagina, lateral view. (Redrawn from J. D. Smith 1984b)

Hosts: *Acipenser fulvescens* (25); *Ambloplites rupestris* (10, 17); *Catostomus commersonii* (7, 16, 21, 23); *Coregonus artedi* (7, 21, 23, 29); *Coregonus clupeaformis* (1, 7, 13, 19, 29); *Cottus bairdii* (19); *Cottus cognatus* (1); *Esox lucius* (1, 15, 16, 29); *Etheostoma caeruleum* (11); *Etheostoma exile* (16); *Etheostoma nigrum* (11); *Fundulus diaphanus* (16); *Hiodon alosoides* (21, 23); *Ictalurus punctatus* (10); *Lepomis gibbosus* (20); *Lota lota* (29); *Morone chrysops* (18); *Moxostoma anisurum* (21); *Myoxocephalus thompsonii* (33); *Notemigonus crysoleucas* (16); *Notropis hudsonius* (21, 23); *Perca flavescens* (4, 5, 7, 8, 9, 11, 12, 14, 16, 17,

18, 19, 20, 21, 22, 23, 24, 26, 27, 28, 29, 30, 31, 32, 33); *Percina caprodes* (21, 23); *Percopsis omiscomaycus* (21, 23); *Pimephales notatus* (16); *Pimephales promelas* (16); *Ptychocheilus oregonensis* (2, 6); *Pungitius pungitius* (3); *Salvelinus namaycush* (29); *Sander canadensis* (21, 23); *Sander vitreus* (7, 12, 14, 21, 23); *Thymallus arcticus* (1, 29); *Tinca tinca* (34); *Umbra limi* (16)

Distribution: Alberta, British Columbia, Labrador, Manitoba, Ontario, Quebec, Yukon Territory

Records: 1. Arthur *et al.* 1976 (YT); 2. Anon. 1978 (BC); 3. Leong & Holmes 1981 (AB); 4. J. D. Smith & Anderson 1981 (ON); 5. J. D. Smith & Anderson 1982 (ON); 6. Arai & Mudry 1983 (BC); 7. Poole 1983 (MB); 8. Poole & Dick 1984 (MB); 9. Baker 1984b (ON); 10. J. D. Smith 1984a (ON); 11. J. D. Smith 1984b (ON); 12. Poole & Dick 1986 (MB); 13. Samuel 1985 (AB); 14. Poole & Dick 1985 (MB); 15. Shostak & Dick 1986 (MB); 16. J. D. Smith 1986 (ON); 17. Dechtiar & Lawrie 1988 (ON); 18. Dechtiar & Nepszy 1988 (ON); 19. Dechtiar *et al.* 1988 (ON); 20. Dechtiar *et al.* 1989 (ON); 21. Szalai 1989 (MB); 22. Szalai & Dick 1991 (MB); 23. Szalai *et al.* 1992a (MB); 24. Szalai *et al.* 1992b (MB); 25. Choudhury & Dick 1993 (MB); 26. Zelmer 1994 (AB); 27. Zelmer & Arai 1998 (AB): 28. Carney & Dick 2000 (MB); 29. Johnson & Dick 2001 (ON); 30. Baldwin & Goater 2003 (AB); 31. Zelmer & Arai 2004 (AB); 32. Marcogliese *et al.* 2005 (QC); 33. Carney *et al.* 2009 (ON); 34. Marcogliese *et al.* 2009 (QC)

****_Raphidascaris_ sp.**

Sites: alimentary tract, liver, musculature

Hosts: *Acipenser fulvescens* (26, 28); *Coregonus artedi* (14, 15, 17); *Coregonus clupeaformis* (3, 14, 16, 17, 20, 21, 23); *Coregonus nasus* (27); *Esox lucius* (2, 3, 5, 8, 12, 14, 19, 20, 21, 23); *Morone chrysops* (22); *Perca flavescens* (1, 3, 15, 20, 23); *Pungitius pungitius* (12); *Salmo salar* (6, 7, 9, 10, 11, 13, 18); *Salvelinus fontinalis* (16, 24, 25); *Salvelinus namaycush* (12, 16); *Sander vitreus* (3, 4)

Distribution: Alberta, Hudson Bay Drainage, Labrador, Manitoba, New Brunswick, Northwest Territories, Ontario, Quebec, Saskatchewan

Records: 1. Richardson 1937 (QC); 2. McLeod 1943 (MB); 3. McLeod 1944 (MB); 4. Stewart-Hay 1951b (MB); 5. Stewart-Hay 1953c (MB); 6. Pippy 1967 (LB); 7. Pippy 1969 (AT); 8. Threlfall & Hanek 1970b (LB); 9. Hare 1975 (NB); 10. Hare & Burt 1975a (NB); 11. Hare & Burt 1975b (NB); 12. Leong 1975 (AB); 13. Hare & Burt 1976 (NB); 14. Watson 1977 (MB); 15. Anthony 1978b (ON); 16. Chinniah & Threlfall 1978 (LB); 17. Watson & Dick 1979 (MB); 18. Pippy 1980 (NB); 19. Watson & Dick 1980 (MB); 20. Samuel 1981 (AB); 21. McAllister & Mudry 1983 (AB); 22. Anthony 1984 (ON); 23. Samuel 1985 (AB); 24. Frimeth 1987a (NB); 25. Frimeth 1987b (NB); 26. Choudhury *et al.* 1990 (MB); 27. Choudhury & Dick 1997 (NT); 28. Choudhury & Dick 1998 (HBD, MB)

Superfamily SEURATOIDEA Chabaud, Campana-Rouget & Brygoo, 1959

Key to Families of SEURATOIDEA

1 Buccal cavity absent or, if present, derived from cheilostom; cuticle constituting walls of cheilostom having same structure and staining reactions as external body cuticle . . . . . Quimperiidae

\- Buccal cavity formed from modifications of anterior end of oesophagus (oesophastom); walls of oesophastom surrounded by oesophageal tissue . . . . . Cucullanidae

Family CUCULLANIDAE Cobbold, 1864

Key to genera of CUCULLANIDAE

1 Mouth markedly inclined dorsally; cuticular lining of oesophastom consisting of complex set of thickened cuticularized pieces separated by sutures; cuticularized frame around mouth opening absent. . . . . *Truttaedacnitis*

\- Mouth opening perpendicular to body axis or slightly inclined dorsally; cuticularized plates of oesophastom few in number and separated by simple Y-shaped sutures; mouth opening supported by peribuccal cuticularized frame to which are joined some

	cuticularized pieces inserted into adjacent oesophageal muscles	2
2	Intestinal caecum absent	*Cucullanus*
-	Intestinal caecum present	3
3	Intestinal caecum dorsal; pre-cloacal sucker absent	*Dichelyne*
-	Intestinal caecum ventral; pre-cloacal sucker present	*Cucullanellus*

Truttaedacnitis Petter, 1974

Synonyms: *Dacnitis* Törnquist, 1931 *nec* Dujardin, 1845; *Bulbodacnitis* Maggenti, 1971 *nec* Lane, 1916

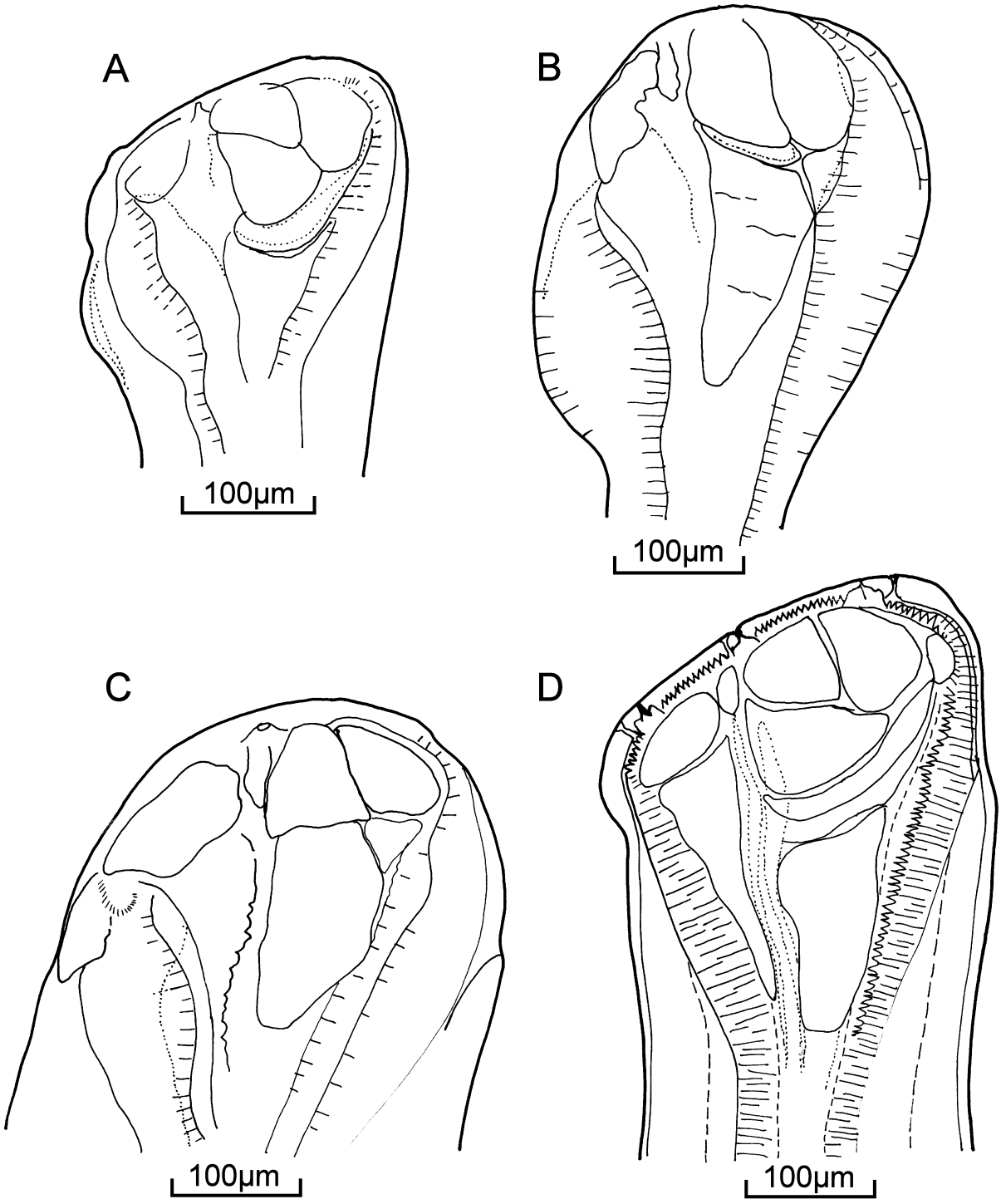

FIGURE 86. *Truttaedacnitis* spp.: heads showing cephalic plates. A. *T. truttae*; B. *T. sphaerocephala*; C. *T. clitellarius*; D. *T. pybusae*. (A., B. and C. redrawn from Choudhury & Dick 1996b; D. redrawn and rotated from Pybus *et al*. 1978a)

Preamble: Choudhury & Dick (1996b) analysed phylogenetically the genus *Truttaedacnitis* referring *inter alia* to the morphology and arrangement of the various cephalic plates. Because the homology of some of the cephalic plates could not be determined, these workers did not use the total number of plates in their analysis. Illustrations of the plates in the four species of *Truttaedacnitis* are given here (Fig. 86).

Generic diagnosis (after Berland 1970). Cucullanidae. Mouth a dorso-ventral slit, directed antero-dorsally, surrounded by cuticular collarette bearing conspicuous or inconspicuous "teeth". A dorsal cephalic swelling (tubercle) more or less pronounced. Oesophagus with three pairs of longitudinal rods and serrated plates diverging in pseudobuccal capsule, leaving between them thick cuticular plates separated by narrow sutures forming a characteristic pattern. Vulva with conspicuous lips. Male with ventral pre-cloacal sucker. Spicules equal or sub-equal, straight or bent. Short gubernaculum. Eleven pairs caudal papillae.

Key to species of *Truttaedacnitis*

1	Excretory pore situated at level of pseudobuccal capsule; oral collarette structures weak	2
-	Excretory pore situated behind nerve ring; oral collarette structures conspicuous	3
2	Spicules straight	*T. clitellarius*
-	Spicules bent	*T. sphaerocephala*
3	Dorsal cephalic ridge absent	*T. pybusae*
-	Dorsal cephalic ridge present	*T. truttae*

Truttaedacnitis clitellarius (Ward & Magath, 1917) Petter, 1974

Synonym: *Cucullanus clitellarius* Ward & Magath, 1917

Description (after Choudhury & Dick 1996a). With characteristics of the genus. Body moderately robust, cephalic end rounded, cuticle with transverse striations. Posterior part of body often curved ventrally. Narrow lateral alae beginning in cervical region, terminating at anal region. Mouth opening spindle-shaped, with three conspicuous papillae on either side—the central one likely an amphid. Mouth opening bordered by transparent cuticular collarette bearing weak longitudinal rib-like structures ("teeth"). Inner circle of three small papillae present. Two bud-shaped deirids, one on either side, often asymmetrical, adjacent to lateral alae, and posterior to nerve ring. Tail conical, gently tapering, bearing mucron. Hemizonid posterior to nerve ring. Oesophagus muscular, clavate, expanded anteriorly to form pseudobuccal capsule. Bilaterally symmetrical cephalic plates present, separated by narrow sutures and attached to thickened cuticular plates of pseudobuccal capsule (Fig. 86C). Oesophageal lumen lined by cuticle, each side of triradiate lumen thickened to give appearance of "longitudinal rods" embedded into oesophageal musculature. Oesophago-intestinal junction guarded by cuticular folded valve. Excretory pore at about mid-level of pseudobuccal capsule (Fig. 87A). Excretory duct long, cuticular, extending posteriorly along ventral body wall past nerve ring to first half of oesophagus, with prominent nucleus present immediately posterior to base of excretory duct (Fig. 87A).

Males: 13.5 (9.6–16.9) long; maximum width 0.40 (0.24–0.59). Nerve ring 0.585 (0.526–0.640) from anterior end. Oesophagus 1.35 (1.10–1.55) long. Tail 0.428 (0.301–0.564) long. Single testis originating posteriorly, extending anteriorly and looping back on itself. Posterior pre-cloacal sucker bordered by radially situated muscle bands, 1.70 (1.25–2.10) from posterior end (Fig. 87B). Spicules equal or slightly sub-equal, gouge shaped with median serrated margins; left spicule 1.12 (0.90–1.30) long, right one 1.14 (0.87–1.35) long. Gubernaculum with Y-shaped sclerotized body, 0.139 (0.101–0.172) long. Eleven pairs of sessile caudal papillae: four pairs pre-cloacal, one pair ad-cloacal, and six pairs post-cloacal, of which one pair are phasmids. Median papilla immediately anterior to anterior margin of cloacal opening (Fig. 87B).

Females: 15.1 (9.9–18.6) long; maximum width 0.43 (0.33–0.53). Nerve ring 0.613 (0.564–0.677) from anterior end. Oesophagus 1.42 (1.15–1.60) long. Tail 0.380 (0.245–0.498) long. Ovaries coiled. Anterior ovary at level of, or posterior to, oesophago-intestinal junction, in anterior third of body. Posterior ovary in posterior fifth of body (Fig. 87C). Oviducts extending beyond vulvar region, reflexing and giving rise to thin-walled uteri containing eggs. Vulval opening a transverse slit. Eggs ovoid, thin-shelled, 0.067 x 0.041–0.079 x 0.049.
Site: intestinal lumen

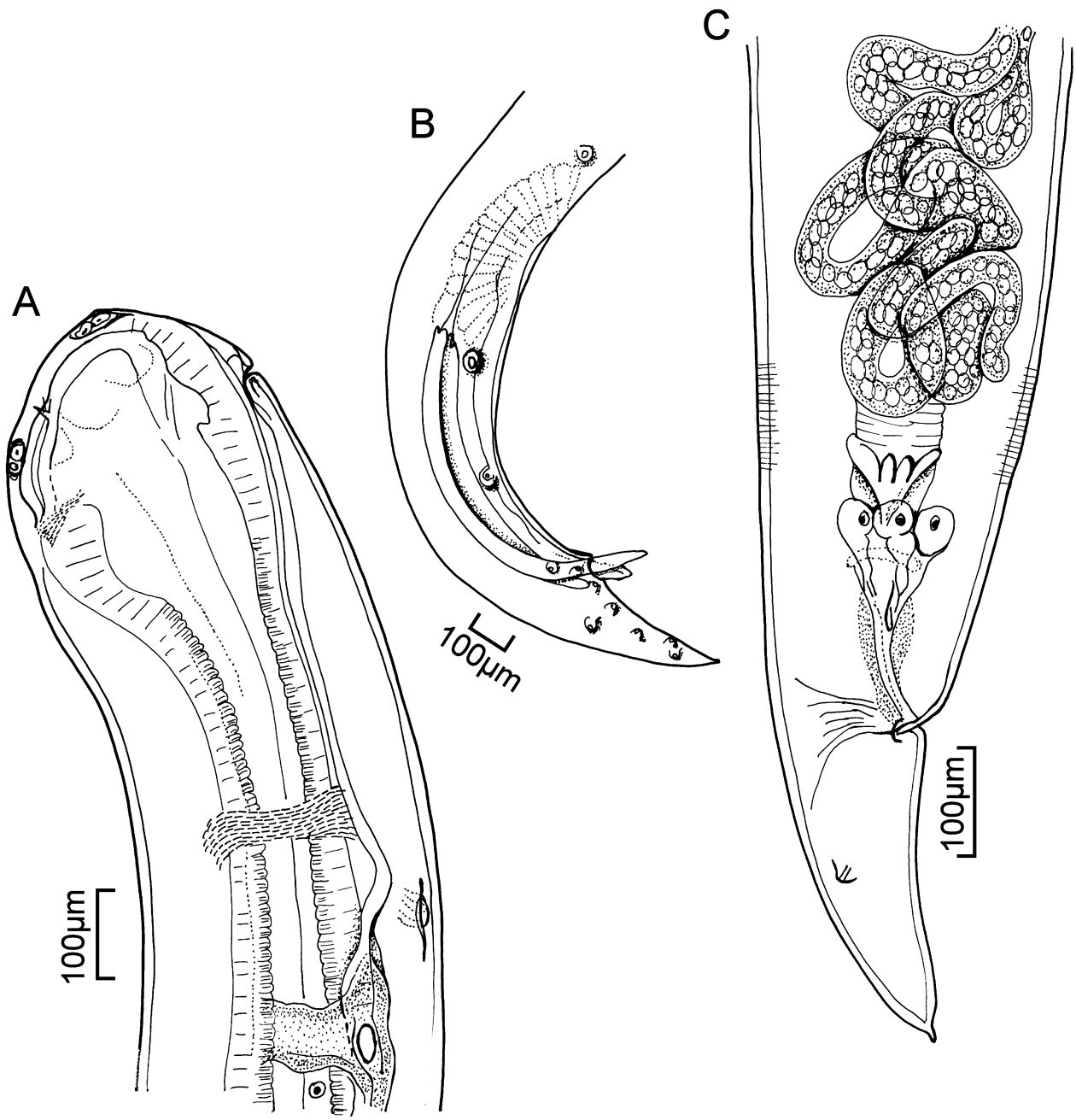

FIGURE 87. *Truttaedacnitis clitellarius* (Ward & Magath, 1917) Petter, 1974. A. male, anterior end showing excretory pore and duct, lateral view; B. male, posterior region showing pre-cloacal sucker, spicules and papillae, lateral view; C. female, posterior end showing posterior coiled ovary, rectal glands, phasmid and mucron, lateral view. (Redrawn from Choudhury & Dick 1996a)

Host: *Acipenser fulvescens*

Distribution: Canada, Central Canada, Hudson Bay Drainage, Manitoba, Ontario, Saskatchewan

Records: Bangham & Hunter 1939 (ON); Bangham 1951 (ON); Bangham 1955 (ON); Anthony 1974 (ON); Dechtiar & Christie 1988 (ON); Choudhury *et al.* 1990 (MB, SK); Swanson *et al.* 1991 (MB); Choudhury & Dick 1993 (CC); Choudhury & Dick 1996a (MB, SK); Choudhury & Dick 1996b (CA); Choudhury & Dick 1998 (HBD)

*****Truttaedacnitis pybusae*** **Anderson, 1992**

Synonym: *Truttaedacnitis stelmioides* of Pybus, Uhazy & Anderson, 1978

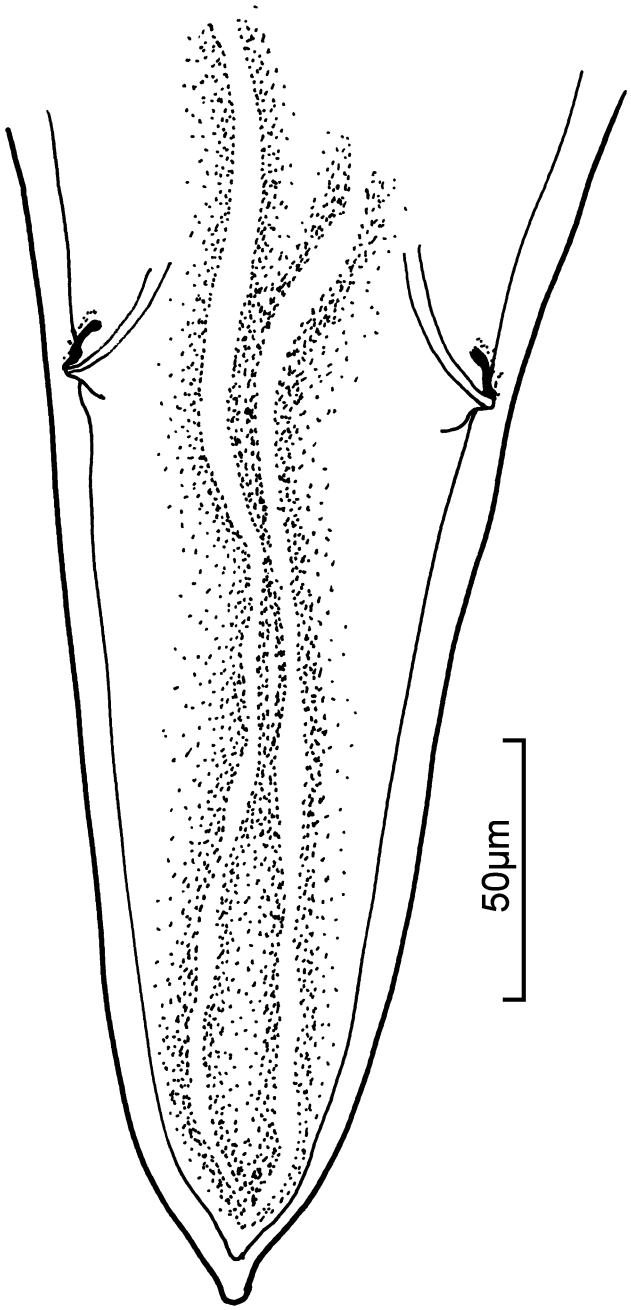

FIGURE 88. ***Truttaedacnitis pybusae* Anderson, 1992. Female, posterior end showing phasmids, ventral view. (Redrawn from Pybus *et al*. 1978a)

Description (after Pybus *et al.* 1978a). With characteristics of the genus. Slender worms with blunt anterior end and pointed, conical tail with small mucron. Cuticle smooth or with fine transverse striations. Lateral alae extend from level of nerve ring to posterior border of pre-cloacal sucker. Deirids behind nerve ring either directly opposite each either or one slightly anterior to the other. Excretory pore behind nerve ring, at same level as, or anterior to, at least one deirid. Mouth opening slit-like or triangular, dorso-ventral in position, surrounded by thin collarette containing 100 to 120 conspicuous cuticular ”teeth”. Cephalic papillae comprise four prominent double submedian papillae. Fused papillae of unequal size; larger papilla containing central cuticular rod. Amphids lateral. Six small papillae located near oral margin. Oesophagus clavate and muscular, expanding anteriorly around conical pseudobuccal capsule. Dorsal oesophageal gland nucleus prominent near posterior end oesophagus; gland opens in dorsal angle of mouth opening. Subventral oesophageal gland nuclei inconspicuous, opening at nerve ring level. Cuticle lining each angle of triradiate oesophagus thickened into paired longitudinal rods extending from near oral margin to

anterior oesophago-intestinal valve. Oesophageal rods diverge anteriorly to form pseudobuccal cavity. Cuticle lining capsule thickened to form cephalic plates separated by thin sutures (Fig. 86D). Two to four coelomocytes in body cavity.

Males: 10.2 (8.1–12.9) long; maximum width 0.31 (0.26–0.37). Nerve ring 0.370 (0.324–0.465) from anterior end. Oesophagus 0.97 (0.86–1.15) long. Tail 0.287 (0.237–0.367) long. Single testis in posterior third of body, looping anteriorly then reversing. Muscular pre-cloacal sucker lacks cuticularized rim, 8.8 (7.1–11.3) from anterior end. Spicules equal or sub-equal, 0.502 (0.382–0.650) long; cross section of spicules shows three longitudinal hollow areas running entire length. Arrangement of caudal papillae similar to that of *T. clitellarius* above (Fig. 87B). Gubernaculum Y-shaped, 0.087 (0.074–0.104) long.

Females: 11.6 (9.5–14.3) long; maximum width 0.34 (0.26–0.44). Nerve ring 0.397 (0.350–0.470) from anterior end. Oesophagus 1.040 (0.937–1.200) long. Anterior ovary in middle third of body, the posterior one in posterior third. Oviducts looping beyond vulva, then reversing and expanding into uteri. Vulva located behind midbody, anterior lip larger than posterior. Eggs near vagina in morula stage, 0.063–0.087 x 0.051–0.068. Tail bears one pair lateral papilliform phasmids (Fig. 88).

Larvae: Pybus *et al.* (1978b) and Anderson (1996) discussed the transmission of *T. pybusae*, including the morphometry of larvae in lamprey ammocoetes and "transformers". The biology of the nematode appears to be closely linked to the metamorphosis and maturation of lampreys.

Sites: gills, gonads, intestinal lumen, kidney, liver, mesenteries

Host: *Lethenteron appendix*

Distribution: Ontario

Records: Pybus *et al.* 1978a; Pybus *et al.* 1978b; Anderson 1996

***Truttaedacnitis sphaerocephala* (Rudolphi, 1809) Petter, 1974**

Synonym: *Bulbodacnitis sphaerocephala* (Rudolphi, 1809) Maggenti, 1971

Description (after Choudhury & Dick 1996b, and Moravec 2013). With characteristics of the genus. Moderately large worms with thick cuticle. Anterior end often dorsally flexed and mouth opening markedly oblique. Mouth opening bordered by cuticular collarette bearing weakly developed inconspicuous longitudinal riblike structures ("teeth"). Ventral cephalic ridge traverses ventral side at level of pseudobuccal capsule; excretory pore occurs between the two hemispheres of this ridge. Two very narrow alae extend along anterior part of body, starting below level of posterior end of pseudobuccal capsule. Two broad closely apposed cephalic plates are on either side of the mouth opening (Fig. 86B). The pseudobuccal capsule has a thickened cuticular lining surrounded by musculature that becomes progressively thinner posteriorly. Hemizonid and asymmetrical deirids behind nerve ring. Tail conical. [Measurements in square parentheses are taken from Moravec's (2013) description of European material.]

Males: 11.9–16.2 long. [11.24–22.71 long; maximum width 0.31–0.48. Nerve ring 0.468–0.640 from anterior end. Oesophagus 1.64–2.12 long. Tail conical, 0.265–0.374 long, pointed tip.] Testis single. Posterior end of body bent ventrally, with well developed pre-cloacal sucker. Spicules equal, bent [0.270–0.440 long] (Fig. 89). [Gubernaculum 0.075–0.096 long.] Arrangement of caudal papillae similar to that of *T. clitellarius* above (Fig. 87B).

Females: 15.9–18.8 long. [17.44–28.56 long; maximum width 0.30–0.48. Nerve ring 0.468–0.640 from anterior end. Oesophagus 1.89–2.28 long. Deirids asymmetrical, 0.075–0.160 from anterior end. Tail 0.374–0.562 long, conical, tip rounded with mucron.] Vulva in posterior half of body, anterior lip large, overlapping posterior lip. Eggs oval, thin-walled, [0.070–0.092 x 0.045–0.064].

Site: spiral valve

Host: *Acipenser oxyrinchus*

Distribution: Atlantic, New Brunswick

Records: Linkletter *et al.* 1977 (AT); Appy & Dadswell 1978 (NB)

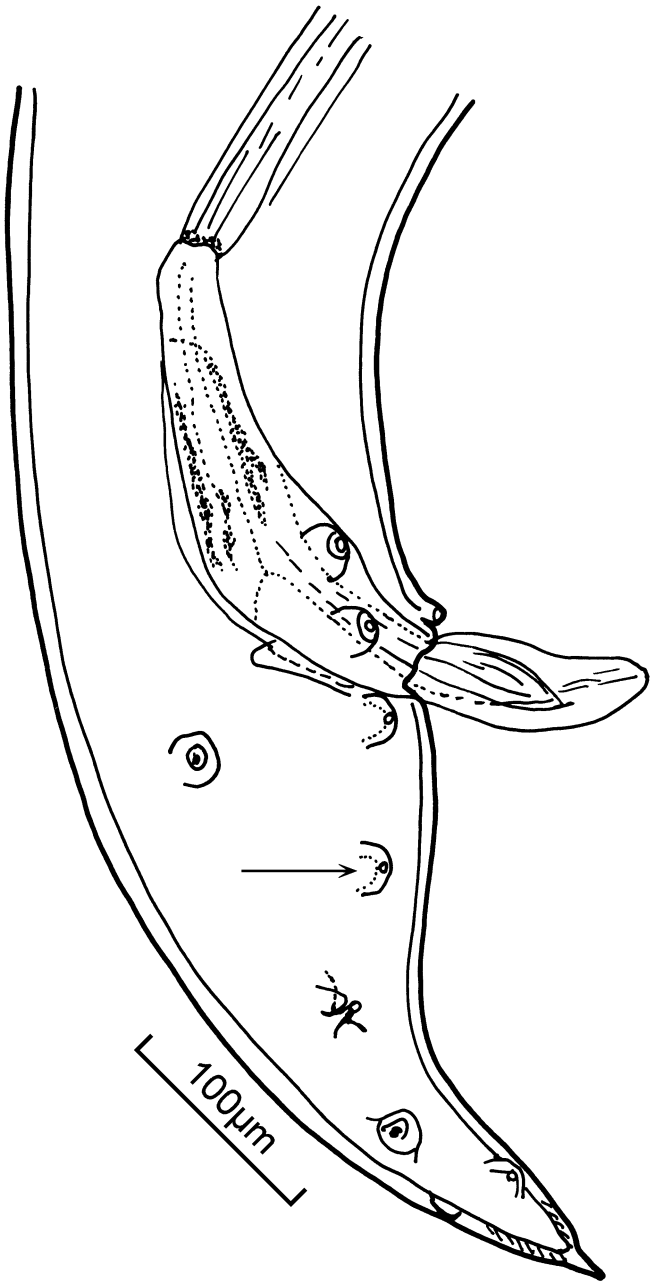

FIGURE 89. *Truttaedacnitis sphaerocephala* (Rudolphi, 1809) Petter, 1974. Male, posterior end showing papillae and bent spicules, lateral view. Arrow indicates the 9th papilla. (Redrawn from Choudhury & Dick 1996b)

***Truttaedacnitis truttae* (Fabricius, 1794) Petter, 1974**

Synonyms: *Bulbodacnitis globosa* (Zeder, 1800) Lane, 1916; *Bulbodacnitis occidentalis* Smedley, 1933; *Bulbodacnitis truttae* (Fabricius, 1794) Maggenti, 1971; *Bulbodacnitis alpinus* Mudry and McCart, 1974; *Truttaedacnitis alpinus* (Mudry and McCart, 1974) Pybus, Uhazy and Anderson, 1978

Description (after Berland 1970, and Mudry & McCart 1974). With characteristics of the genus. Medium sized worms, cuticle moderately thick, minutely striated throughout. Head bulbous, inclined dorsally. Oral aperture bordered by cuticular collarette bearing about 100 small conspicuous "teeth". Six cephalic papillae surround oral aperture. Pseudobuccal cavity with cephalic plates (Fig. 86A). Excretory pore about midway between nerve ring and oesophago-intestinal junction. Deirids located anterior to excretory pore. Tail conical, bearing button-shaped or nipple-shaped mucron (North American material) or pointed mucron (European material).

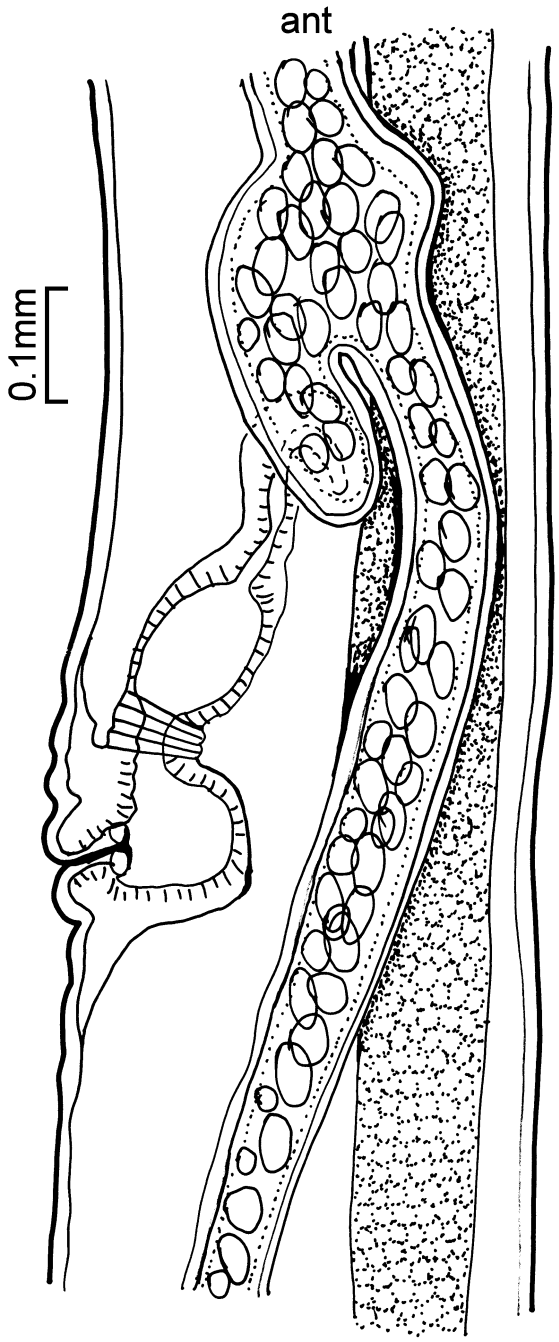

FIGURE 90. ***Truttaedacnitis truttae* (Fabricius, 1794) Petter, 1974. Female, vulvar region, lateral view. (Redrawn from Mudry & McCart 1974)

Males: 8.37–15.27 long; maximum width 0.25–0.42. Nerve ring 0.374–0.537, and excretory pore 0.584–0.931 from anterior end. Oesophagus clavate, 0.928–1.341 long. Single testis 0.36–2.04 from oesophagus base. Posterior lip of pre-cloacal sucker 0.836–1.251 from tail tip. Spicules equal, 0.455–0.537 long, not overlapping pre-cloacal sucker when fully retracted. Arrangement of caudal papillae similar to that of *T. clitellarius* above (Fig. 87B). Gubernaculum 0.107–0.134 long.

Females: 11.81–18.00 long; maximum width 0.27–0.42. Nerve ring 0.421–0.523, and excretory pore 0.612–0.877 from anterior end. Oesophagus clavate, 1.049–1.375 long. Posterior ovary extends into tail region. Vulva raised, located 7.482–11.080 from anterior end (Fig. 90). Eggs 0.044–0.054 x 0.062–0.083.

Larvae: the variety of hosts from which *Truttaedacnitis truttae* has been recovered and the extra-alimentary tract sites occupied (see below) suggest that larvae are present, though none appears to have been described *in litt*.

Sites: alimentary tract, gills, gonads, intestinal lumen, kidneys, liver, mesenteries, pyloric caeca

Hosts: *Coregonus clupeaformis* (13); *Oncorhynchus clarkii* (2); *Oncorhynchus mykiss* (1, 2, 7, 8, 9, 10, 11, 12, 13, 19); *Oncorhynchus nerka* (10, 13); *Petromyzon marinus* (3, 4); *Prosopium cylindraceum* (2); *Prosopium williamsoni* (2, 7, 8, 10, 11, 13, 18); *Ptychocheilus oregonensis* (10, 13); *Salvelinus alpinus* (5, 6); *Salvelinus fontinalis* (2, 14, 15, 16, 17, 19); *Salvelinus malma* (2, 8, 10, 11, 13, 19); *Salvelinus namaycush* (7, 8, 11, 13, 19)

Distribution: Alberta, British Columbia, New Brunswick, Ontario, Yukon Territory

Records: 1. Smedley 1933 (BC); 2. Bangham & Adams 1954 (BC); 3. Wilson 1967 (ON); 4. Wilson & Ronald 1967 (ON); 5. Mudry & McCart 1974 (YT); 6. Mudry & McCart 1976 (YT); 7. Mudry & Anderson 1977 (AB); 8. Anon. 1978 (BC); 9. Russell 1980 (BC); 10. Anon. 1981 (BC); 11. Arai & Mudry 1983 (BC); 12. Dunn *et al.* 1983 (BC); 13. Anon. 1984 (BC); 14. Frimeth 1986 (NB); 15. Frimeth 1987a (NB); 16. Frimeth 1987b (NB); 17. Marcogliese & Cone 1991a (NB); 18. Nener *et al.* 1995 (BC); 19. Choudhury & Dick 1996b (BC, NB, YT)

Truttaedacnitis sp.

Site: ?

Hosts: *Mylocheilus caurinus*; *Prosopium cylindraceum*; *Prosopium williamsoni*; *Rhinichthys cataractae*; *Richardsonius balteatus*; *Salvelinus fontinalis*

Distribution: British Columbia

Record: Bangham & Adams 1954

Cucullanus Mueller, 1777

Synonym: *Indocucullanus* Ali, 1956

Generic diagnosis (after Berland 1970, and Moravec 2013). Cucullanidae. Mouth opening perpendicular to body axis or slightly inclined dorsally, and supported by peribuccal cuticularized frame to which are joined some cuticularized pieces inserted into adjacent oesophageal muscles. Lips and pseudolabia absent. External circle of eight cephalic papillae arranged in incompletely fused pairs; inner circle of six very small papillae near border of mouth opening. Amphids at level of external circle of papillae. Oesophagus undivided, expanded both anteriorly and posteriorly. Intestinal caecum absent. Pre-cloacal sucker of males lacking sclerotized rim. Caudal alae absent. Spicules equal. Gubernaculum present. Vulva near middle of body. Vagina directed anteriorly. Two ovaries. Oviparous, eggs thin-walled.

Key to species of *Cucullanus*

1	Males and females over 25 mm long	*C. elongatus*
-	Males and females less than 21 mm long	2
2	Cuticle with prominent transverse annulations anteriorly	*C. annulatus*
-	Cuticle with only fine transverse striations throughout	3
3	Males 5.3–9.2 mm, females 7.5–12.3 long; parasites of flatfishes	*C. heterochrous*
-	Males 9.5–14.7 mm, females 12.9–20.8 mm long; parasites mainly of Gadidae and Merlucciidae	*C. cirratus*

Cucullanus annulatus Margolis, 1960

Synonym: *Cucullanus* of Arai (1967 *partim*)

Description (after Margolis 1960). With characteristics of the genus.

Males: slender, 2.21–5.50 long, anterior end bent dorsad to varying degrees, and tail curved ventrad. Head

slightly swollen, 0.12–0.18 wide. Body narrows behind head towards mid-oesophageal region then widens again to 0.10–0.25 just behind oesophagus. Body tapers gradually from post-oesophageal region to cloaca and then abruptly

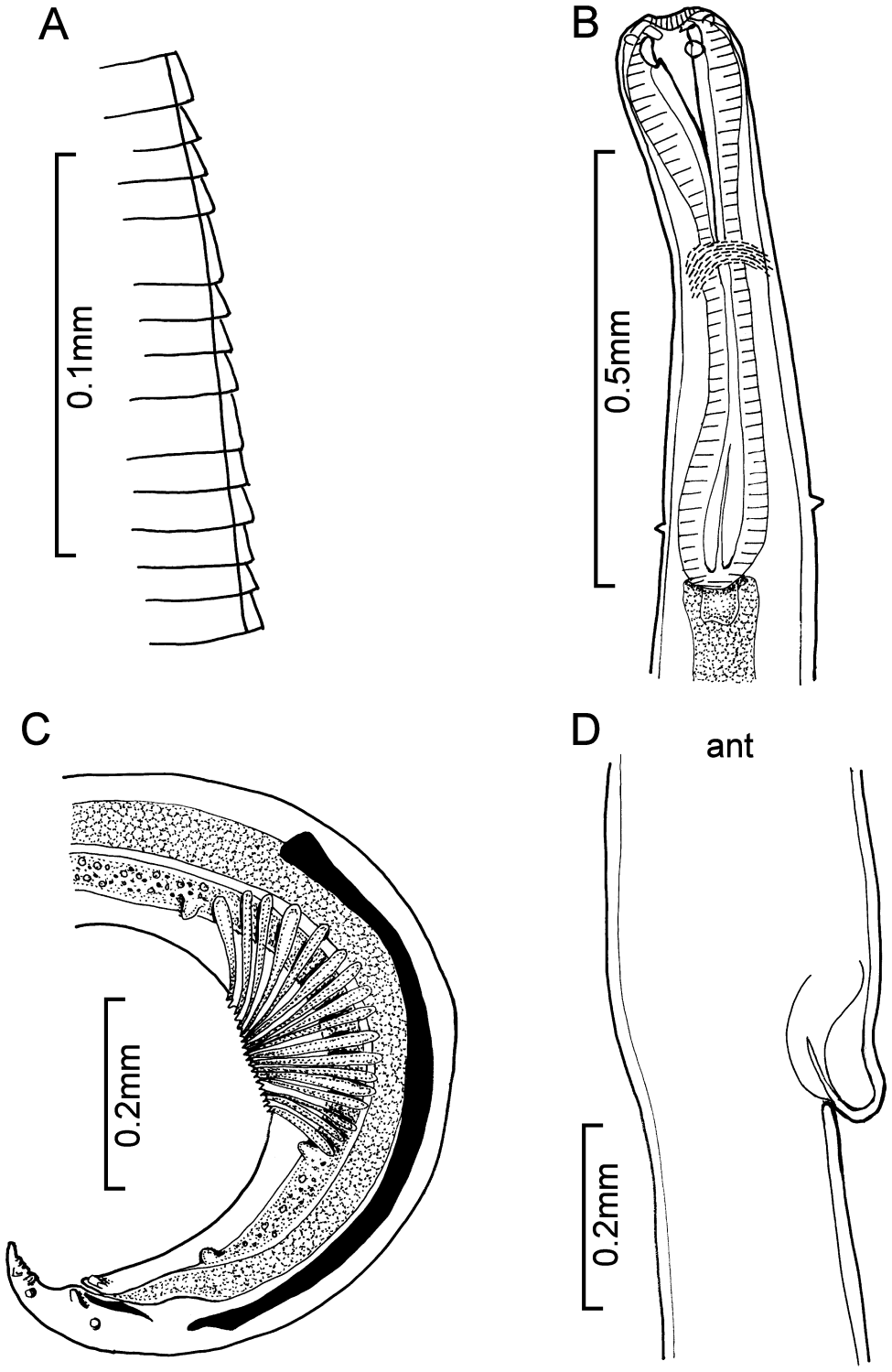

FIGURE 91. *Cucullanus annulatus* Margolis, 1960. A. cuticle of ventral oesophageal region; B. male, anterior end, ventral view; C. male, posterior end, pre-cloacal sucker, lateral view; D. female, vulvar region, lateral view. (Redrawn from Margolis 1960)

to pointed extremity; tail 0.083–0.13 long. Cuticle, 0.002–0.005 thick, appears devoid of transverse striations in posterior half, and very fine striations are barely discernible about mid-length of body, more anteriorly striations become more definite and farther apart; ventrally from a short distance posterior to the oesophago-intestinal

junction to the anterior oesophageal swelling they are more properly termed annulations (Fig. 91A). Attached to cuticular collar surrounding mouth is a continuous membranous flange with many small teeth on internal face. Head with two pairs of cephalic papillae and one pair of lateral amphids. Internally there is a chitinous framework around mouth opening. Oesophagus 0.43–0.70 long, enlarged anteriorly, narrows at midlength then expands again to a swelling less pronounced than the anterior one (Fig. 91B). Two-lobed valve projects from oesophagus into intestine. Intestine opens into short rectum which receives ejaculatory duct to form a cloaca. Nerve ring 0.21–0.30 from anterior end. Lateral cervical papillae 0.026–0.097 anterior to oesophago-intestinal junction. Excretory pore 0.057–0.17 behind oesophagus. Testis originates at about level of anterior margin of pre-cloacal sucker, follows straight course anteriorly then turns back on itself to join seminal vesicle. Pre-cloacal sucker in lateral view appears as fan-shaped group of muscles that when contracted take the form of cup-shaped sucker; it is 0.14–0.29 long and its posterior margin is 0.18–0.37 in front of cloaca. Eleven pairs of caudal papillae. Slender spicules, 0.47–0.76 long, pointed distally and slightly enlarged proximally (Fig. 91C). Gubernaculum 0.065–0.085 long.

Females: egg-bearing specimens 5.16–9.43 long. Dorsal flexure of head not as pronounced as in males. Width at head and posterior end of oesophagus 0.12–0.15 and 0.15–0.21 respectively. Tail pointed, 0.15–0.24 long. Cuticle 0.004–0.008 thick. Cuticular annulations, mouth and associated structures like those of males. Nerve ring 0.28–0.33 from anterior end. Lateral cervical papillae 0.07–0.16 anterior to posterior end of oesophagus. Another pair of lateral papillae occurs about mid-length of the tail. Excretory pore 0.10–0.29 posterior to oesophagus. Vulva, overhung by prominent anterior lip, 3.1–6.1 from anterior end (Fig. 91D). Vagina directed anteriorly joins divergent uteri. Eggs, thin-shelled, 0.072–0.085 x 0.042–0.050.

Site: intestinal lumen

Hosts: *Microstomus pacificus* (4); *Parophrys vetulus* (1, 4); *Platichthys stellatus* (2, 3);

Distribution: Pacific

Records: 1. Margolis 1960; 2. Arai 1967a; 3. Arai 1969; 4. Kabata & Whitaker 1984

Cucullanus cirratus Müller, 1777

Description (after Berland 1970). With characteristics of the genus. Head slightly swollen and bent dorsad, with characteristic two pairs cephalic papillae and one pair amphids. Mouth bordered externally by collarette, bearing on its inner face many (60 to 70) small teeth on each side. Body widest just behind oesophagus. Excretory pore about midway between nerve ring and oesophago-intestinal junction. Deirids about midway between excretory pore and nerve ring (Fig. 92A). Cuticle with fine striations throughout body.

Males: 10.4–14.7 long; maximum width 0.26–0.32. Oesophagus 1.33–1.62 long. Nerve ring 0.474–0.586, deirids 0.744–0.944 and excretory pore 0.960–1.157 from anterior end. Anus to tail tip 0.218–0.296. Cuticle 0.006–0.007 thick. Right spicule 0.915–0.978 long, left one 0.914–1.02 long. Y-shaped gubernaculum 0.160–0.178 long. Pre-cloacal sucker without cuticular rim present. Eleven pairs caudal papillae (Fig. 92B).

Females: 13.1–20.8 long; maximum width 0.29–0.44. Oesophagus 1.47–1.95 long. Nerve ring 0.525–0.653, deirids 0.82–1.08, excretory pore 1.02–1.34 and vulva 7.50–11.72 from anterior end. Anus to tail tip 0.460–0.514. Cuticle 0.005–0.007 thick. Anterior end to vulva 7.50–11.72 (Fig. 92C). Eggs 0.075–0.098 x 0.041–0.052.

Sites: intestinal lumen, stomach

Hosts: *Gadus morhua* (2, 4); *Hippoglossus hippoglossus* (7); *Melanogrammus aeglefinus* (1, 3); *Pollachius virens* (5); *Urophycis tenuis* (6)

Distribution: Atlantic

Records: 1. Kuitunen-Ekbaum 1937b; 2. Gaevskaya & Umnova 1977; 3. Scott 1981; 4. Appy & Burt 1982; 5. Scott 1985; 6. Scott 1987; 7. Scott & Bray 1989

Cucullanus elongatus Smedley, 1933

Synonym: *Cucullanus smedleyi* Campana-Rouget, 1957

Description (after Berland 1983). With characteristics of the genus. Body exceptionally long for a cucullanid, up to

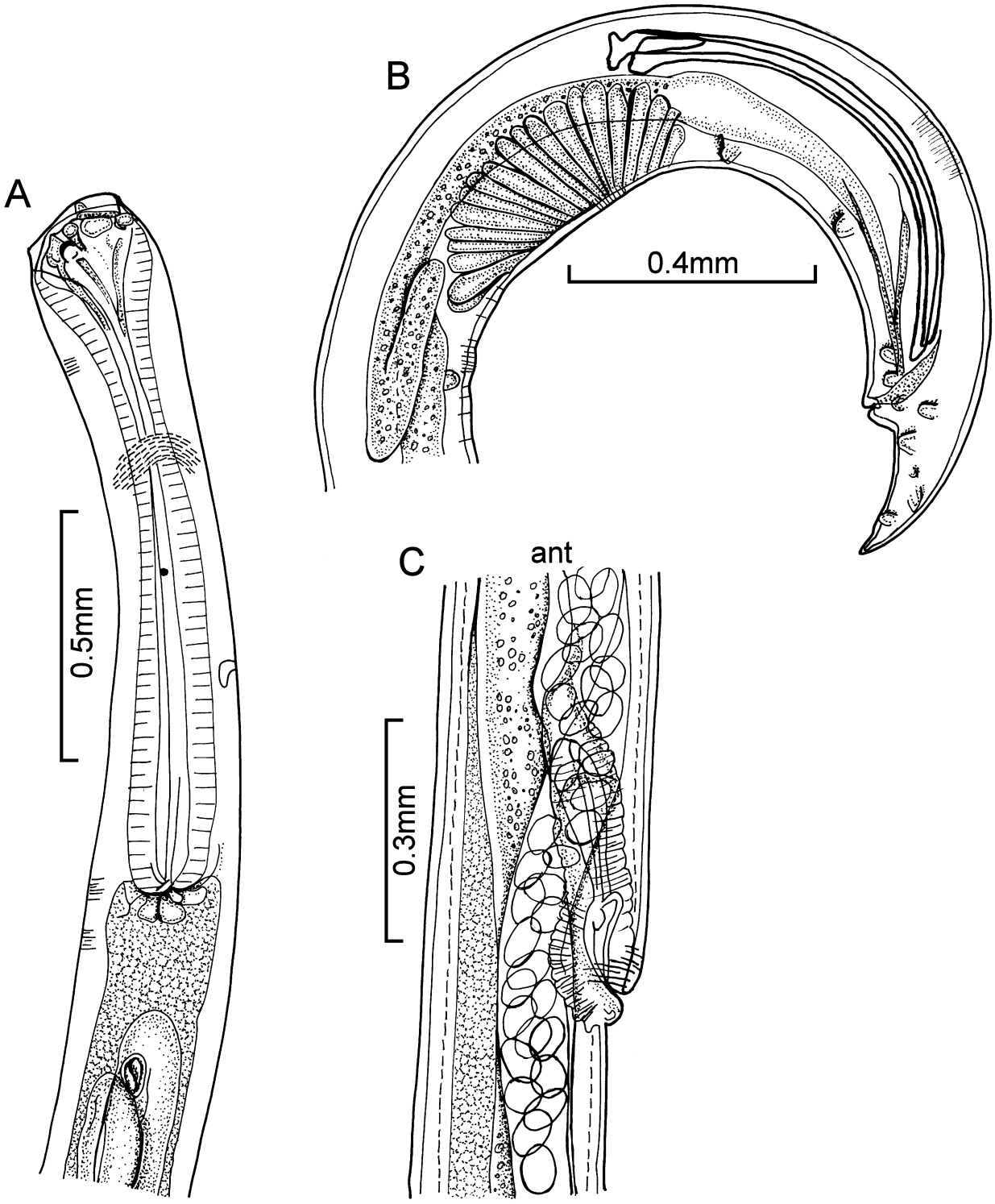

FIGURE 92. *Cucullanus cirratus* Müller, 1777. A. anterior end, lateral view; B. male, posterior end, lateral view; C. female, vulvar region. (Redrawn from Berland 1970)

over 30 in males, and 40 in females. Head rounded, slit-like mouth opening shifted slightly to dorsal side. Double club-shaped oesophagus. Narrow isthmus between anterior and posterior swollen portions of oesophagus surrounded by nerve ring. Excretory pore between nerve ring and intestine. Cuticle thin in anterior body, increasing to about 0.007 at mid-body, and to about 0.010 near anus. Cuticular striations relatively fine throughout. Pair of lateral deirids at about level of mid-oesophagus, and pair of lateral papillae near mid-body (Fig. 93A). Mouth opening oval, surrounded by collarette, provided on inner face with about 60 short triangular teeth on each side.

Two pairs of large cephalic papillae and one pair lateral amphids external to collarette. Raised, smooth, tubular peribuccal rim lying internal to collarette. Posterior to peribuccal rim on each side a large, bilobed, rounded structure ("peribuccal tooth") projects into pseudobuccal capsule. Cuticular lining of oesophagus and pseudobuccal capsule complex, with cuticular structures extending into surrounding muscles. Tail simple and conical, tapering evenly to a point.

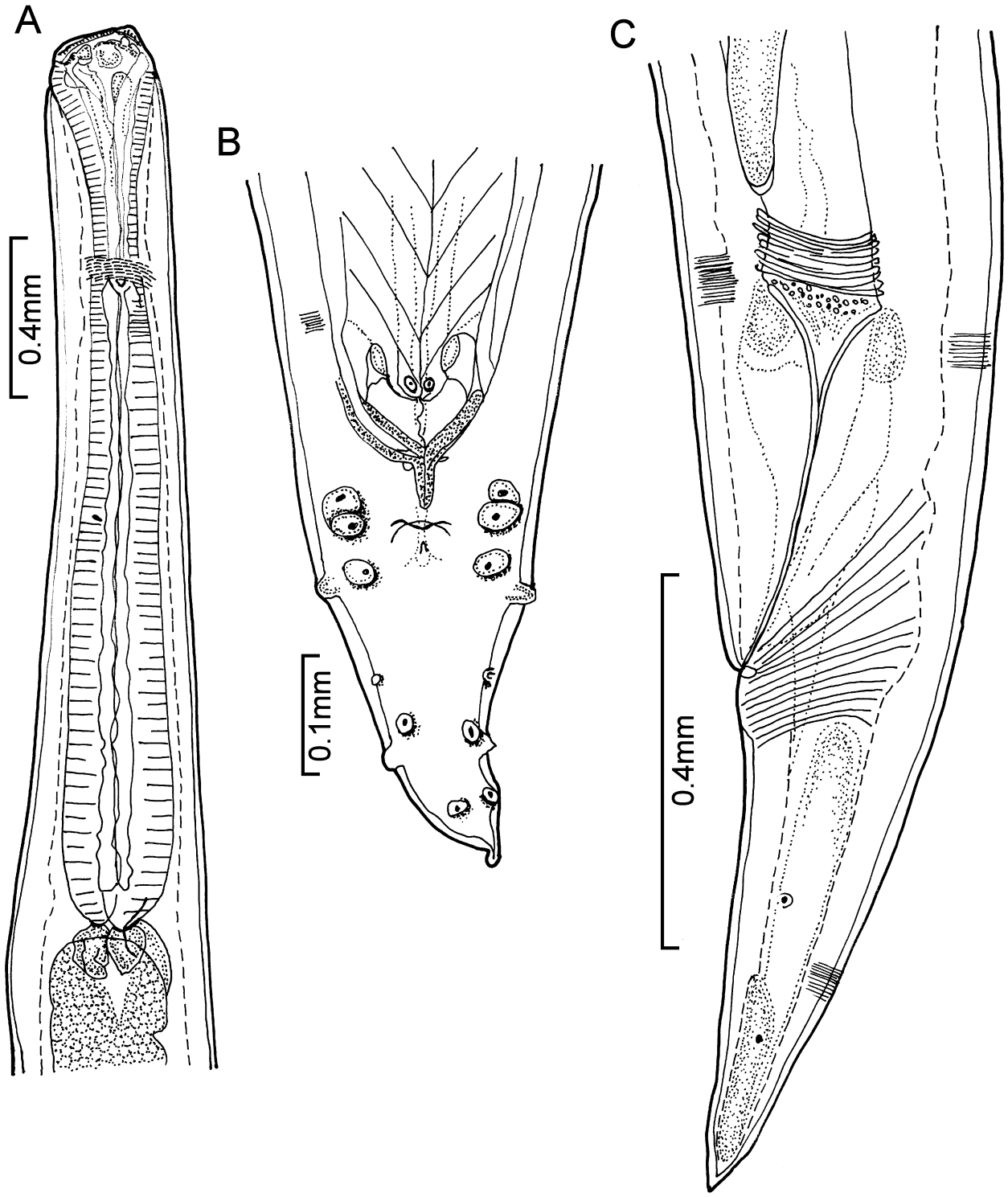

FIGURE 93. *Cucullanus elongatus* Smedley, 1933. A. anterior end, lateral view; B. male, posterior end, ventral view; C. female, posterior end, lateral view. (Redrawn from Berland 1983)

Males: 25.54–30.90 long, tapering posteriorly but widening at pre-cloacal sucker; maximum width 0.33–0.40. Oesophagus 1.96–2.32 long. Nerve ring 0.53–0.60, deirids 1.18–1.44 and excretory pore 1.59–1.79 from anterior end. Small spine on post-cloacal wall. Testis single, in anterior body, a loop extends forward to some distance posterior to oesophagus. Left spicule 1.19–1.45, and right spicule 1.19–1.52 long. Gubernaculum 0.064–0.101 long. Proximal cavity or sac ventral to gubernacular limbs, Y-shaped in ventral view. Ten pairs caudal papillae: five pairs pre-cloacal, five pairs post-cloacal. One pair small phasmids (Fig. 93B).

Females: 38.41–43.25 long; maximum width 0.47–0.54. Oesophagus 2.21–2.51 long. Nerve ring 0.60–0.63, deirids 1.29–1.48, excretory pore 1.64–2.05 and vulva 21.38–24.74 from anterior end. Phasmids at about mid-length of long tapering tail (Fig. 93C). Eggs 0.082–0.099 x 0.040–0.047.

Site: intestinal lumen

Hosts: *Ophiodon elongatus* (1, 2, 5); *Sebastes caurinus* (3, 4); *Sebastes maliger* (4); *Sebastes nebulosus* (6); *Sebastes ruberrimus* (4)

Distribution: Pacific

Records: 1. Smedley 1933; 2. Margolis 1952b; 3. Arai 1969; 4. Sekerak & Arai 1977; 5. Berland 1983; 6. Holmes 1990

Cucullanus heterochrous Rudolphi, 1802

Description (after Berland 1970). With characteristics of the genus. Body fairly stout and of even breadth, greatest width just behind oesophagus. Head straight or slightly bent dorsally, and only slightly swollen. Cuticle transversely striated throughout, 0.003–0.007 thick. Mouth a dorso-ventral slit. Collarette surrounding the mouth well developed, the inner face with about 50 teeth on either side. Characteristic two pairs large papillae and one pair amphids on head. Internal circle of six relatively large papillae. Dorsal half of pseudobuccal capsule wide. Peribuccal rim lies well within mouth opening. Oesophagus relatively short, straight at nerve ring level but slightly dilated just behind it (Fig. 94A).

Males: 5.33–7.55 long; maximum width 0.17–0.22. Oesophagus 0.77–0.94 long. Nerve ring 0.31–0.38, deirids 0.69–0.75 and excretory pore 0.91–1.08 from anterior end. Pre-cloacal sucker present. Left spicule 0.78–1.08 long, right spicule 0.71–0.97 long; one spicule, usually the left one, has a screw-like tip, whilst the other is usually straight and more blunt. Both spicules carry broad alae. Gubernaculum 0.046–0.059 long. Pointed tail narrows abruptly behind cloaca. In addition to the usual 11 pairs of caudal papillae there is one large median papilla behind the cloaca (Fig. 94B).

Females: 7.50–10.78 long; maximum width 0.21–0.29. Oesophagus 0.93–1.03 long. Nerve ring 0.37–0.42, deirids 0.82–0.96, excretory pore 1.11–1.19 and vulva 4.56–6.50 from anterior end. Protrusion (“post-cloacal lip”) behind anus (Fig. 94C). Eggs 0.072–0.091 x 0.042–0.049.

Site: alimentary tract

Hosts: *Hippoglossus stenolepis* (2, 3); *Limanda ferrugineus* (1); *Pseudopleuronectes americanus* (1)

Distribution: Atlantic, Pacific

Records: 1. Ronald 1963 (AT); 2. Blaycock 1996 (PA); 3. Blaycock *et al.* 1998a (PA)

Cucullanus sp.

Site: intestinal lumen

Hosts: *Cymatogaster aggregata* (2, 4, 5); *Fundulus diaphanus* (6); *Oncorhynchus kisutch* (5); *Parophrys vetulus* (1); *Perca flavescens* (8); *Platichthys stellatus* (3); *Paraplagusia bilineata* (3, 5); *Ronquilus jordani* (3, 5); *Sebastes aleutianus* (7); *Sebastes alutus* (7); *Sebastes babcocki* (7); *Sebastes borealis* (7); *Sebastes crameri* (7); *Sebastes flavidus* (7); *Sebastes paucispinis (*7); *Sebastes ruberrimus* (7)

Distribution: Atlantic, Ontario, Pacific

Records: 1. Margolis 1952a (PA); 2. Arai 1964 (PA); 3. Arai 1967a (PA); 4. Arai 1967b (PA); 5. Arai 1969 (PA); 6. Wiles 1975 (AT); 7. Sekerak & Arai 1977 (PA); 8. Anthony 1978b (ON)

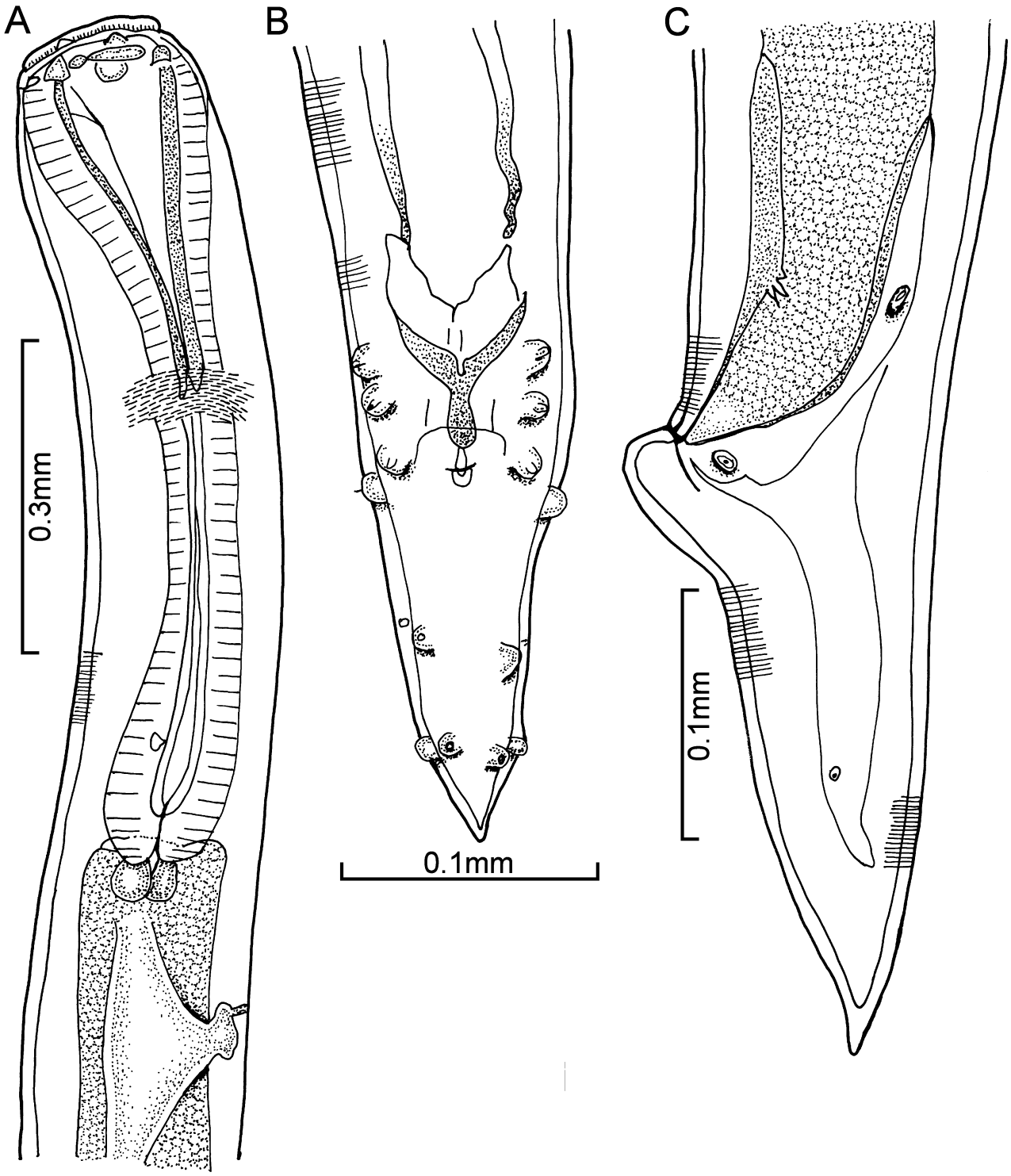

FIGURE 94. *Cucullanus heterochrous* Rudolphi, 1802. A. anterior end, lateral view; B. male, tail, ventral view; C. female, tail, lateral view. (Redrawn from Berland 1970)

Dichelyne Jägerskiöld, 1902

Generic diagnosis (after Moravec 2013). Cucullanidae. Mouth opening perpendicular to body axis. Pseudobuccal capsule laterally narrowed. Three small papillae on either side of mouth opening. Oesophagus simple, undivided. Dorsal intestinal caecum present. Pre-cloacal sucker absent. Spicules equal and similar. Gubernaculum present. Vulva behind middle of body. Two ovaries. Oviparous.

One species, *D. robustus*, is known from two species of *Ameiurus* in Canada.

Dichelyne robustus (Van Cleave & Mueller, 1932) Mueller, 1933

Synonym: *Dacnitoides robusta* Van Cleave & Mueller, 1932

Description (after Van Cleave & Mueller 1932). With characteristics of the genus. Body robust, with conspicuous cuticular thickening from oral region to beyond limit of oesophagus. Prominent pair of amphids or cephalic papillae near posterior limit of oesophagus. Oesophagus 0.38–0.43 long. Ventral intestinal caecum extends anteriorly almost to buccal cavity (Fig. 95A).

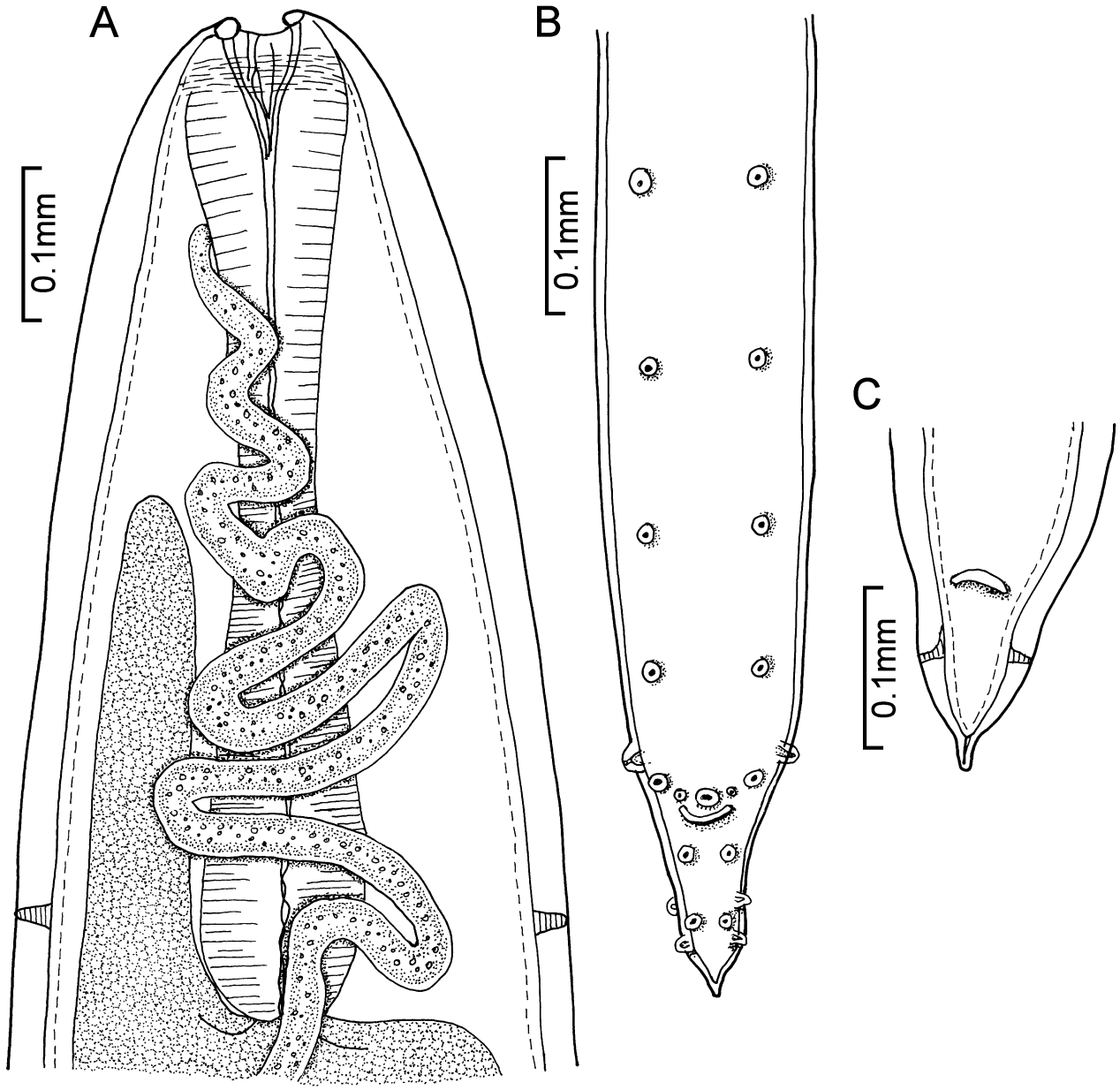

FIGURE 95. *Dichelyne robustus* (Van Cleave & Mueller, 1932) Mueller, 1933. A. female, anterior end, dorsal view; B. male, posterior end, ventral view; C. female, tail, ventral view. (Redrawn from Van Cleave & Mueller 1932)

Males: 4.25–4.50 long; width about 0.32. Pre-cloacal sucker absent. Four pairs of pre-cloacal and four pairs of post-cloacal papillae. One median and three pairs of lateral papillae just anterior to cloaca (Fig. 95B). Spicules relatively short; when withdrawn they appear tubular but when extruded are broad, ribbon-like, with frilled tips. Gubernaculum apparently absent.

Females: about 5.0 long; width 0.47–0.51. Ovarian coils extend almost to anterior end of body (Fig. 93A). Vulva short distance behind mid-body. Anus about 0.15 from tail tip. Pair minute lateral papillae in middle of post-cloacal region. Tail bears spine with "the structure of a sensory papilla" (Fig. 95C).

Comments: the original description of *D. robustus* is inadequate and, according to Caspeta-Mandujano *et al*. (1999), type specimens are not available in the US National Parasite Collection, Beltsville, Maryland—collections that have been transferred to the Smithsonian Institution, National Museum of Natural History (Washington, DC, USA). It seems that Maggenti (1971) was not first to transfer *Dacnitoides robusta* to *Dichelyne* as "*Dichelyne robusta*" [= *Dichelyne robustus*]. The *n.comb.* appears to have been first proposed by Mueller (1933).

Site: intestinal lumen

Hosts: *Ameiurus melas* (2); *Ameiurus nebulosus* (1)

Distribution: Manitoba, Ontario

Records: 1. Bangham 1955 (ON); 2. Choudhury & Nadler 2016 (MB)

Dichelyne sp.

Site: ?

Host: *Etheostoma nigrum*

Distribution: Ontario

Record: Bangham 1955

Cucullanellus Törnquist, 1931

Generic diagnosis (after Bykhovskaya-Pavlovskaya *et al*. 1964). Cucullanidae. Anterior end of body not inflated or only slightly so. Lateral alae absent. Mouth opening transverse to body axis or slightly inclined dorsally. Pseudobuccal capsule a laterally compressed slit. Three small papillae on each side of mouth opening. Oesophagus expanded at both ends. Ventral intestinal caecum present. Males with pre-cloacal sucker. First three pairs of caudal papillae distributed anteriorly. Spicules equal or nearly so. Gubernaculum present. Vulva behind mid-body.

Key to species of *Cucullanellus*

1	Cuticle 0.020-0.050 thick; mouth opening slightly inclined dorsally	*C. cotylophora*
-	Cuticle thinner than 0.020; mouth opening transverse to body axis	2
2	Ventral intestinal caecum not reaching nerve ring	*C. kanabus*
-	Ventral intestinal caecum reaches nerve ring, its apex sometimes double	*C. minutus*

Cucullanellus cotylophora (Ward & Magath, 1917) Petter, 1974

Synonyms: *Dacnitoides cotylophora* Ward & Magath, 1917; *Dichelyne cotylophora* (Ward & Magath, 1917) Gendre 1927 (?1928)

Description (after Baker 1984). With characteristics of the genus. Body robust. Cuticle relatively thick, 0.020–0.050 near mid-body, with faint irregularly spaced striations. Mouth opening slightly inclined dorsally, dorso-ventrally elongated in large specimens, surrounded by raise collarette with rib-like thickenings. Six small inner labial papillae, and four outer double cephalic papillae present. Cheilostom absent. In large worms (> 5 mm long), oesophastom well developed, consisting of anterior dorso-ventrally elongate ring forming the mouth and extending posteriorly in a funnel-shaped triradiate structure lining the lumen of anterior third of oesophagus; three lobes of funnel portion with sharp processes on outer edges

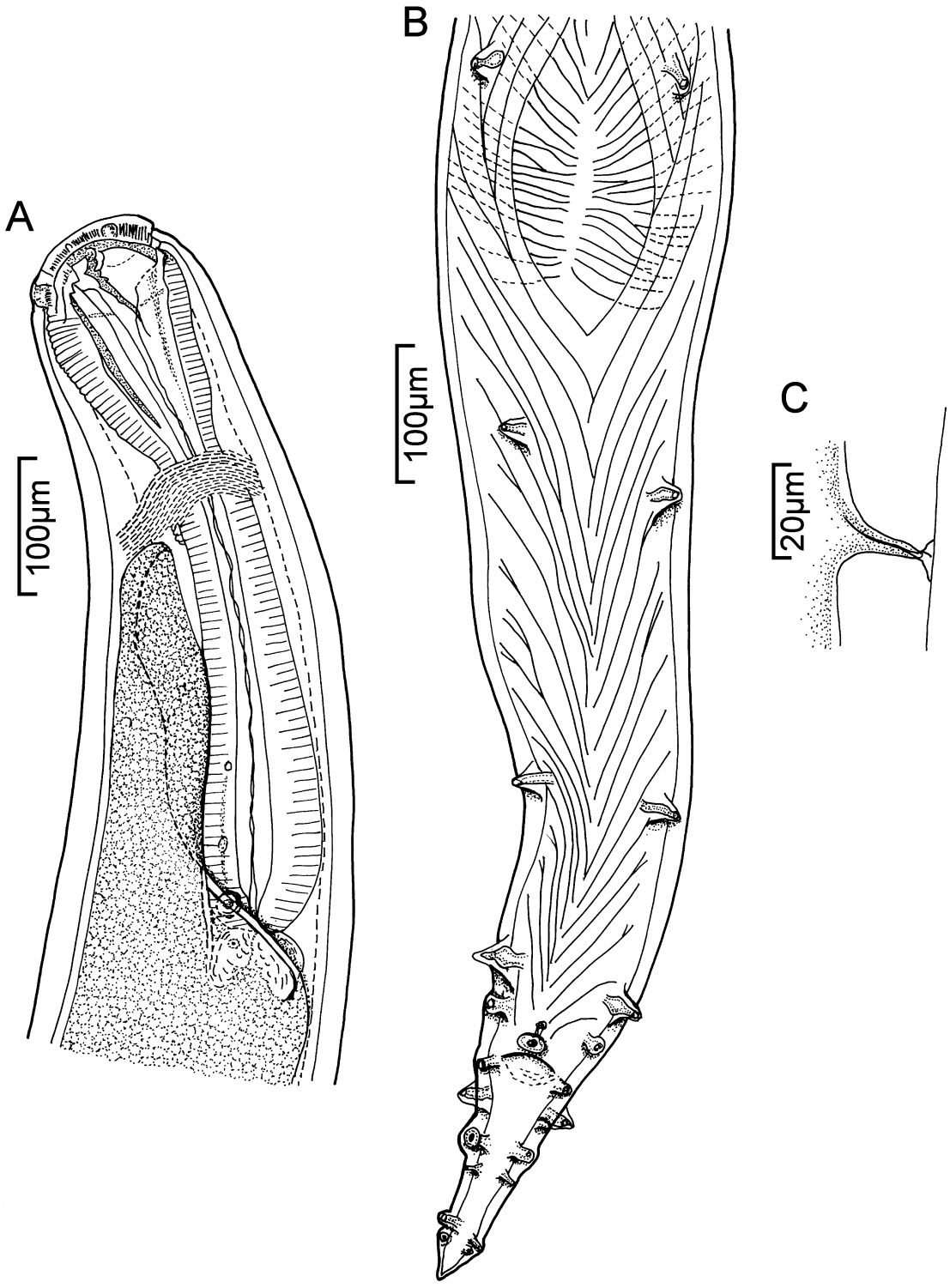

FIGURE 96. *Cucullanellus cotylophora* (Ward & Magath, 1917) Petter, 1974. A. large male [> 5 mm long], anterior end, lateral view; B. large male, posterior end, ventral view; C. phasmid of gravid female, dorsal view. (Redrawn from Baker 1984a)

extending into oesophageal musculature; ventral edge of oesophastomal ring with short bilobed process extending on top of adjacent oesophageal tissue; dorso-lateral edges of ring with pair of blindly ending, wide, flat cuticular processes extending posteriorly over exterior surface of oesophagus; lateral edges of ring with pair of blindly ending elongate processes extending posteriorly over surface of oesophagus and connected to lining of oesophageal lumen by thin cuticular connective running through oesophagus. In small worms (< 2 mm long)

oesophastom relatively weakly sclerotized, oesophastomal ring more ovoid in apical view than in larger worms; dorso-lateral and lateral pairs of blindly ending processes on ring relatively short and undeveloped; lumen of oesophastom relatively thin. Oesophagus wide at anterior and posterior ends. Excretory pore posterior to oesophagus. Ventral intestinal caecum well developed in large worms, extending anterior to oesophagus; less well developed in small worms (Fig. 96A). Anterior pair of digitiform deirids near posterior end of oesophagus; another pair deirid-like digitiform papillae just posterior to mid-body.

Males: 1.14–6.48 long. Oesophagus 0.212–0.567 long. Nerve ring 0.084–0.208, and excretory pore 0.253–0.824 from anterior end. Tail 0.078–0.151, spicules 0.233–1.024, and gubernaculum 0.050–0.098 long. Ten pairs and one unpaired caudal papillae present (Fig. 96B): tail with one lateral pair, two subventral pairs, and one subdorsal pair; area adjacent to and just anterior to cloaca with three pairs closely spaced subventral papillae and one unpaired papilla on cloacal lip; pre–cloacal region with three pairs subventral papillae distributed relatively anteriad. Large pair lateral phasmids near middle of tail. Large mature males with 18 pairs muscle cells extending to large protruding pre-cloacal sucker. Small males have poorly developed sucker, not protruding. Spicules of large worms heavily sclerotized with lateral alae in medial portion; in small worms spicules weakly sclerotized, alae not differentiated. Gubernaculum heavily sclerotized in large worms. Testis relatively undifferentiated in small worms, not patent with developing *vas deferens*. Testis connected to *vas deferens* when worms 2.2 long; sexual maturity seen at 3.5 long.

Females: 1.19–7.17 long. Oesophagus 0.221–0.655 long. Nerve ring 0.074–0.229, excretory pore 0.291–0.914, and vulva 0.075–4.47 from anterior end. Tail 0.086–0.191 long, conical with pair large lateral phasmids near middle (Fig. 96C). Amphidelphic, each uterus with up to 100 eggs at 1–4 cell stage. Eggs 0.070–0.073 x 0.047–0.055.

Site: intestinal lumen

Hosts: *Ambloplites rupestris* (6); *Ameiurus melas* (2); *Ameiurus nebulosus* (3); *Aplodinotus grunniens* (2, 13); Centrarchidae gen. sp. (17); *Esox americanus vermiculatus* (2); *Lepomis gibbosus* (19); *Lepomis macrochirus* (2); *Lota lota* (10, 18); *Luxilus cornutus* (16); *Micropterus dolomieu* (2, 6, 19, 21); *Micropterus salmoides* (2, 6); *Morone americana* (9, 19); *Morone chrysops* (2, 14); *Perca flavescens* (1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 15, 16, 19, 20, 21, 22, 23); *Sander vitreus* (2, 6, 19)

Distribution: Manitoba, Ontario, Quebec

Records: 1. Smedley 1934 (ON); 2. Bangham & Hunter 1939 (ON); 3. Bangham 1941 (ON); 4. Bangham & Venard 1946 (ON); 5. Worley & Bangham 1952 (QC); 6. Bangham 1955 (ON); 7. Tedla 1969 (ON); 8. Tedla & Fernando 1969a (ON); 9. Tedla & Fernando 1969b (ON); 10. Dechtiar 1972a (ON); 11. Tedla & Fernando 1972 (ON); 12. Cannon 1973 (ON); 13. Anthony 1982 (ON); 14. Anthony 1984 (ON); 15. Baker 1984a (ON); 16. Baker 1984b (ON); 17. Anthony 1985 (ON); 18. Anthony 1987 (ON); 19. Dechtiar & Christie 1988 (ON); 20. Dechtiar & Lawrie 1988 (ON); 21.Dechtiar & Nepszy 1988 (ON); 22. Dechtiar *et al.* 1988 (ON); 23. Choudhury & Dick 1996b (MB)

Cucullanellus kanabus Walder & Arai, 1974

Synonym: *Cucullanus* sp. of Arai (1967, 1969 *partim*)

Description (after Walder & Arai 1974). With characteristics of the genus. Relatively slender worms, head not enlarged. Cuticle 0.002–0.009 thick, with fine striae visible only in larger worms. Mouth a dorso-ventral slit, transverse to body axis, surrounded by short collarette bearing many small teeth. Two lateral amphids and 4 submedian cephalic papillae present. Oesophagus with sclerotized lining, dilated anteriorly as a laterally compressed pseudobuccal capsule. Dorsally, capsule lining produced into lateral plates appearing in dorsal view as a pair of anterior horn-shaped structures and a pair of broad, blade-like structures tapering posteriorly and extending almost to nerve ring level. Anterior portion of capsule a thickened sclerotized rim with short angular block ventrally. Oesophago-intestinal valve consisting of two lateral lobes. Ventral intestinal caecum not reaching nerve ring (Fig. 97A). Both sexes with tapering tail.

Males: 3.05–7.48 long maximum width 0.084–0.20. Posterior end curved ventrally, tail 0.065–0.11 long. Oesophagus 0.47–0.71, and ventral intestinal caecum 0.14–0.37 long. Nerve ring 0.14–0.27 from anterior end.

Excretory pore 0.030–0.48 [*sic*] behind oesophagus (Fig. 97A). Cervical papillae anterior or posterior to posterior end of oesophagus. Two lateral papillae in mid-body region. Posterior margin of pre-cloacal sucker 0.23–0.48 from anus. Testis not convoluted, origin near level of, or posterior to, sucker, anterior extent 0.14–2.25 from oesophagus. Spicules slender, pointed, virtually equal at 0.33–0.60 (left) and 0.32–0.61 (right) long (Fig. 97B). Gubernaculum 0.034–0.059 long. Eleven pairs caudal papillae: three pairs pre-cloacal, subventral, distributed relatively anteriad; four pairs ad-cloacal; four pairs post-cloacal near tip of tail (Fig. 97B).

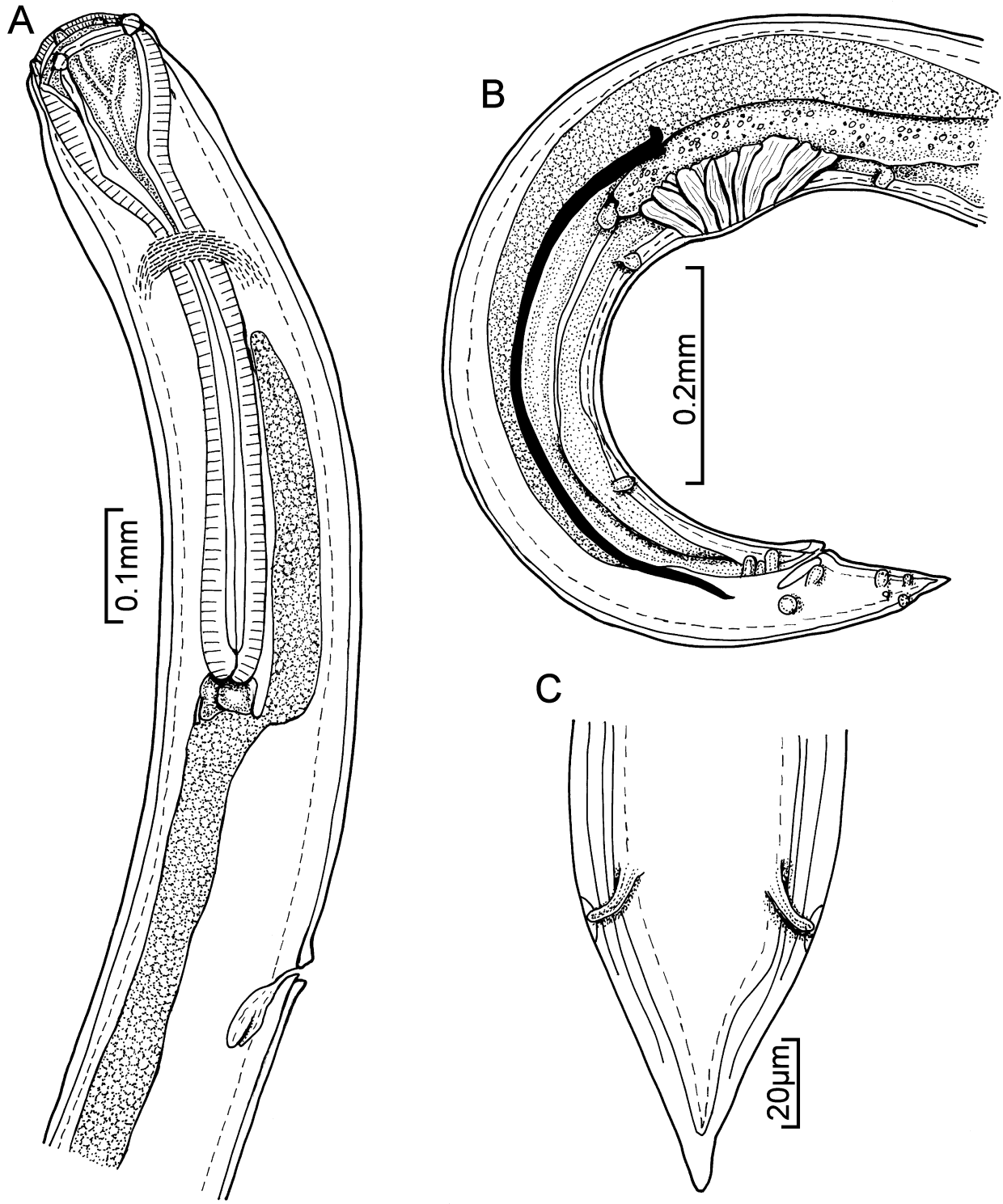

FIGURE 97. *Cucullanellus kanabus* Walder & Arai, 1974. A. male, anterior end, lateral view; B. male, posterior end, lateral view; C. female, posterior end, ventral view. (Redrawn from Walder & Arai 1974)

Females: 4.99–10.61 long; maximum width 0.12–0.27. Oesophagus 0.57–0.77, and ventral intestinal caecum 0.17–0.42 long. Nerve ring 0.22–0.27 from anterior end. Excretory pore 0.13–0.46 behind posterior end of oesophagus. Cervical and lateral papillae as in males. One pair lateral phasmids, not papillose, about one-third distance from posterior end to anus (Fig. 97C). Vulva in posterior half of body, 3.26–6.11 from anterior end. Vagina directed anteriorly, amphidelphic. Ovaries convoluted, anterior one extending to near oesophagus, posterior one to near anus. Eggs 0.059–0.074 x 0.034–0.058.
Site: intestinal lumen
Host: *Cymatogaster aggregata*
Distribution: Pacific
Records: Arai 1967b; Walder & Arai 1974; Arai & Arthur 1977; Arai *et al.* 1988

***Cucullanellus minutus* (Rudolphi, 1819) Törnquist, 1931**

Description (after Berland 1970). With characteristics of the genus. Worms broad relative to their length, widest

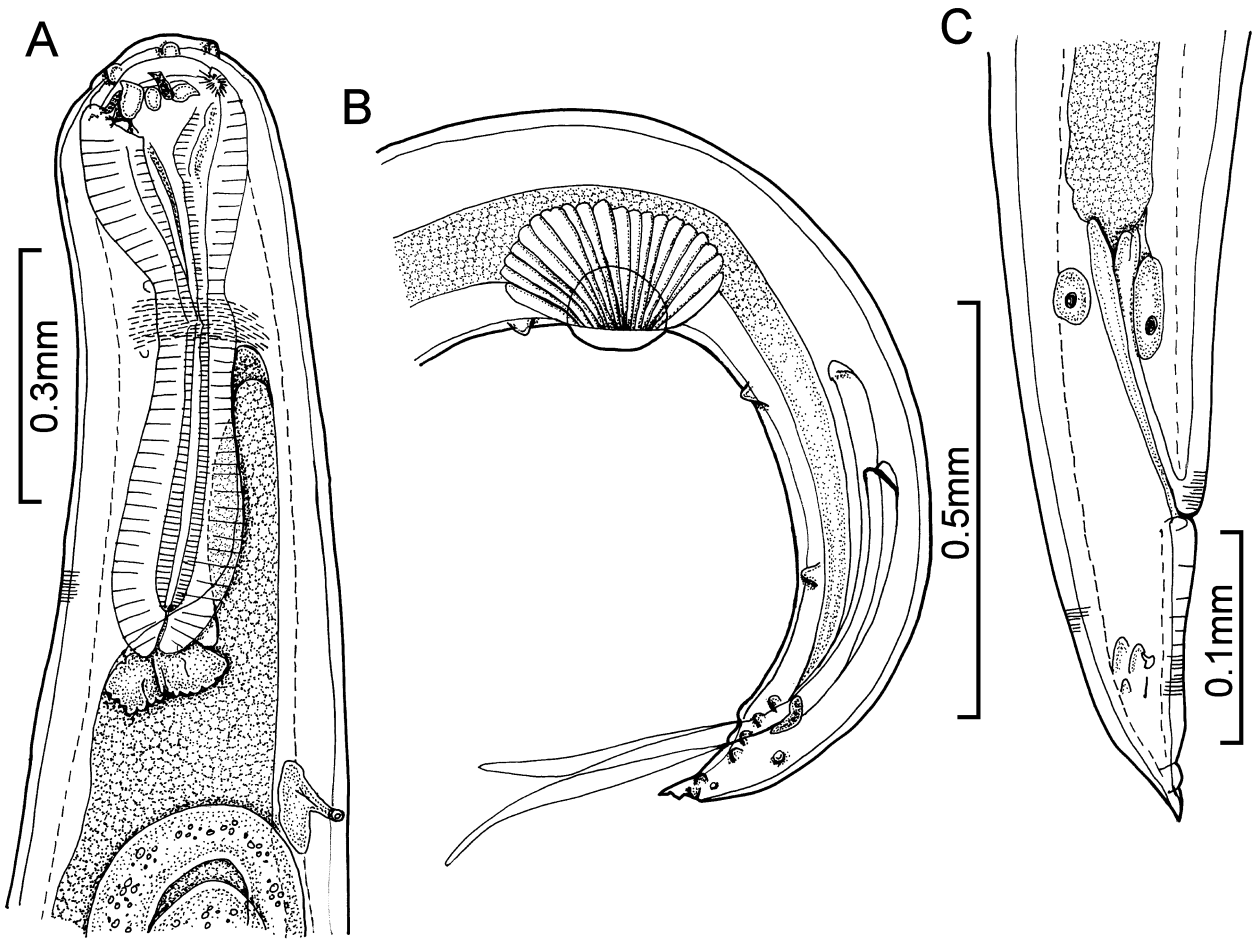

FIGURE 98. *Cucullanellus minutus* Törnquist, 1931. A. anterior end, lateral view; B. male, posterior end, lateral view; C. female, posterior end, lateral view. (Redrawn from Berland 1970)

about the mid-body. Cuticle 0.010–0.020 thick, with fine transverse striae. Head rounded, not dilated, with two pairs large cephalic papillae and one pair amphids. Internal circle of six very small papillae. Mouth a dorso-ventral slit, transverse to body axis, with well developed collarette bearing many (70–80) relatively long, narrow teeth on each side. Simple pseudobuccal capsule, laterally compressed. Peribuccal rim lies well within capsule, and from which several cuticular structures extend into surrounding muscle mass. Ventral intestinal caecum may reach as far anteriorly as nerve ring, its apex sometimes double (Fig. 98A).

Males: 3.70–4.60 long; maximum width 0.36–0.44. Tail curved ventrally. Oesophagus 0.612–0.695 long.

Nerve ring 0.260–0.280, deirids 0.545–0.680, and excretory pore 0.655–0.860 from anterior end. Anus to conical tail 0.123–0.148. Conspicuous pre-cloacal sucker, with rim. Spicules virtually equal, 0.800–0.895 (left) and 0.730–0.895 (right) long. Y-shaped gubernaculum about 0.050 long. Eleven pairs caudal papillae with a distribution similar to that of *C. cotylophora* and *C. kanabus* (Fig. 98B).

Females: 3.42–4.90 long; maximum width 0.52–0.62. Oesophagus 0.657–0.710 long. Nerve ring 0.275–0.297, deirids 0.465–0.763, excretory pore 0.534–0.890 and vulva 2.05–3.10 from anterior end. Pair small lateral papillae about midway between anus and tip of conical tail (Fig. 98C). Eggs 0.068–0.081 x 0.044–0.055.
Site: intestinal lumen
Host: *Tautogolabrus adspersus*
Distribution: Atlantic
Record: Sekhar S. [*sic*] & Threlfall 1970

Family QUIMPERIIDAE (Gendre, 1928 [?1927]) Baylis, 1930

Subfamily QUIMPERIINAE Gendre, 1928 [?1927]

Intestinal caecum absent. Buccal cavity small or absent. Gubernaculum small or absent. Pre-cloacal sucker absent or weakly developed. Anterior part of body with large lateral alae. Deirids large.

Key to the two genera of QUIMPERIINAE known from Canadian fishes

1 Oblique muscle bands in pre-cloacal region of male absent; lips absent; oesophagus without pharynx and without teeth protruding into buccal cavity . . . . . *Haplonema*
- Distinct oblique muscle bands in pre-cloacal region of male present; mouth opening surrounded by three small lips; oesophagus with distinct pharyngeal portion and teeth protruding into buccal cavity . . . . . *Paraquimperia*

Haplonema Ward & Magath, 1917

Generic diagnosis (after Arthur & Margolis 1975). Quimperiidae. Medium-sized worms with anterior end bent dorsally: head with four single or double submedian papillae and two lateral amphids; mouth without lips, opening directly into oesophagus; oesophagus muscular throughout, divided at nerve ring level into two sections, the posterior of greater width than anterior; lateral alae and deirids present. Excretory pore anterior or posterior to oesophago-intestinal junction. Males with caudal papillae present or absent; posterior end strongly curved ventrad; 10 or 11 pairs of caudal papillae, five pairs pre-cloacal, one pair ad-cloacal, four or five pairs post-cloacal; one median pre-cloacal papilla present or absent; spicules equal, gubernaculum present. Females with straight posterior end, vulva slightly behind middle of body; amphidelphic; eggs oval, smooth-shelled, unsegmented or two-celled stage *in utero*.

Key to species of *Haplonema*

1 Head with four submedian double papillae, two lateral amphids, and six radially arranged ridges; males with 11 pairs caudal papillae and one unpaired median pre-cloacal papilla; vulva protruding beyond body wall . . . . . *H. hamulatum*
- Head with four submedian single papillae, and two lateral amphids, lacking radially arranged ridges; males with 10 pairs caudal papillae, lacking an unpaired papilla; vulva not protruding beyond body wall . . . . . *H. immutatum*

Haplonema hamulatum Moulton, 1932

Description (after Arthur & Margolis 1975). With characteristics of the genus. [Two sets of measurement are given, the first for syntypes, the second in parentheses for material collected subsequently.]

Males: syntypes length not available (8.31–11.76); maximum width 0.20 (0.14–0.20). Cuticular striations very

fine. Head with four submedian double papillae, two lateral amphids, and six radially arranged ridges, one extending from each of the papillae and amphids to rim of mouth. Lips and buccal capsule absent, mouth opening directly into oesophagus, 0.512 (0.595–0.890) long. Nerve ring 0.248 (0.312–0.383) from anterior end. Excretory pore slightly posterior to oesophago-intestinal junction, distance from anterior end not available for syntypes (0.717–1.036). Lateral alae extending 1.03 (0.828–1.840) posteriorly from anterior end. Digitate deirids anterior to oesophago-intestinal junction, 0.392 (0.450–0.754) from anterior end (Fig. 99A). Testis originating a little anterior to anus and extending anteriorly beyond mid-body before doubling back to proceed posteriorly and join seminal vesicle. Spicules short, about equal: left one 0.130–0.151 (0.118–0.157), right one 0.130–0.150 (0.104–0.156) long. Gubernaculum wedge-shaped, 0.036–0.041 (0.027–0.045) long. Eleven pairs caudal papillae and one unpaired median pre-cloacal papilla. Phasmids not observed. Caudal alae present, extending from tip of tail to slightly anterior to 1st pair caudal papillae. Tail attenuated, 0.214–0.229 (0.156–0.230) long (Fig. 99B).

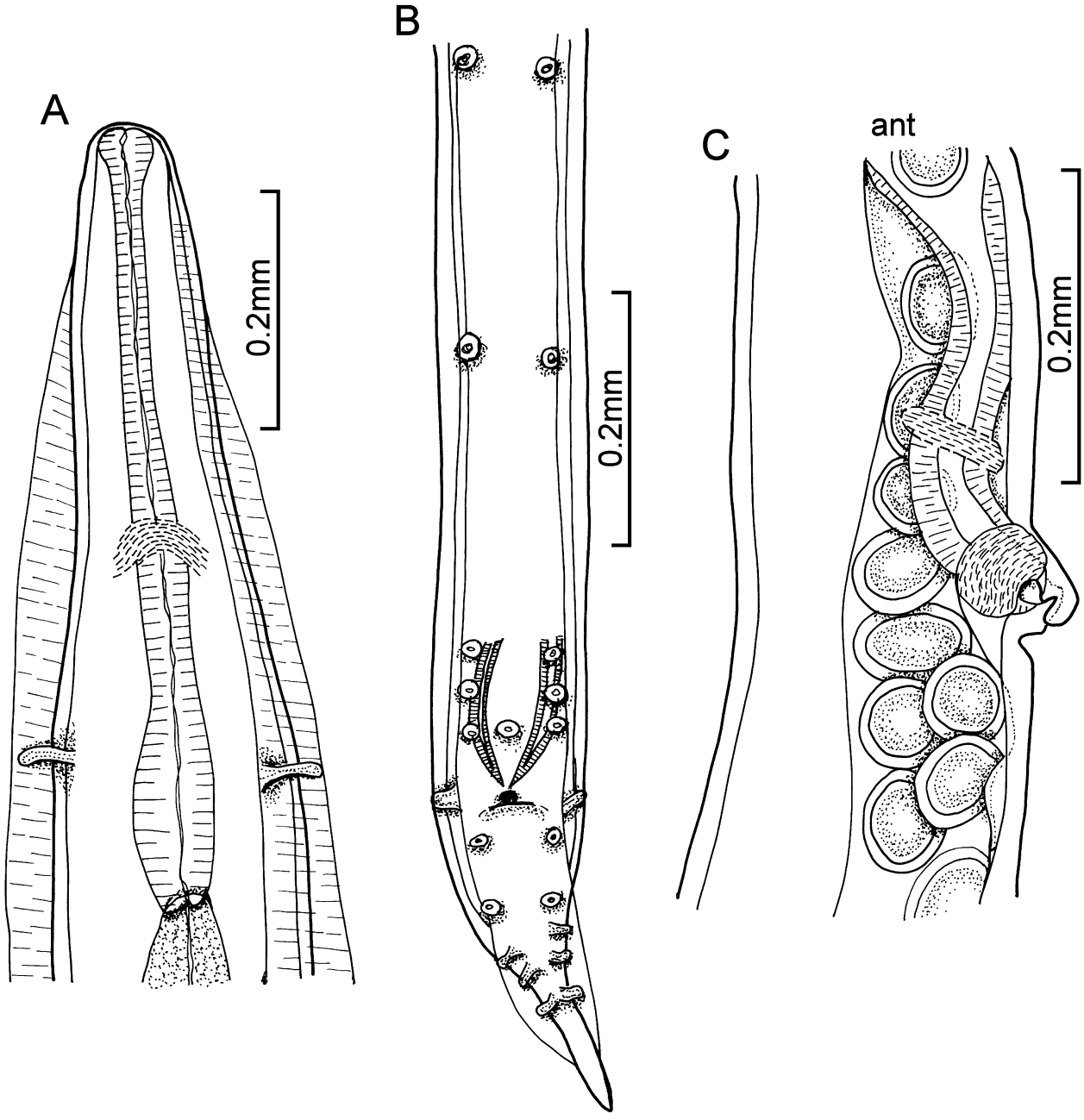

FIGURE 99. *Haplonema hamulatum* Moulton, 1932. A. female, anterior end, ventral view; B. male, posterior end, ventral view; C. female, vulvar region, lateral view. (Redrawn from Arthur & Margolis 1975)

Females: 9.50–9.91 (9.51–10.88) long; maximum width 0.22–0.28 (0.16–0.18). Head and oesophagus structure and cuticular striations as in males. Oesophagus 0.602–0.615 (0.628–0.709) long. Nerve ring 0.325–0.461 (0.310–0.372) from anterior end. Lateral alae extending posteriorly 1.03–1.84 (1.43–1.69) from anterior end. Deirids 0.511–0.523 (0.486–0.582) from anterior end. Excretory pore a little posterior to oesophago-intestinal junction, 0.692–0.794 from anterior end. Vulva prominent, protruding beyond body wall and guarded by two digitate lateral projections, 5.42–5.79 (5.97–6.67) from anterior end (Fig. 99C). Muscular vagina directed anteriorly, 0.177–0.186 (0.195–0.266) long. Uteri amphidelphic. Eggs 0.065–0.077 x 0.043–0.051 (0.050–0.072 x 0.047–0.058). Tail 0.457–0.486 (0.0470–0.538) long. Phasmids not observed.

Site: intestinal lumen

Hosts: *Lota lota* (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14); *Oncorhynchus mykiss* (8, 11); *Prosopium williamsoni* (8, 11); *Salvelinus malma* (8, 11)

Distribution: Alberta, British Columbia, Ontario, Yukon Territory

Records: 1. Moulton 1932 (ON); 2. Bangham & Hunter 1939 (ON); 3. Bangham 1941 (ON); 4. Bangham & Venard 1946 (ON); 5. Bangham 1955 (ON); 6. Arthur & Margolis 1975 (YT); 7. Arthur *et al.* 1976 (YT); 8. Anon. 1978 (BC); 9. Anon. 1981 (BC); 10. Leong & Holmes 1981 (AB); 11. Arai & Mudry 1983 (BC); 12. Anon. 1984 (BC); 13. Dechtiar & Lawrie 1988 (ON); 14. Dechtiar *et al.* 1988 (ON)

Haplonema immutatum Ward & Magath, 1917

Description (after Arthur & Margolis 1975). With characteristics of the genus.

Males: 11.82–15.50 (10.40–11.64) long; maximum width 0.21–0.27 (0.25–0.28). Cuticle striated. Head with four submedian single papillae and two lateral amphids. Lips absent, mouth opening directly into oesophagus, 0.673–0.828 (0.724–0.811) long. Nerve ring 0.301–0.361 (0.304–0.336) from anterior end. Excretory pore slightly anterior to oesophago-intestinal junction. 0.723 in one syntype (0.680–0.689) from anterior end. Lateral alae extending from anterior end to level of 1st pair caudal papillae. Digitate deirids anterior to oesophago-intestinal junction, 0.504–0.616 (0.483–0.525) from anterior end (Fig. 100A). Testis origin as in *H. hamulatum* (see above). Spicules long, slender, about equal: left one 0.584–0.747 (0.740–0.756), right one 0.573–0.712 (0.738–0.758) long. Gubernaculum small, curved ventrally, 0.051–0.054 (0.050–0.054) long. Ten pairs caudal papillae (Fig. 100B). Phasmids not observed. Caudal alae absent. Tail 0.164–0.201 (0.195–0.208) long.

Females: 13.29–15.57 (11.69–14.74) long. Head and oesophagus structure and cuticular striations as in males. Oesophagus 0.678–0.805 (0.680–0.856) long. Nerve ring 0.320–0.369 (0.286–0.3740 from anterior end. Excretory pore slightly anterior to oesophago-intestinal junction, 0.515 in one syntype (0.585–0.763) from anterior end. Lateral alae extending from anterior end to slightly anterior to anus. Digitate deirids slightly anterior to oesophago-intestinal junction, 0.565–0.577 (0.425–0.569) from anterior end. Vulva in posterior half of body, 8.61–9.81 (7.19–9.48) from anterior end (Fig. 100C). Muscular vagina directed anteriorly, 0.230–0.268 (0.212–0.336) long. Uteri amphidelphic. Eggs 0.052–0.069 x 0.039–0.052 (0.044–0.064 x 0.034–0.045). Tail 0.221–0.297 (0.209–0.253) long. Phasmids distinct, anterior to mid-length of tail.

Site: intestinal lumen

Host: *Amia calva*

Distribution: Ontario

Records: Bangham & Hunter 1939; Bangham 1955

Haplonema sp.

Site: intestinal lumen

Hosts: *Cottus cognatus* (1); *Lota lota* (2, 3)

Distribution: Alberta, British Columbia, Labrador

Records: 1. Bangham & Adams 1954 (BC); 2. Threlfall & Hanek 1971 (LB); 3. Leong 1975 (AB)

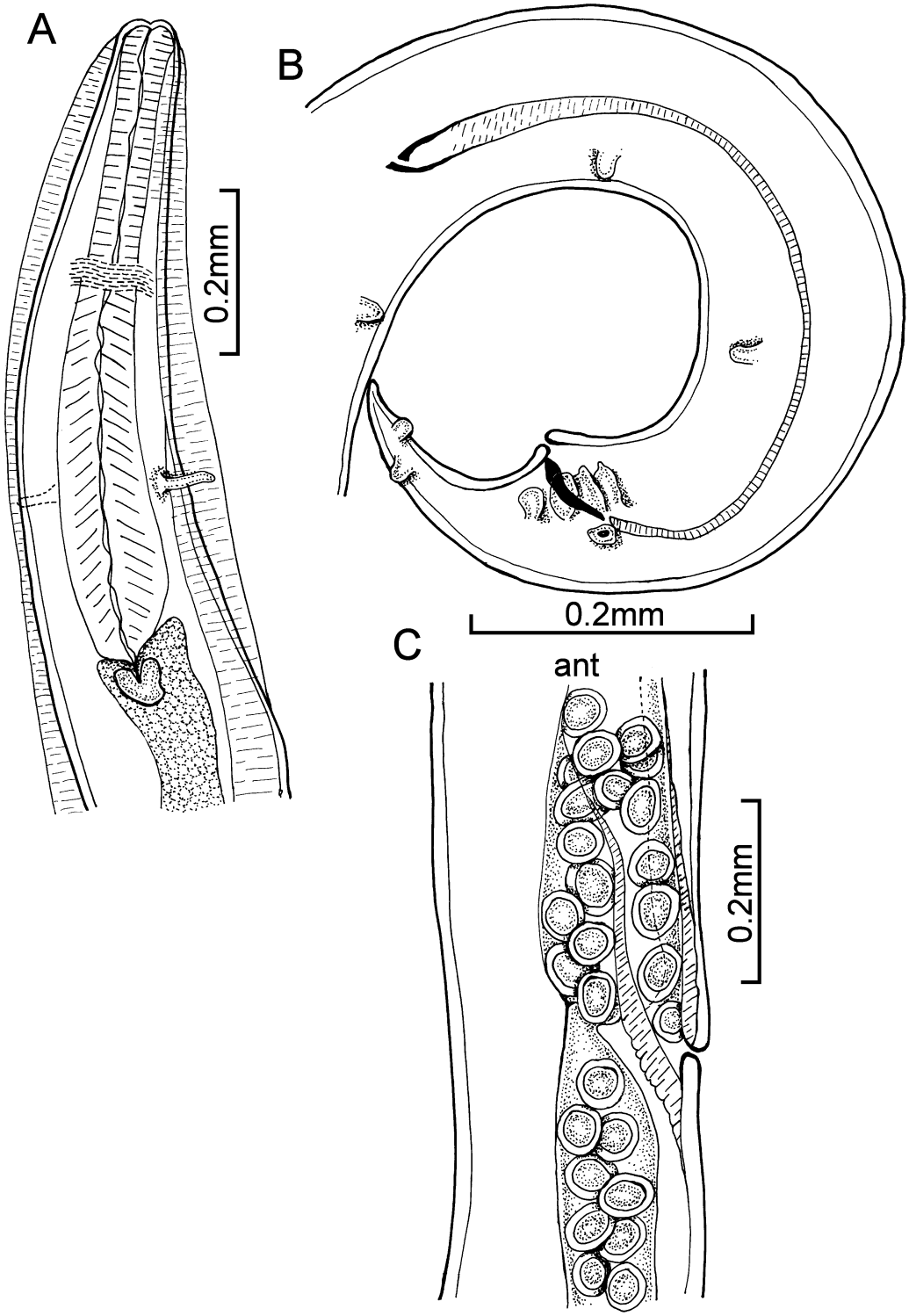

FIGURE 100. *Haplonema immutatum* Ward & Magath, 1917. A. male, anterior end, ventral view; B. male, posterior end, lateral view; C. female, vulvar region, lateral view. (Redrawn from Arthur & Margolis 1975)

Paraquimperia Baylis, 1934

Generic diagnosis (after Moravec 2013). Quimperiidae. Thread-like worms, anterior end dorsally bent. Cuticle with fine transverse striations. Broad lateral alae and deirids present. Head with three rudimentary lips, and small buccal cavity with three teeth. Muscular oesophagus comprises distinct pharyngeal region, narrow anterior portion

and wider posterior portion (Fig. 101A). Tail of both sexes conical, sharply pointed, that of males bent ventrad. Pre-cloacal region of males with distinct oblique muscle bands; caudal alae absent. Four pairs of pre-cloacal and seven pairs of post-cloacal papillae, plus one unpaired pre-cloacal papilla. Vulva in posterior third of body. Uteri amphidelphic. Eggs uncleaved, or cleaved into four blastomeres at most.

One species, *P. tenerrima*, is known from one fish species in Canada.

Paraquimperia tenerrima (von Linstow, 1878) Baylis, 1934

Synonyms: *Haplonema aditum* Mueller, 1934; *Paraquimperia aditum* (Mueller, 1934) Moravec, 1966

Description (after Moravec 2013). With characteristics of the genus. Lateral alae up to 0.045 wide at anterior end of

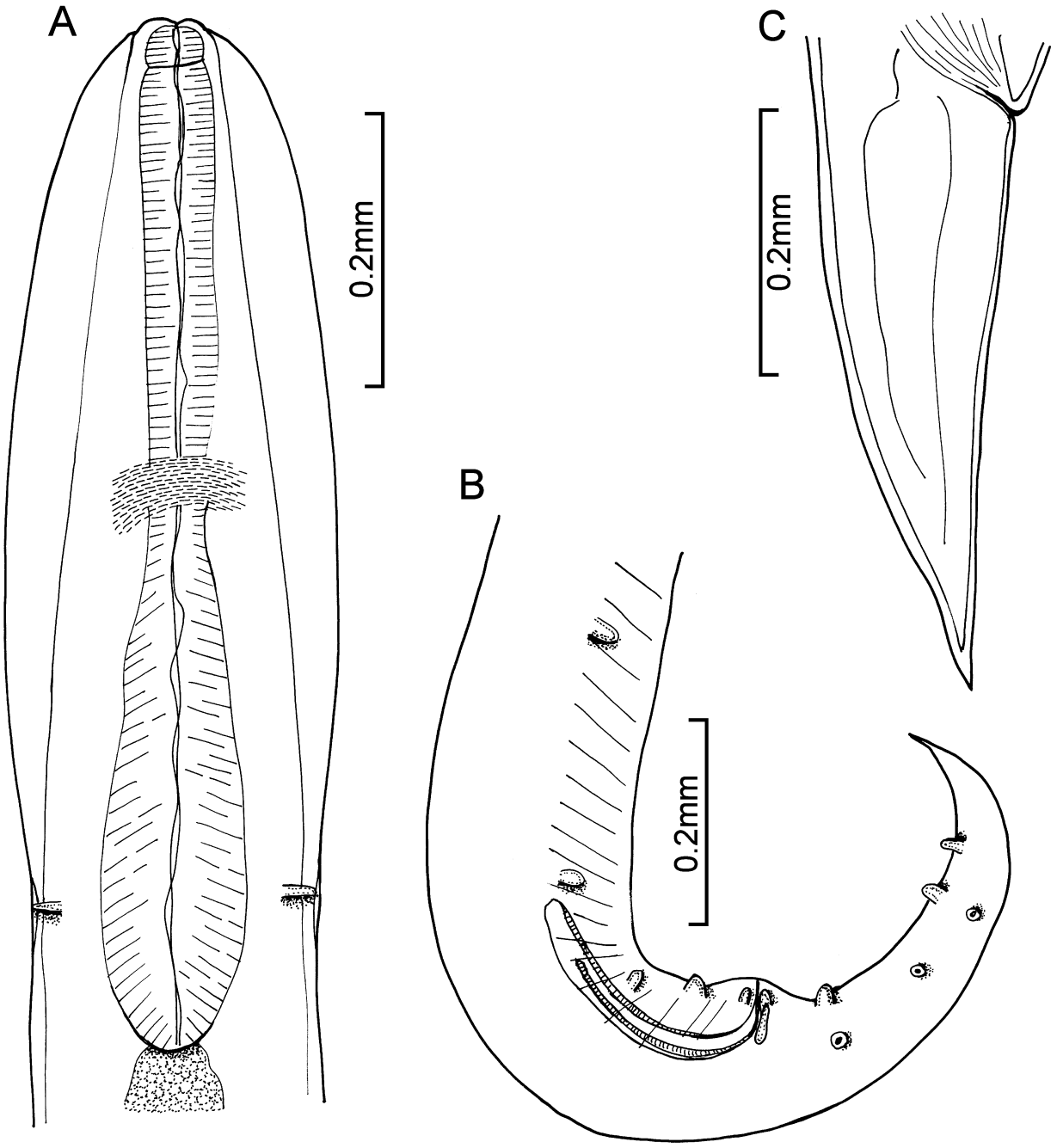

FIGURE 101. *Paraquimperia tenerrima* (von Linstow, 1878) Baylis, 1934. A. anterior end, dorsal view; B. male, posterior end, lateral view; C. female, tail, lateral view. (Redrawn from Moravec 2013)

body, becoming narrower behind deirids and extending posteriad along length of body. Mouth slightly depressed. Oesophagus opens into intestine through valves. Nerve ring about 0.28 from anterior end. Excretory pore located just posterior to nerve ring. Well developed deirids about 0.56 from anterior end.

Males: 4.3–11.2 long; maximum width 0.15–0.28. Entire oesophagus 0.78 long. Tail 0.34–0.44 long. About 30 pairs of oblique muscle bands anterior to cloaca; precloacal sucker absent. Eleven pairs caudal papillae. Spicules equal, somewhat sickle-shaped, 0.250–0.394 long, maximum width 0.021–0.027. Small gubernaculum, 0.063–0.069 long (Fig. 101B).

Females: 3.6–13.7 long; maximum width 0.11–0.29. Entire oesophagus 0.70–0.80 long. Tail straight, conical, 0.34–0.450 long (Fig. 101C). Lateral outlets of phasmids located behind mid-length of tail. Vulva in posterior third of body, situated more posteriorly in older than younger females. Vagina long, muscular, directed anteriorly. Eggs thin-walled, 0.060–0.072 x 0.048–0.051.

Sites: intestinal lumen, swim bladder

Host: *Anguilla rostrata*

Distribution: Atlantic, Labrador, Newfoundland, Nova Scotia, Ontario, Quebec

Records: Bangham and Venard 1946 (ON); Hanek & Threlfall 1970b (LB, NL); Hanek & Molnar 1974 (QC); Cone *et al.* 1993 (NS); Barker *et al.* 1996 (NS); Marcogliese & Cone 1996 (NS); Marcogliese & Cone 1998 (AT)

Superfamily METASTRONGYLOIDEA Cram, 1927

Family PSEUDALIIDAE Railliet, 1916

***Pharurus pallasii* (Van Beneden, 1870) Arnold & Gaskin, 1975**

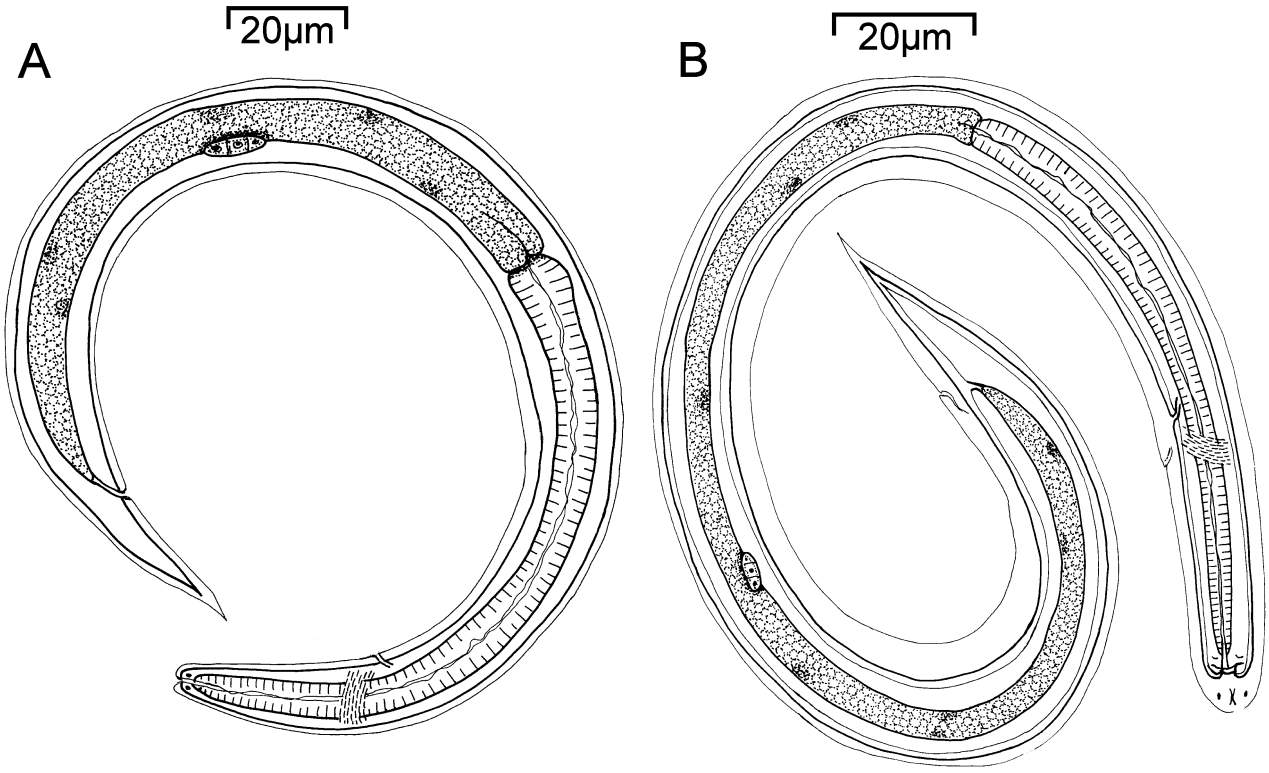

FIGURE 102. **Pharurus pallasii* (Van Beneden, 1870) Arnold & Gaskin, 1975. A. 1st-stage larva, lateral view; B. 2nd-stage larva within loose cuticle of 1st-stage larva, lateral view. (Redrawn from Houde *et al*. 2003)

Preamble: *Pharurus pallasii* matures in the cranial sinuses, middle ears, and Eustachian tubes of beluga whales (*Delphinapterus leucas*) in Canadian and other waters. Some 1st-stage larvae of *P. pallasii* intubated by Houde *et al.* (2003) into the stomach of Canadian-caught American plaice (*Hippoglossoides platessoides*) and Arctic

sculpins (*Myoxocephalus scorpioides*) moulted to 2nd stage in the intestinal wall of both fish species. A description of 1st- and 2nd-stage larvae of *P. pallasii* is provided here although evidence that fishes serve as intermediate hosts of the species in Canadian waters appears to be lacking.

First-stage larvae (measurements in μm): 295±21 long, 15±1 wide (Fig. 102A). Oesophagus 134±8 long. Nerve ring 62±5, excretory pore 66±7, and genital primordium 176±7 from anterior end. Tail 37±7 long, delicate, ending in sharp point.

Second-stage larvae (measurements in μm): 364±21.3 long, 12 ±1 wide, 2nd-stage larvae retain cuticle of the 1st stage (Fig. 102B). Oesophagus 166±30 long. Nerve ring 64±6, excretory pore 69±5, and genital primordium 212±34 from anterior end. Tail 33±7 long, resembles that of the 1st stage.

Site: intestinal wall

Hosts: *Hippoglossoides platessoides* (EX); *Myoxocephalus scorpioides* (EX)

Distribution: Quebec

Record: Houde, Measures & Huot 2003

****Nematoda gen. sp.**

Includes: *Agamonema* sp. *auct*.; *Agamospirura* sp. *auct*.

Sites: body cavity, intestinal lumen, mesenteries, musculature, pyloric caeca, stomach, swim bladder

Hosts: *Acipenser transmontanus* (68); *Ambloplites rupestris* (12); *Ameiurus nebulosus* (12); *Ammocrypta pellucida* (12); *Anoplopoma fimbria* (61); *Aplodinotus grunniens* (12); *Carassius auratus* (12); *Catostomus catostomus* (42); *Catostomus commersonii* (12, 22); *Clinocottus acuticeps* (70); *Clupea pallasi* (45, 63); *Coregonus artedi* (24, 30, 31); *Coregonus clupeaformis* (6, 8, 17, 26, 30, 31, 52); *Coregonus sardinella* (57); *Coryphaenoides rupestris* (66); *Culaea inconstans* (12, 46, 71); *Cymatogaster aggregata* (67); *Cyprinella spiloptera* (12); *Cyprinus carpio* (12); *Dorosoma cepedianum* (12); *Esox lucius* (16, 18, 30, 31, 56, 65); *Etheostoma exile* (12); *Etheostoma nigrum* (12); *Fundulus diaphanus* (12); *Gadus morhua* (75, 80); *Gasterosteus aculeatus* (79); *Glyptocephalus cynoglossus* (54); *Gobiesox maeandricus* (3); *Hexagrammos decagrammus* (44); *Hiodon alosoides* (42); *Hippoglossoides platessoides* (1, 69); *Hippoglossus stenolepis* (76); *Ictalurus punctatus* (12); *Labidesthes sicculus* (12); *Lepomis gibbosus* (7, 12, 14, 21,3 27, 34); *Lota lota* (18, 39, 59); *Macrhybopsis storeriana* (12); *Mallotus villosus* (11, 74); *Merluccius bilinearis* (69, 73); *Microgadus tomcod* (11); *Micropterus dolomieu* (12, 14, 46); *Micropterus salmoides* (12); *Morone chrysops* (12); *Myoxocephalus scorpius* (28); *Nocomis micropogon* (12); *Notemigonus crysoleucas* (12, 81); *Notropis atherinoides* (12); *Notropis heterodon* (12); *Notropis hudsonius* (12); *Oligocottus maculosus* (70); *Oncorhynchus clarkii* (13); *Oncorhynchus gorbuscha* (64); *Oncorhynchus keta* (64); *Oncorhynchus kisutch* (60, 64); *Oncorhynchus mykiss* (5, 51, 55, 60); *Oncorhynchus nerka* (36, 37, 43, 55, 60); *Oncorhynchus tshawytscha* (45, 55, 60, 64); *Ophiodon elongatus* (61); *Perca flavescens* (14, 21, 24, 25, 29, 56, 65, 78); *Percina caprodes* (12); *Percopsis omiscomaycus* (12, 27, 34); *Chrosomus eos* (14, 21); *Phoxinus neogaeus* (21); *Pimephales notatus* (14); *Platichthys stellatus* (45); *Pomoxis annularis* (12); *Prosopium cylindraceum* (47); *Prosopium williamsoni* (51, 55, 60); *Pseudopleuronectes americanus* (48); *Reinhardtius hippoglossoides* (77); *Salmo salar* (50); *Salvelinus alpinus* (28, 32, 35, 47, 53, 57, 58, 62); *Salvelinus fontinalis* (9, 10, 15, 22, 23, 47, 50); *Salvelinus malma* (5, 55, 60, 64); *Salvelinus namaycush* (15, 30, 40, 47, 57, 59); *Sander vitreus* (12, 16, 24, 59); *Sebastes nebulosus* (72); *Semotilus atromaculatus* (12, 14); *Tautogolabrus adspersus* (4); *Thymallus arcticus* (19); *Xiphias gladius* (41); *Zoarces americanus* (2, 20); unspecified "cod" (2, 38); unspecified "flounder" (2); unspecified "herring" (49); unspecified "sculpin" (52)

Distribution: Alberta, Atlantic, British Columbia, Labrador, Manitoba, New Brunswick, Nova Scotia, Northwest Territories, Nunavut, Ontario, Pacific, Quebec, Saskatchewan

Records: 1. Huntsman 1918 (AT); 2. Clemens 1920 (AT); 3. Fraser 1921 (PA); 4. Johansen 1925 (AT); 5. Neave & Bajkov 1929 (AB); 6. Bajkov 1930 (MB); 7. Reid 1930 (NB); 8. Hart 1931 (ON); 9. Ricker 1932 (ON); 10. Richardson 1935 (QC); 11. Pigeon & Vallee 1937 (QC); 12. Bangham & Hunter 1939 (ON); 13. Rawson 1939 (AB); 14. Bangham 1941 (ON); 15. MacLulich 1943 (ON); 16. McLeod 1943 (MB); 17. Miller 1944 (AB); 18. Miller 1945 (AB); 19. Miller 1946 (NT); 20. Olsen & Merriman 1946 (AT); 21. Bangham & Venard 1946 (ON); 22. Fantham & Porter 1948 (QC); 23. Choquette 1948a (QC); 24. Stewart-Hay 1951a (MB); 25.

Stewart-Hay 1951c (MB); 26. Wheaton & Hazen 1951 (SK); 27. Bangham 1951 (ON); 28. Dunbar & Hildebrand 1952 (NU); 29. Stewart-Hay 1952a (MB); 30. Stewart-Hay 1953a (MB); 31. Stewart-Hay 1953b (MB); 32. Andrews & Lear 1954 (LB); 33. Bangham & Adams 1954 (BC); 34. Bangham 1955 (ON); 35. Andrews & Lear 1956 (LB); 36. Margolis 1956 (BC, PA); 37. Margolis 1957 (BC); 38. Homans & MacFarlane 1958 (AT); 39. Fillion 1961 (AB); 40. Rawson 1961 (SK); 41. Tibbo *et al.* 1961 (AT); 42. Reed 1962 (SK); 43. Margolis 1963 (BC); 44. Barraclough 1967 (PA); 45. Robinson *et al.* 1968 (PA); 46. Dechtiar 1972a (ON); 47. Hicks & Threlfall 1973 (LB); 48. Wells *et al.* 1973 (AT); 49. Parsons & Hodder 1974 (AT); 50. Frantsi *et al.* 1975 (NS); 51. Mudry & Anderson 1977 (AB); 52. Pybus & Samuel 1978 (AB); 53. Stewart & MacDonald 1978 (NT); 54. Zubchenko 1980 (AT); 55. Anon. 1981 (BC); 56. Samuel 1981 (AB); 57. Stewart & Bernier 1982 (NT); 58. Stewart & Bernier 1983 (NT); 59. McAllister & Mudry 1983 (AB); 60. Anon. 1984 (BC); 61. E. A. Black 1984 (PA); 62. Stewart & Bernier 1984 (NT); 63. E. A. Black 1985 (PA); 64. Black & Low 1985 (PA); 65. Samuel 1985 (AB); 66. Zubchenko 1985b (AT); 67. Arai 1986 (PA); 68. Margolis & McDonald 1986 (BC); 69. Morrison *et al.* 1986 (AT); 70. Roth 1988 (PA); 71. Dechtiar *et al.* 1989 (ON); 72. Holmes 1990 (PA); 73. Waldron 1992 (AT); 74. Arthur *et al.* 1995 (AT); 75. Khan & Tuck 1995 (AT); 76. Blaycock 1996 (PA); 77. Boje *et al.* 1997 (AT); 78. Carney & Dick 2000 (MB); 79. Reimchen & Nosil 2001 (BC); 80. Khan & Chandra 2006 (LB); 81. Forest & Cone 2011 (ON)

HOST-NEMATODE PARASITE LIST

Preamble: As explained in the Introduction, a single asterisk (*) preceding a nematode's scientific name in any of the Keys denotes that the taxon has been recorded only as a larval stage in given fish host(s), a double asterisk (**) denotes records of both larvae and adults, whilst an unadorned taxon denotes records of adults only. For the sake of simplicity asterisks have been omitted from the various nematode taxa in the following List. Reference to the Keys will soon ascertain if a given taxon is represented by larvae, adults, or both larvae and adults.

Inevitably the List contains controversial records—for example the occurrence of *Cystidicola stigmatura* in *Coregonu*s spp. (for discussion see p. 99 above).

The classification and scientific and common English nomenclature of fishes follow Page *et al.* (2013). For the few species occurring at depths greater than 200 m, and which are therefore outside the coverage of Page *et al.* (2013), we have consulted the on-line source FishBase (www.fishbase.org).

CLASS PETROMYZONTIDA

ORDER PETROMYZONTIFORMES

Family Petromyzontidae

Lethenteron appendix (DeKay) — American Brook Lamprey
Truttaedacnitis pybusae

Entosphenus tridentatus (Gairdner) — Pacific Lamprey
Eustrongylides sp.

Petromyzon marinus Linnaeus — Sea Lamprey
Truttaedacnitis truttae

CLASS CHONDRICHTHYES

ORDER CHIMAERIFORMES

Family Chimaeridae

Hydrolagus colliei (Lay & Bennett) — Spotted Ratfish
Contracaecum sp.

Family Rhinochimaeridae

Rhinochimaera atlantica Holt & Byrne — Atlantic Spearnose Chimaera
Hysterothylacium aduncum

ORDER SQUALIFORMES

Family Squalidae

Squalus acanthias Linnaeus — Spiny Dogfish
Anisakis simplex
Anisakis sp.
Contracaecum sp.
Pseudanisakis tricupola
Pseudoterranova sp.

ORDER RAJIFORMES

Family Rajidae

Amblyraja radiata (Donovan) — Thorny Skate
Anisakis simplex
Anisakis sp.
Contracaecum sp.
Pseudanisakis tricupola
Pseudoterranova decipiens
Pseudoterranova sp.

Bathyraja interrupta (Gill & Townsend) — Sandpaper Skate
Piscicapillaria (Piscicapillaria) freemani

Dipturus laevis (Mitchill) — Barndoor Skate
Anisakis sp.
Pseudanisakis tricupola

Leucoraja erinacea (Mitchill) — Little Skate
Pseudanisakis tricupola

Leucoraja ocellata (Mitchill) — Winter Skate
Anisakis sp.
Pseudoterranova sp.
Pseudanisakis tricupola

Raja rhina Jordan & Gilbert — Longnose Skate
Anisakis sp.

Piscicapillaria (Piscicapillaria) freemani

Raja stellulata Jordan & Gilbert — Starry Skate
Piscicapillaria (Piscicapillaria) freemani

"skate"
Contracaecum sp. and/or *Phocascaris* sp.
Eustoma sp.
Pseudanisakis sp.
Pseudoterranova sp.

CLASS ACTINOPTERYGII

Family Acipenseridae

Acipenser brevirostrum Lesueur — Shortnose Sturgeon
Capillospirura pseudoargumentosa

Acipenser fulvescens Rafinesque — Lake Sturgeon
Camallanus sp.
Capillospirura pseudoargumentosa
Raphidascaris acus
Raphidascaris sp.
Rhabdochona cascadilla
Rhabdochonidae gen. sp.
Salmonema sp.
Spinitectus acipenseri
Spinitectus gracilis
Spinitectus sp.
Truttaedacnitis clitellarius

Acipenser oxyrinchus Mitchill — Atlantic Sturgeon
Capillospirura pseudoargumentosa
Truttaedacnitis sphaerocephala

Acipenser transmontanus Richardson — White Sturgeon
Anisakis simplex
Anisakis sp.
Cystoopsis acipenseris
Nematoda gen. sp.
Spiruroidea gen. sp.

ORDER LEPISOSTEIFORMES

Family Lepisosteidae

Lepisosteus osseus (Linnaeus) — Longnose Gar
Cystidicola lepisostei
Spiroxys sp.

ORDER AMIIFORMES

Family Amiidae

Amia calva Linnaeus — Bowfin
- *Haplonema immutatum*
- *Spinitectus carolini*

ORDER HIODONTIFORMES

Family Hiodontidae

Hiodon alosoides (Rafinesque) — Goldeye
- *Camallanus oxycephalus*

Hiodon tergisus Lesueur — Mooneye
- Nematoda gen. sp.
- *Raphidascaris acus*
- *Rhabdochona canadensis*
- *Rhabdochona cascadilla*
- *Salmonema ephemeridarum*
- *Spinitectus macrospinosus*

ORDER ANGUILLIFORMES

Family Anguillidae

Anguilla rostrata (Lesueur) — American Eel
- *Anguillicola crassus*
- *Contracaecum* sp.
- *Daniconema anguillae*
- *Hysterothylacium brachyurum*
- *Paraquimperia tenerrima*
- *Salmonema ephemeridarum*
- *Spinitectus* sp.

Family Synathobranchidae

Synaphobranchus kaupii Johnson — Northern Cutthroat Eel
- *Contracaecum* sp.
- *Hysterothylacium* sp.

ORDER CLUPEIFORMES

Family Clupeidae

Alosa aestivalis (Mitchill) — Blueback Herring
- *Anisakis simplex*
- *Anisakis* sp.
- *Hysterothylacium* sp.

Pseudoterranova decipiens

Alosa pseudoharengus (Wilson) — Alewife
- *Anisakis simplex*
- *Anisakis* sp.
- *Hysterothylacium aduncum*
- *Hysterothylacium* sp.
- *Pseudoterranova decipiens*

Alosa sapidissima (Wilson) — American Shad
- *Ascarophis morrhuae*
- *Hysterothylacium aduncum*

Clupea harengus Linnaeus — Atlantic Herring
- Anisakinae gen. sp.
- *Anisakis simplex*
- *Anisakis* sp.
- *Hysterothylacium aduncum*
- *Pseudoterranova decipiens*

Clupea pallasii Valenciennes — Pacific Herring
- *Anisakis simplex*
- *Anisakis* sp.
- *Contracaecum* sp.
- *Hysterothylacium aduncum*
- Nematoda gen. sp.
- Oxyuroidea gen. sp.
- *Pseudoterranova decipiens*
- Spirurida gen. sp.

Dorosoma cepedianum (Lesueur) — Gizzard Shad
- Nematoda gen. sp.

"herring"
- *Anisakis* sp.
- *Contracaecum* sp.
- Nematoda gen. sp.

ORDER CYPRINIFORMES

Family Cyprinidae

Acrocheilus alutaceus Agassiz & Pickering — Chiselmouth
- *Philonema* sp.
- *Rhabdochona cascadilla*

Carassius auratus (Linnaeus) — Goldfish
- Nematoda gen. sp.
- *Paracuaria adunca* (EX)
- *Syncuaria squamata* (EX)

Chrosomus eos Cope	Northern Redbelly Dace
Contracaecum sp.	
Nematoda gen. sp.	
Raphidascaris acus	
Rhabdochona canadensis	
Rhabdochona cascadilla	
Tetrameres sp.	
Chrosomus neogaeus (Cope)	Finescale Dace
Nematoda gen. sp.	
Rhabdochona canadensis	
Spiroxys sp.	
Couesius plumbeus (Agassiz)	Lake Chub
Pseudocapillaria (Pseudocapillaria) tomentosa	
Rhabdochona canadensis	
Rhabdochona cascadilla	
Rhabdochona sp.	
Cyprinella spiloptera (Cope)	Spotfin Shiner
Camallanus oxycephalus	
Nematoda gen. sp.	
Rhabdochona cascadilla	
Cyprinus carpio Linnaeus	Common Carp
Nematoda gen. sp.	
Pseudocapillaria (Pseudocapillaria) tomentosa	
Rhabdochona cascadilla	
Spinitectus carolini	
Spinitectus gracilis	
Cyprinus carpio x *Carassius auratus*	
Pseudocapillaria (Pseudocapillaria) tomentosa	
Luxilus cornutus (Mitchill)	Common Shiner
Contracaecum sp.	
Rhabdochona cascadilla	
Rhabdochona decaturensis	
Rhabdochona rotundicaudatum	
Rhabdochona sp.	
Spinitectus gracilis	
Spiroxys sp.	
Macrhybopsis storeriana (Kirtland)	Silver Chub
Nematoda gen. sp.	
Margariscus margarita (Cox)	Allegheny Pearl Dace
Rhabdochona canadensis	
Rhabdochona cascadilla	
Mylocheilus caurinus (Richardson)	Peamouth
Capillariidae gen. sp.	

Eustrongylides sp.
Pseudocapillaria (Pseudocapillaria) tomentosa
Rhabdochona cascadilla
Rhabdochona sp.
Truttaedacnitis sp.

Nocomis biguttatus (Kirtland) — Hornyhead Chub
Rhabdochona cascadilla
Rhabdochona rotundicaudatum
Rhabdochona sp.

Nocomis micropogon (Cope) — River Chub
Nematoda gen. sp.
Rhabdochona rotundicaudatum

Notemigonus crysoleucas (Mitchill) — Golden Shiner
Camallanus oxycephalus
Hysterothylacium brachyurum
Nematoda gen. sp.
Raphidascaris acus
Rhabdochona cascadilla
Rhabdochona sp.

Notropis anogenus Forbes — Pugnose Shiner
Rhabdochona cascadilla

Notropis atherinoides Rafinesque — Emerald Shiner
Camallanus oxycephalus
Contracaecum sp.
Hysterothylacium brachyurum
Nematoda gen. sp.
Rhabdochona sp.

Notropis buccatus (Cope) — Silverjaw Minnow
Camallanus oxycephalus

Notropis heterodon (Cope) — Blackchin Shiner
Camallanus oxycephalus
Nematoda gen. sp.

Notropis heterolepis Eigenmann & Eigenmann — Blacknose Shiner
Camallanus oxycephalus
Spiroxys sp.

Notropis hudsonius (Clinton) — Spottail Shiner
Camallanus oxycephalus
Contracaecum sp.
Cosmocephalus obvelatus
Nematoda gen. sp.
Paracuaria adunca
Raphidascaris acus
Rhabdochona cascadilla

Rhabdochona decaturensis
Rhabdochona sp.
Spinitectus gracilis
Spiroxys sp.

Notropis stramineus (Cope) — Sand Shiner
Camallanus oxycephalus
Rhabdochona cascadilla

Notropis volucellus (Cope) — Mimic Shiner
Rhabdochona cascadilla

Pimephales notatus (Rafinesque) — Bluntnose Minnow
Nematoda gen. sp.
Raphidascaris acus
Rhabdochona cascadilla
Spiroxys sp.

Pimephales promelas Rafinesque — Fathead Minnow
Contracaecum sp.
Raphidascaris acus
Rhabdochona sp.

Platygobio gracilis (Richardson) — Flathead Chub
Rhabdochona canadensis

Ptychocheilus oregonensis (Richardson) — Northern Pikeminnow
Capillariidae gen. sp.
Contracaecum spiculigerum
Eustrongylides sp.
Hysterothylacium sp.
Pseudocapillaria (*Pseudocapillaria*) *tomentosa*
Raphidascaris canadensis
Rhabdochona cascadilla
Rhabdochona sp.
Spiroxys sp.
Truttaedacnitis truttae

Rhinichthys atratulus (Hermann) — Blacknose Dace
Rhabdochona cascadilla

Rhinichthys cataractae (Valenciennes) — Longnose Dace
Camallanus oxycephalus
Rhabdochona canadensis
Rhabdochona cascadilla
Rhabdochona milleri
Salmonema ephemeridarum
Spiroxys sp.
Truttaedacnitis sp.

Richardsonius balteatus (Richardson) — Redside Shiner
Pseudocapillaria (Pseudocapillaria) tomentosa

Rhabdochona cascadilla
Rhabdochona sp.
Spiroxys sp.
Truttaedacnitis sp.

Semotilus atromaculatus (Mitchill) — Creek Chub
Cosmocephalus obvelatus
Paracuaria adunca
Nematoda gen. sp.
Rhabdochona canadensis
Rhabdochona cascadilla
Rhabdochona rotundicaudatum
Rhabdochona sp.
Spiroxys sp.

Semotilus corporalis (Mitchill) — Fallfish
Rhabdochona canadensis
Rhabdochona cascadilla

Tinca tinca (Linnaeus) — Tench
Raphidascaris acus

"carp"
Pseudocapillaria (Pseudocapillaria) tomentosa

"lake chub"
Pseudocapillaria (Pseudocapillaria) tomentosa
Rhabdochona canadensis
Rhabdochona cascadilla
Rhabdochona sp.

"dace"
Salmonema ephemeridarum

Family Catostomidae

Carpiodes cyprinus (Lesueur) — Quillback
Camallanus ancylodirus
Camallanus oxycephalus
Philometroides nodulosus
Rhabdochona cascadilla
Rhabdochona milleri

Catostomus catostomus (Forster) — Longnose Sucker
Cystidicola farionis
Eustrongylides tubifex
Nematoda gen. sp.
Philometra sp.
Philometroides huronensis
Philometroides nodulosus
Pseudocapillaria (Pseudocapillaria) tomentosa

Raphidascaris acus
Rhabdochona cascadilla
Rhabdochona catostomi
Rhabdochona ovifilamenta
Rhabdochona sp.

Catostomus columbianus (Eigenmann & Eigenmann) Bridgelip Sucker
Hysterothylacium sp.

Catostomus commersonii (Lacépède) White Sucker
Camallanus oxycephalus
Contracaecum sp.
Capillaria (Capillaroides) catenata
Eustrongylides sp.
Eustrongylides tubifex
Nematoda gen. sp.
Philometra kobuleji
Philometra sp.
Philometroides huronensis
Philometroides nodulosus
Philometroides sp.
Philonema sp.
Pseudocapillaria (Pseudocapillaria) tomentosa
Raphidascaris acus
Rhabdochona canadensis
Rhabdochona cascadilla
Rhabdochona ovifilamenta
Rhabdochona sp.
Spinitectus gracilis
Spiroxys sp.

Catostomus macrocheilus Girard Largescale Sucker
Eustrongylides sp.
Philometroides huronensis
Pseudocapillaria (Pseudocapillaria) tomentosa
Rhabdochona cascadilla
Rhabdochona zacconis
Rhabdochona sp.
Spiroxys sp.

Catostomus platyrhynchus (Cope) Mountain Sucker
Rhabdochona ovifilamenta
Rhabdochona sp.

Hypentelium nigricans (Lesueur) Northern Hogsucker
Philometra sp.

Moxostoma anisurum (Rafinesque) Silver Redhorse
Contracaecum sp.
Hysterothylacium brachyurum
Raphidascaris acus
Raphidascaris canadensis

Spinitectus gracilis

Moxostoma erythrurum (Rafinesque) — Golden Redhorse
Rhabdochona milleri

Moxostoma macrolepidotum (Leseuer) — Shorthead Redhorse
Philometroides huronensis
Rhabdochona cascadilla
Rhabdochona milleri

ORDER SILURIFORMES

Family Ictaluridae

Ameiurus melas (Rafinesque) — Black Bullhead
Cucullanellus cotylophora
Dichelyne robustus
Rhabdochona sp.

Ameiurus nebulosus (Lesueur) — Brown Bullhead
Camallanus oxycephalus
Capillaria sp.
Contracaecum sp.
Cucullanellus cotylophora
Dichelyne robustus
Dioctophyme renale
Eustrongylides tubifex
Nematoda gen. sp.
Rhabdochona cascadilla
Rhabdochona rotundicaudatum
Rhabdochona sp.
Salmonema prevosti
Spinitectus carolini
Spinitectus gracilis
Spiroxys contortus
Spiroxys sp.

Ictalurus punctatus (Rafinesque) — Channel Catfish
Camallanus oxycephalus
Eustrongylides tubifex
Nematoda gen. sp.
Raphidascaris acus
Spinitectus gracilis
Spinitectus macrospinosus

Noturus flavus Rafinesque — Stonecat
Camallanus oxycephalus
Hysterothylacium brachyurum
Rhabdochona canadensis
Rhabdochona decaturensis
Spinitectus gracilis

Spinitectus macrospinosus

Noturus gyrinus (Mitchill) — Tadpole Madtom
Rhabdochona decaturensis

ORDER ARGENTINIFORMES

Family Argentinidae

Argentina silus (Ascanius) — Atlantic Argentine
Anisakis simplex

ORDER OSMERIFORMES

Family Osmeridae

Hypomesus pretiosus (Girard) — Surf Smelt
Contracaecum sp.
Hysterothylacium aduncum

Mallotus villosus (Müller) — Capelin
Anisakis simplex
Anisakis sp.
Ascarophis sp.
Contracaecinea gen. sp.
Contracaecum osculatum
Contracaecum sp.
Contracaecum sp. and/or *Phocascaris* sp.
Hysterothylacium aduncum
Hysterothylacium sp.
Nematoda gen. sp.
Phocascaris sp.
Pseudoterranova decipiens
Spirurida gen. sp.

Osmerus mordax (Mitchill) — Rainbow Smelt
Anisakis sp.
Ascarophis arctica
Capillaria (Capillaroides) catenata
Cosmocephalus obvelatus
Cystidicola farionis
Cystidicola stigmatura
Hysterothylacium sp.
Philometra sp.
Philonema agubernaculum
Pseudocapillaria (Ichthyocapillaria) salvelini
Pseudoterranova decipiens
Pseudoterranova sp.
Spinitectus carolini

Spinitectus gracilis

Thaleichthys pacificus (Richardson) — Eulachon
Contracaecum sp.

Family Alepocephalidae

Alepocephalus agassizii Goode & Bean — Agassiz' Slickhead
Anisakis sp.

ORDER SALMONIFORMES

Family Salmonidae

Coregonus artedi Lesueur — Lake Cisco
Cystidicola farionis
Cystidicola serratus
Cystidicola sp.
Cystidicola stigmatura
Hysterothylacium brachyurum
Nematoda gen. sp.
Philometra sp.
Philonema agubernaculum
Philonema sp.
Raphidascaris acus
Raphidascaris sp.
Salmonema ephemeridarum
Spinitectus gracilis

Coregonus clupeaformis (Mitchill) — Lake Whitefish
Contracaecum sp.
Cystidicola farionis
Cystidicola sp.
Cystidicola stigmatura
Hysterothylacium sp.
Nematoda gen. sp.
Philometra sp.
Philonema agubernaculum
Philonema sp.
Pseudocapillaria (Ichthyocapillaria) salvelini
Pseudocapillaria (Pseudocapillaria) tomentosa
Raphidascaris acus
Raphidascaris sp.
Rhabdochona sp.
Salmonema ephemeridarum
Spinitectus carolini
Spinitectus gracilis
Truttaedacnitis truttae

Coregonus hoyi (Milner) — Bloater

Cystidicola farionis
Cystidicola sp.
Cystidicola stigmatura

Coregonus huntsmani Scott — Atlantic Whitefish
Anisakis simplex
Pseudoterranova decipiens

Coregonus kiyi (Koelz) — Kiyi
Cystidicola sp.

Coregonus nasus (Pallas) — Broad Whitefish
Ascarophis sp.
Cystidicola farionis
Raphidascaris sp.

Coregonus nigripinnis (Milner) — Blackfin Cisco
Cystidicola farionis

Coregonus reighardi (Koelz) — Shortnose Cisco
Cystidicola farionis
Cystidicola sp.

Coregonus sardinella Valenciennes — Least Cisco
Nematoda gen. sp.

Oncorhynchus clarkii (Richardson) — Cutthroat Trout
Contracaecum sp.
Eustrongylides sp.
Nematoda gen. sp.
Philonema oncorhynchi
Philonema sp.
Pseudocapillaria (Pseudocapillaria) tomentosa
Rhabdochona cascadilla
Rhabdochona milleri
Salmonema ephemeridarum
Salvelinema walkeri
Truttaedacnitis truttae

Oncorhynchus gorbuscha (Walbaum) — Pink Salmon
Anisakis simplex
Anisakis sp.
Ascarophis sp.
Contracaecum sp.
Cystidicola farionis
Cystidicola stigmatura
Hysterothylacium aduncum
Nematoda gen. sp.
Philonema oncorhynchi
Raphidascaris acus

Oncorhynchus keta (Walbaum) — Chum Salmon

Anisakis simplex
Anisakis sp.
Contracaecum sp.
Hysterothylacium aduncum
Nematoda gen. sp.
Salvelinema walkeri

Oncorhynchus kisutch (Walbaum) — Coho Salmon
Anisakis sp.
Ascarophis sebastodis
Camallanus oxycephalus
Capillaria sp.
Contracaecum sp.
Cucullanus sp.
Cystidicola farionis
Cystidicola stigmatura
Eustrongylides sp.
Hysterothylacium aduncum
Nematoda gen. sp.
Philonema agubernaculum
Philonema oncorhynchi
Philonema sp.
Pseudocapillaria (Ichthyocapillaria) salvelini
Pseudocapillaria (Pseudocapillaria) tomentosa
Rhabdochona kisutchi
Rhabdochona sp.
Salmonema ephemeridarum
Salvelinema salmonicola
Salvelinema walkeri

Oncorhynchus mykiss (Walbaum) — Rainbow Trout
Anisakis simplex
Capillariidae gen. sp.
Contracaecum sp.
Cystidicola farionis
Cystidicola sp.
Eustrongylides sp.
Haplonema hamatulum [*sic*] for *H. hamulatum*
Haplonema hamulatum
Hysterothylacium aduncum
Hysterothylacium sp.
Nematoda gen. sp.
Philonema agubernaculum
Philonema oncorhynchi
Philonema sp.
Pseudocapillaria (Ichthyocapillaria) salvelini
Pseudocapillaria (Pseudocapillaria) tomentosa
Pseudoterranova decipiens
Rhabdochona canadensis
Rhabdochona cascadilla
Rhabdochona kisutchi
Rhabdochona milleri

Rhabdochona sp.
Salmonema ephemeridarum
Spirurida gen. sp.
Truttaedacnitis truttae

Oncorhynchus nerka (Walbaum) — Sockeye Salmon
Anisakis sp.
Ascarophis sebastodis
Capillaria (Capillaroides) catenata
Contracaecum spiculigerum
Contracaecum sp.
Cystidicola farionis
Cystidicola stigmatura
Hysterothylacium aduncum
Hysterothylacium sp.
Nematoda gen. sp.
Philonema agubernaculum
Philonema oncorhynchi
Philonema sp.
Pseudoterranova sp.
Rhabdochona cascadilla
Rhabdochona kisutchi
Rhabdochona sp.
Salmonema ephemeridarum
Spinitectus gracilis
Truttaedacnitis truttae

Oncorhynchus tshawytscha (Walbaum) — Chinook Salmon
Anisakis simplex
Anisakis sp.
Capillaria sp.
Contracaecum osculatum
Contracaecum sp.
Cystidicola farionis
Cystidicola sp.
Nematoda gen. sp.
Philonema oncorhynchi
Philonema sp.
Rhabdochona sp.
Salvelinema walkeri

Prosopium coulterii (Eigenmann & Eigenmann) — Pygmy Whitefish
Cystidicola farionis
Cystidicola sp.
Rhabdochona milleri

Prosopium cylindraceum (Pennant) — Round Whitefish
Cystidicola farionis
Cystidicola stigmatura
Eustrongylides sp.
Nematoda gen. sp.
Philometra sp.

Philonema agubernaculum
Philonema sp.
Pseudocapillaria (Ichthyocapillaria) salvelini
Salmonema ephemeridarum
Spinitectus gracilis
Truttaedacnitis sp.
Truttaedacnitis truttae

Prosopium williamsoni (Girard) — Mountain Whitefish
Anisakidae gen. sp.
Cystidicola farionis
Cystidicola sp.
Eustrongylides sp.
Haplonema hamatulum [*sic*] for *H. hamulatum*
Haplonema hamulatum
Hysterothylacium sp.
Nematoda gen. sp.
Philonema agubernaculum
Philonema sp.
Pseudocapillaria (Pseudocapillaria) tomentosa
Rhabdochona cascadilla
Rhabdochona kisutchi
Rhabdochona milleri
Rhabdochona sp.
Salmonema ephemeridarum
Truttaedacnitis sp.
Truttaedacnitis truttae

Salmo salar Linnaeus — Atlantic Salmon
Anisakis simplex
Anisakis sp.
Camallanus oxycephalus
Contracaecum sp.
Hysterothylacium aduncum
Nematoda gen. sp.
Philonema agubernaculum
Pseudocapillaria (Ichthyocapillaria) salvelini
Pseudoterranova decipiens
Raphidascaris sp.
Salmonema ephemeridarum

Salmo trutta Linnaeus — Brown Trout
Cystidicola farionis
Salmonema ephemeridarum

Salvelinus alpinus (Linnaeus) — Arctic Char
Anisakis simplex
Anisakis sp.
Contracaecum sp.
Contracaecinea gen. sp.
Cystidicola farionis
Cystidicola sp.

Cystidicola stigmatura
Hysterothylacium aduncum
Nematoda gen. sp.
Philonema agubernaculum
Philonema sp.
Pseudocapillaria (Ichthyocapillaria) salvelini
Pseudoterranova decipiens
Salmonema ephemeridarum
Truttaedacnitis truttae

Salvelinus fontinalis (Mitchill) — Brook Trout
Anisakis simplex
Anisakis sp.
Contracaecum sp.
Cystidicola farionis
Cystidicola stigmatura
Eustrongylides sp.
Hysterothylacium aduncum
Hysterothylacium brachyurum
Hysterothylacium sp.
Nematoda gen. sp.
Philometra cylindracea
Philometra sp.
Philonema agubernaculum
Philonema sp.
Pseudocapillaria (Ichthyocapillaria) salvelini
Pseudocapillaria (Pseudocapillaria) tomentosa
Raphidascaris acus
Raphidascaris sp.
Rhabdochona cascadilla
Rhabdochona milleri
Rhabdochona ovifilamenta
Rhabdochona sp.
Salmonema ephemeridarum
Seuratiinae gen. sp.
Truttaedacnitis sp.
Truttaedacnitis truttae

Salvelinus malma (Walbaum) — Dolly Varden
Contracaecum sp.
Cystidicola farionis
Eustrongylides sp.
Hysterothylacium brachyurum
Hysterothylacium sp.
Nematoda gen. sp.
Haplonema hamatulum [*sic*] for *H. hamulatum*
Haplonema hamulatum
Philonema agubernaculum
Philonema oncorhynchi
Philonema sp.
Pseudocapillaria (Ichthyocapillaria) salvelini
Pseudocapillaria (*Pseudocapillaria*) *tomentosa*

Rhabdochona canadensis
Rhabdochona kisutchi
Rhabdochona milleri
Rhabdochona sp.
Salmonema ephemeridarum
Salvelinema salmonicola
Truttaedacnitis truttae

Salvelinus namaycush (Walbaum) — Lake Trout
Cystidicola farionis
Cystidicola sp.
Cystidicola stigmatura
Eustrongylides sp.
Hysterothylacium aduncum
Hysterothylacium brachyurum
Nematoda gen. sp.
Philonema agubernaculum
Philonema sp.
Pseudocapillaria (Ichthyocapillaria) salvelini
Raphidascaris acus
Raphidascaris sp.
Salmonema ephemeridarum
Truttaedacnitis truttae

Thymallus arcticus (Pallas) — Arctic Grayling
Cystidicola farionis
Metabronema sp.
Nematoda gen. sp.
Philonema sp.
Pseudocapillaria (Ichthyocapillaria) salvelini
Raphidascaris acus
Rhabdochona cascadilla
Salmonema ephemeridarum

"salmonids"
Cystidicola farionis
Salmonema ephemeridarum

"splake"
Cystidicola farionis
Cystidicola stigmatura
Hysterothylacium brachyurum
Pseudocapillaria (Ichthyocapillaria) salvelini
Rhabdochona sp.
Spinitectus gracilis

"whitefish"
Cystidicola farionis
Philonema sp.

ORDER ESOCIFORMES

Family Esocidae

Esox americanus americanus Gmelin	Redfin Pickerel
Cystidicola farionis	
Esox americanus vermiculatus Lesueur	Grass Pickerel
Cucullanellus cotylophora	
Spinitectus gracilis	
Esox lucius Linnaeus	Northern Pike
Camallanus oxycephalus	
Camallanus sp.	
Contracaecum sp.	
Cystidicola sp.	
Hysterothylacium brachyurum	
Nematoda gen. sp.	
Philonema sp.	
Raphidascaris acus	
Raphidascaris sp.	
Rhabdochona canadensis	
Spinitectus carolini	
Spinitectus gracilis	
Esox masquinongy Mitchill	Muskellunge
Hysterothylacium brachyurum	
Raphidascaris acus	
Salmonema ephemeridarum	
Esox niger Lesueur	Chain Pickerel
Philometra sp.	
Umbra limi (Kirtland)	Central Mudminnow
Raphidascaris acus	
Spiroxys sp.	

ORDER PERCOPSIFORMES

Family Percopsidae

Percopsis omiscomaycus (Walbaum)	Trout-perch
Camallanus oxycephalus	
Hysterothylacium brachyurum	
Nematoda gen. sp.	
Raphidascaris acus	
Rhabdochona canadensis	
Rhabdochona cascadilla	
Rhabdochona sp.	
Spinitectus gracilis	

ORDER GADIFORMES

Family Macrouridae

Coryphaenoides rupestris Gunnerus — Roundnose Grenadier
- *Anisakis* sp.
- *Contracaecum* sp.
- *Hysterothylacium aduncum*
- Nematoda gen. sp.

Macrourus berglax Lacépède — Roughhead Grenadier
- *Anisakis* sp.
- *Capillaria (Procapillaria) gracilis*
- *Hysterothylacium aduncum*
- *Hysterothylacium* sp.
- *Spinitectus* sp.

Nezumia bairdii (Goode & Bean) — Marlin-spike
- *Anisakis simplex*
- *Capillaria (Procapillaria) gracilis*
- *Contracaecum* sp. and/or *Phocascaris* sp.
- *Hysterothylacium aduncum*
- *Hysterothylacium* sp.
- *Pseudoterranova decipiens*

Family Merlucciidae

Merluccius albidus (Mitchill) — Offshore Hake
- *Anisakis* sp.
- *Capillaria (Procapillaria) gracilis*
- *Hysterothylacium aduncum*

Merluccius bilinearis (Mitchill) — Silver Hake
- *Anisakis simplex*
- *Anisakis* sp.
- *Ascarophis arctica*
- *Capillaria (Procapillaria) gracilis*
- *Hysterothylacium aduncum*
- *Hysterothylacium* sp.
- Nematoda gen. sp.
- *Pseudoterranova decipiens*

Merluccius productus (Ayres) — Pacific Hake
- *Anisakis simplex*
- *Anisakis* sp.
- *Ascarophis* sp.
- *Contracaecum* sp.
- *Hysterothylacium aduncum*
- *Pseudoterranova decipiens*

"hake"
- *Pseudoterranova decipiens*

Family Phycidae

Enchelyopus cimbrius (Linnaeus)	Fourbeard Rockling
Pseudoterranova decipiens	
Phycis chesteri (Goode & Bean)	Longfin Hake
Anisakis simplex	
Hysterothylacium aduncum	
Pseudoterranova decipiens	
Spinitectus cristatus	
Urophycis chuss (Walbaum)	Red Hake
Anisakis simplex	
Anisakis sp.	
Capillaria (Procapillaria) gracilis	
Hysterothylacium aduncum	
Pseudoterranova decipiens	
Spinitectus cristatus	
Urophycis tenuis (Mitchill)	White Hake
Anisakis simplex	
Anisakis sp.	
Ascarophis arctica	
Capillaria (Procapillaria) gracilis	
Contracaecum osculatum	
Contracaecum sp. and/or *Phocascaris* sp.	
Cucullanus cirratus	
Hysterothylacium aduncum	
Pseudoterranova decipiens	
Spinitectus cristatus	
Spinitectus sp.	

Family Gadidae

Boreogadus saida (Lepechin)	Arctic Cod
Anisakis simplex	
Ascarophis filiformis	
Contracaecum osculatum	
Hysterothylacium sp.	
Pseudoterranova decipiens	
Brosme brosme (Ascanius)	Cusk
Anisakis simplex	
Pseudoterranova decipiens	
Gadus macrocephalus Tilesius	Pacific Cod
Anisakis simplex	
Anisakis sp.	
Ascarophis sp.	
Contracaecum osculatum	
Contracaecum sp. and/or *Phocascaris* sp.	

Hysterothylacium aduncum
Pseudoterranova bulbosa
Pseudoterranova decipiens
Pseudoterranova sp.

Gadus morhua Linnaeus — Atlantic Cod
Anisakidae gen. sp.
Anisakis simplex
Anisakis sp.
Ascarophis arctica
Ascarophis extalicola
Ascarophis filiformis
Ascarophis morrhuae
Capillaria sp.
Contracaecinea gen. sp.
Contracaecum osculatum
Contracaecum sp.
Contracaecum sp. and/or *Phocascaris* sp.
Cucullanus cirratus
Hysterothylacium aduncum
Hysterothylacium sp.
Nematoda gen. sp.
Phocascaris sp.
Pseudoterranova decipiens
Pseudoterranova sp.

Lota lota (Linnaeus) — Burbot
Camallanus oxycephalus
Cucullanellus cotylophora
Eustrongylides sp.
Haplonema hamatulum [*sic*] for *H. hamulatum*
Haplonema hamulatum
Haplonema sp.
Hysterothylacium brachyurum
Nematoda gen. sp.
Pseudocapillaria (Pseudocapillaria) tomentosa
Raphidascaris acus
Rhabdochona cascadilla
Spinitectus gracilis

Melanogrammus aeglefinus (Linnaeus) — Haddock
Anisakis simplex
Anisakis sp.
Ascarophis arctica
Ascarophis extalicola
Capillaria sp.
Contracaecum sp.
Contracaecum sp. and/or *Phocascaris* sp.
Cucullanus cirratus
Hysterothylacium aduncum
Hysterothylacium melanogrammi
Hysterothylacium sp.

Pseudoterranova decipiens
Pseudoterranova sp.

Microgadus tomcod (Walbaum) — Atlantic Tomcod
Anguillicola crassus
Anisakis simplex
Anisakis sp.
Ascarophis arctica
Hysterothylacium aduncum
Nematoda gen. sp.
Pseudoterranove decipiens
Pseudoterranova sp.

Pollachius virens (Linnaeus) — Pollock
Anisakidae gen. sp.
Anisakis simplex
Anisakis sp.
Cucullanus cirratus
Hysterothylacium sp.
Pseudoterranova decipiens

Theragra chalcogramma Pallas — Walleye Pollock
Anisakis simplex
Anisakis sp.
Ascarophis sp.
Contracaecum osculatum
Contracaecum sp.
Contracaecum sp. and/or *Phocascaris* sp.
Hysterothylacium aduncum
Pseudoterranova decipiens
Pseudoterranova sp.
Spirurida gen. sp.

"cod"
Nematoda gen. sp.
Pseudoterranova decipiens
Pseudoterranova sp.

ORDER LOPHIIFORMES

Family Lophiidae

Lophius americanus Valenciennes — Goosefish
Anisakis simplex
Pseudoterranova decipiens
Pseudoterranova sp.

ORDER ATHERINIFORMES

Family Atherinopsidae

Labidesthes sicculus (Cope) — Brook Silverside
Camallanus oxycephalus
Nematoda gen. sp.

Menidia menidia — Atlantic silverside
Pseudoterranova decipiens

Family Scomberesocidae

Scomberesox saurus (Walbaum) — Atlantic Saury
Anisakis simplex

ORDER CYPRINODONTIFORMES

Family Fundulidae

Fundulus diaphanus (Lesueur) — Banded Killifish
Camallanus oxycephalus
Cucullanus sp.
Cystidicola sp.
Eustrongylides tubifex
Hedruris sp.
Hysterothylacium sp.
Nematoda gen. sp.
Raphidascaris acus
Rhabdochona sp.
Spiroxys sp.

Fundulus heteroclitus (Linnaeus) — Mummichog
Contracaecinea gen. sp.
Cosmocephalus obvelatus
Paracuaria adunca

Family Poeciliidae

Poecilia reticulata Peters — Guppy
Contracaecum rudolphii (EX)

ORDER GASTEROSTEIFORMES

Family Aulorhynchidae

Aulorhynchus flavidus Gill — Tube-snout
Anisakis sp.
Ascarophis sebastodis
Contracaecum sp.
Hysterothylacium aduncum
Philometra sp.

Family Gasterosteidae

Apeltes quadracus (Mitchill) — Fourspine Stickleback
- *Contracaecum* sp.
- *Cosmocephalus obvelatus*
- *Cystidicola farionis*
- *Paracuaria adunca*
- *Pseudoterranova decipiens*

Culaea inconstans (Kirtland) — Brook Stickleback
- *Camallanus oxycephalus*
- *Contracaecum* sp.
- *Eustrongylides tubifex*
- *Hysterothylacium brachyurum*
- *Hysterothylacium* sp.
- Nematoda gen. sp.
- *Spiroxys* sp.

Gasterosteus aculeatus Linnaeus — Threespine Stickleback
- *Anisakis* sp.
- *Ascarophis morrhuae*
- *Contracaecum* sp.
- *Cosmocephalus obvelatus*
- *Eustrongylides* sp.
- *Hysterothylacium* sp.
- Nematoda gen. sp.
- *Paracuaria adunca*
- *Philonema agubernaculum*
- *Pseudoterranova decipiens*

Pungitius pungitius (Linnaeus) — Ninespine Stickleback
- Contracaecinea gen. sp.
- *Contracaecum* sp.
- *Cosmocephalus obvelatus*
- *Paracuaria adunca*
- *Raphidascaris acus*
- *Raphidascaris* sp.

Family Syngnathidae

Syngnathus leptorhynchus Girard — Bay Pipefish
- *Anisakis* sp.
- *Contracaecum* sp.
- *Pseudodelphis oligocotti*

ORDER SCORPAENIFORMES

Family Scorpaenidae

Sebastes aleutianus (Jordan & Evermann)	Rougheye Rockfish
Contracaecum sp.	
Cucullanus sp.	
Hysterothylacium aduncum	
Sebastes alutus (Gilbert)	Pacific Ocean Perch
Anisakis sp.	
Ascarophis sebastodis	
Capillaria sp.	
Contracaecum sp.	
Cucullanus sp.	
Hysterothylacium aduncum	
Pseudoterranova decipiens	
Sebastes babcocki (Thompson)	Redbanded Rockfish
Capillaria sp.	
Contracaecum sp.	
Cucullanus sp.	
Hysterothylacium aduncum	
Sebastes borealis Barsukov	Shortraker Rockfish
Ascarophis sebastodis	
Capillaria sp.	
Contracaecum sp.	
Cucullanus sp.	
Sebastes brevispinis (Bean)	Silvergray Rockfish
Anisakis sp.	
Contracaecum sp.	
Hysterothylacium aduncum	
Sebastes caurinus Richardson	Copper Rockfish
Ascarophis sebastodis	
Capillaria sp.	
Contracaecum sp.	
Cucullanus elongatus	
Hysterothylacium aduncum	
Sebastes ciliatus (Tilesius)	Dusky Rockfish
Contracaecum sp.	
Hysterothylacium aduncum	
Sebastes crameri (Jordan)	Darkblotched Rockfish
Contracaecum sp.	
Cucullanus sp.	
Hysterothylacium aduncum	
Sebastes diploproa (Gilbert)	Splitnose Rockfish
Ascarophis sebastodis	
Contracaecum sp.	
Hysterothylacium aduncum	

Sebastes elongatus Ayres	Greenstriped Rockfish
Contracaecum sp.	
Sebastes entomelas (Jordan & Gilbert)	Widow Rockfish
Contracaecum sp.	
Hysterothylacium aduncum	
Sebastes fasciatus Storer	Acadian Redfish
Anisakidae gen. sp.	
Anisakinae gen. sp.	
Anisakis simplex	
Anisakis sp.	
Contracaecinea gen. sp.	
Contracaecum sp.	
Hysterothylacium aduncum	
Pseudoterranova decipiens	
Sebastes flavidus (Ayres)	Yellow Rockfish
Anisakis sp.	
Ascarophis sebastodis	
Capillaria sp.	
Contracaecum sp.	
Cucullanus sp.	
Hysterothylacium aduncum	
Pseudoterranova decipiens	
Pseudoterranova sp.	
Sebastes goodei (Eigenmann & Eigenmann)	Chilipepper
Contracaecum sp.	
Sebastes helvomaculatus Ayres	Rosethorn Rockfish
Contracaecum sp.	
Hysterothylacium aduncum	
Sebastes maliger (Jordan & Gilbert)	Quillback Rockfish
Ascarophis sebastodis	
Capillaria sp.	
Contracaecum sp.	
Cucullanus elongatus	
Hysterothylacium aduncum	
Sebastes mentella (Travin)	Deepwater Redfish
Anisakinae gen. sp.	
Anisakis simplex	
Anisakis sp.	
Contracaecinea gen. sp.	
Contracaecum sp.	
Hysterothylacium aduncum	
Pseudoterranova decipiens	
Sebastes nebulosus Ayres	China Rockfish

Ascarophis sebastodis
Caballeronema wardlei
Contracaecum sp.
Cucullanus elongatus
Hysterothylacium aduncum
Nematoda gen. sp.

Sebastes nigrocinctus Ayres — Tiger Rockfish
Capillaria sp.
Contracaecum sp.

Sebastes norvegicus (Ascanius) — Golden Redfish
Anisakinae gen. sp.
Anisakis sp.
Contracaecum sp.
Hysterothylacium aduncum
Pseudoterranova decipiens
Pseudoterranova sp.

Sebastes paucispinis Ayres — Bocaccio
Anisakis sp.
Capillaria sp.
Contracaecum sp.
Cucullanus sp.
Hysterothylacium aduncum

Sebastes pinniger (Gill) — Canary Rockfish
Anisakis sp.
Contracaecum sp.
Hysterothylacium aduncum

Sebastes polyspinis (Taranetz & Moiseev) — Northern Rockfish
Contracaecum sp.
Hysterothylacium aduncum

Sebastes proriger (Jordan & Gilbert) — Redstripe Rockfish
Ascarophis sebastodis
Contracaecum sp.
Hysterothylacium aduncum

Sebastes reedi (Westrheim & Tsuyuki) — Yellowmouth Rockfish
Contracaecum sp.
Hysterothylacium aduncum

Sebastes ruberrimus (Cramer) — Yelloweye Rockfish
Ascarophis sebastodis
Capillaria sp.
Contracaecum sp.
Cucullanus elongatus
Cucullanus sp.
Hysterothylacium aduncum

Sebastes variegatus Quast — Harlequin Rockfish
- *Ascarophis sebastodis*
- *Contracaecum* sp.
- *Hysterothylacium aduncum*

Sebastes wilsoni (Gilbert) — Pygmy Rockfish
- *Contracaecum* sp.

Sebastes zacentrus (Gilbert) — Sharpchin Rockfish
- *Ascarophis sebastodis*
- *Contracaecum* sp.
- *Hysterothylacium aduncum*

"rockfish"
- *Anisakis simplex*
- *Contracaecum* sp.
- *Huffmanela* sp.
- *Hysterothylacium* sp.

Family Anoplopomatidae

Anoplopoma fimbria (Pallas) — Sablefish
- *Anisakis* sp.
- Nematoda gen. sp.
- *Pseudoterranova decipiens*
- *Pseudoterranova* sp.

Family Hexagrammidae

Hexagrammos decagrammus (Pallas) — Kelp Greenling
- *Ascarophis* sp.
- Nematoda gen. sp.

Hexagrammos lagocephalus (Pallas) — Rock Greenling
- *Anisakis* sp.
- *Ascarophis sebastodis*
- *Capillaria* sp.
- *Contracaecum* sp.

Ophiodon elongatus Girard — Lingcod
- *Anisakis* sp.
- *Contracaecum* sp.
- *Cucullanus elongatus*
- *Hysterothylacium aduncum*
- *Hysterothylacium magnum*
- Nematoda gen. sp.
- *Pseudoterranova decipiens*
- *Pseudoterranova* sp.

Family Rhamphocottidae

Rhamphocottus richardsoni Günther	
[*Rhamphocottus richardsonii* Girard]	Grunt Sculpin
Ascarophis sebastodis	
Pseudoterranova sp.	

Family Cottidae

Artediellus atlanticus Jordan & Evermann	Atlantic Hookear Sculpin
Pseudoterranova decipiens	
Artedius harringtoni (Starks)	Scalyhead Sculpin
Ascarophis sebastodis	
Capillaria sp.	
Contracaecum sp.	
Artedius lateralis (Girard)	Smoothhead Sculpin
Pseudodelphis oligocotti	
Chitonotus pugetensis (Steindachner)	Roughback Sculpin
Capillaria sp.	
Contracaecum sp.	
Clinocottus acuticeps (Gilbert)	Sharpnose Sculpin
Nematoda gen. sp.	
Cottus aleuticus Gilbert	Coastrange Sculpin
Ascarophis sp.	
Hysterothylacium sp.	
Cottus asper Richardson	Prickly Sculpin
Clavinema mariae	
Eustrongylides sp.	
Pseudocapillaria (Pseudocapillaria) tomentosa	
Rhabdochona cotti	
Salmonema ephemeridarum	
Cottus bairdii Girard	Mottled Sculpin
Camallanus oxycephalus	
Contracaecum sp.	
Raphidascaris acus	
Rhabdochona cotti	
Cottus caeruleomentum Kinziger, Raesly & Neely	Blue Ridge Sculpin
Rhabdochona cotti	
Cottus cognatus Richardson	Slimy Sculpin
Eustrongylides sp.	
Haplonema sp.	
Raphidascaris acus	
Rhabdochona cotti	

Rhabdochona sp.
Spinitectus gracilis

Hemilepidotus hemilepidotus (Tilesius) — Red Irish Lord
Ascarophis sebastodis
Capillaria sp.

Icelinus filamentosus Gilbert — Threadfin Sculpin
Contracaecum sp.

Jordania zonope Starks — Longfin Sculpin
Contracaecum sp.

Leptocottus armatus Girard — Pacific Staghorn Sculpin
Anisakis sp.
Contracaecum sp.
Hysterothylacium magnum
Pseudodelphis oligocotti

Myoxocephalus aenaeus (Mitchill) — Grubby
Pseudoterranova decipiens

Myoxocephalus octodecemspinosus (Mitchill) — Longhorn Sculpin
Anisakis simplex
Anisakis sp.
Ascarophis extalicola
Capillaria (Procapillaria) gracilis
Capillaria sp.
Contracaecum sp.
Contracaecum sp. and/or *Phocascaris* sp.
Pseudoterranova decipiens
Pseudoterranova sp.

Myoxocephalus polyacanthocephalus (Pallas) — Great Sculpin
Anisakis sp.
Ascarophis sebastodis
Capillaria sp.
Contracaecum sp.
Pseudoterranova sp.

Myoxocephalus quadricornis (Linnaeus) — Fourhorn Sculpin
Pseudoterranova bulbosa

Myoxocephalus scorpius (Linnaeus) — Shorthorn Sculpin
Anisakis simplex
Contracaecum osculatum
Contracaecum sp. and/or *Phocascaris* sp.
Hysterothylacium aduncum
Nematoda gen. sp.
Pharurus pallasii (EX)
Phocascaris sp.
Pseudoterranova decipiens

Myoxocephalus thompsonii (Girard)	Deepwater Sculpin
Cystidicola stigmatura	
Raphidascaris acus	
Spirurinae gen. sp.	
Oligocottus maculosus Girard	Tidepool Sculpin
Anisakis sp.	
Contracaecum sp.	
Nematoda gen. sp.	
Pseudodelphis oligocotti	
Scorpaenichthys marmoratus (Ayres)	Cabezon
Caballeronema wardlei	
Capillaria (Procapillaria) margolisi	
Triglops murrayi Günther	Moustache Sculpin
Pseudoterranova decipiens	
Triglops pingelii Reinhardt	Ribbed Sculpin
Anisakis sp.	
Contracaecum sp.	
Pseudoterranova decipiens	
"sculpin"	
Cosmocephalus obvelatus	
Nematoda gen. sp.	
Paracuaria adunca	
Rhabdochona canadensis	

Family Hemitripteridae

Blepsias cirrhosus (Pallas)	Silverspotted Sculpin
Anisakis sp.	
Contracaecum sp.	
Hemitripterus americanus (Gmelin)	Sea Raven
Anisakis simplex	
Ascarophis arctica	
Pseudoterranova decipiens	
Nautichthys oculofasciatus (Girard)	Sailfin Sculpin
Ascarophis sebastodis	
Ascarophis sp.	

Family Agonidae

Aspidophoroides monopterygius (Bloch)	Alligatorfish
Pseudoterranova decipiens	
Podothecus accipenserinus (Tilesius)	Sturgeon Poacher

Contracaecum sp.
Hysterothylacium aduncum

Family Psychrolutidae

Cottunculus microps Collett — Polar Sculpin
Hysterothylacium sp.

Malacocottus kincaidi Gilbert & Thompson — Blackfin Sculpin
Capillaria sp.
Contracaecum sp.

Psychrolutes sigalutes (Jordan & Starks) — Soft Sculpin
Anisakis sp.

Family Cyclopteridae

Cyclopterus lumpus Linnaeus — Lumpfish
Anisakis sp.
Contracaecum sp. and/or *Phocascaris* sp.
Pseudoterranova decipiens

Eumicrotremus spinosus (Fabricius) — Atlantic Spiny Lumpsucker
Pseudoterranova decipiens

Family Liparidae

Liparis dennyi Jordan & Starks — Marbled Snailfish
Ascarophis filiformis

ORDER PERCIFORMES

Family Moronidae

Morone americana (Gmelin) — White Perch
Contracaecum spiculigerum
Cucullanellus cotylophora
Eustrongylides tubifex
Hysterothylacium sp.
Spinitectus carolini

Morone chrysops (Rafinesque) — White Bass
Camallanus oxycephalus
Cucullanellus cotylophora
Eustrongylides tubifex
Nematoda gen. sp.
Raphidascaris acus
Raphidascaris sp.
Rhabdochona sp.

Spinitectus carolini
Spiroxys sp.

Morone saxatilis (Walbaum) — Striped Bass
Philometra rubra
Philometra sp.

Family Centrarchidae

Ambloplites rupestris (Rafinesque) — Rock Bass
Anisakis sp.
Camallanus oxycephalus
Capillaria (Capillaroides) catenata
Contracaecum sp.
Cucullanellus cotylophora
Eustrongylides tubifex
Hysterothylacium brachyurum
Hysterothylacium sp.
Nematoda gen. sp.
Rhabdochona cascadilla
Rhabdochona rotundicaudatum
Rhabdochona sp.
Raphidascaris acus
Spinitectus carolini
Spinitectus gracilis
Spiroxys sp.

Centrarchidae gen.sp.
Cucullanus cotylophora

Lepomis gibbosus (Linnaeus) — Pumpkinseed
Camallanus oxycephalus
Contracaecum sp.
Cucullanellus cotylophora
Dioctophyma renale
Eustrongylides sp.
Eustrongylides tubifex
Hysterothylacium analarum
Hysterothylacium brachyurum
Nematoda gen. sp.
Philometra sp.
Raphidascaris acus
Rhabdochona sp.
Spinitectus carolini
Spinitectus gracilis
Spiroxys sp.

Lepomis macrochirus Rafinesque — Bluegill
Camallanus oxycephalus
Cucullanellus cotylophora
Hysterothylacium sp.
Rhabdochona sp.

Spinitectus carolini

Micropterus dolomieu Lacépède — Smallmouth Bass
- *Camallanus oxycephalus*
- *Capillaria* sp.
- *Contracaecum* sp.
- *Cucullanellus cotylophora*
- *Eustrongylides tubifex*
- *Hysterothylacium brachyurum*
- Nematoda gen. sp.
- *Philometra* sp.
- *Raphidascaris acus*
- *Rhabdochona cascadilla*
- *Rhabdochona* sp.
- *Spinitectus carolini*
- *Spinitectus gracilis*
- *Spiroxys* sp.

Micropterus salmoides (Lacépède) — Largemouth Bass
- *Camallanus oxycephalus*
- *Contracaecum* sp.
- *Cucullanellus cotylophora*
- *Dioctophyma* sp.
- *Hysterothylacium brachyurum*
- Nematoda gen. sp.
- *Philometra* sp.
- *Spinitectus carolini*

Pomoxis annularis Rafinesque — White Crappie
- *Camallanus oxycephalus*
- Nematoda gen. sp.

Pomoxis nigromaculatus (Lesueur) — Black Crappie
- *Camallanus oxycephalus*
- *Spinitectus carolini*
- *Spinitectus gracilis*

Family Percidae

Ammocrypta pellucida (Agassiz) — Eastern Sand Darter
- *Camallanus oxycephalus*
- Nematoda gen. sp.

Etheostoma blennioides Rafinesque — Greenside Darter
- *Camallanus oxycephalus*

Etheostoma caeruleum Storer — Rainbow Darter
- *Rhabdochona rotundicaudatum*
- *Rhabdochona* sp.

Etheostoma exile (Girard) — Iowa Darter

Camallanus oxycephalus
Hysterothylacium brachyurum
Nematoda gen. sp.
Raphidascaris acus
Rhabdochona cascadilla
Rhabdochona sp.

Etheostoma microperca Jordan & Gilbert — Least Darter
Contracaecum sp.

Etheostoma nigrum Rafinesque — Johnny Darter
Contracaecum sp.
Nematoda gen. sp.
Rhabdochona cascadilla
Spiroxys sp.

Perca flavescens (Mitchill) — Yellow Perch
Camallanus oxycephalus
Camallanus sp.
Contracaecum spiculigerum
Contracaecum sp.
Cucullanellus cotylophora
Cucullanus sp.
Cystidicola farionis
Eustrongylides sp.
Eustrongylides tubifex
Hysterothylacium brachyurum
Nematoda gen. sp.
Philometra cylindracea
Philometra sp.
Raphidascaris acus
Raphidascaris sp.
Rhabdochona cascadilla
Rhabdochona ovifilamenta
Rhabdochona sp.
Spinitectus carolini
Spinitectus gracilis
Spinitectus sp.
Spiroxys contortus
Spiroxys sp.

Percina caprodes (Rafinesque) — Logperch
Camallanus oxycephalus
Contracaecum sp.
Nematoda gen. sp.
Raphidascaris acus
Spinitectus gracilis

Percina copelandi (Jordan) — Channel Darter
Camallanus oxycephalus

Percina maculata (Girard) — Blackside Darter

Camallanus oxycephalus

Sander canadensis (Griffith & Smith) — Sauger
Camallanus oxycephalus
Eustrongylides sp.
Hysterothylacium brachyurum
Raphidascaris acus

Sander vitreus (Mitchill) — Walleye
Camallanus oxycephalus
Contracaecum sp.
Cucullanellus cotylophora
Cystidicola farionis
Eustrongylides sp.
Eustrongylides tubifex
Hysterothylacium brachyurum
Nematoda gen. sp.
Philometra cylindracea
Raphidascaris acus
Raphidascaris sp.
Rhabdochona canadensis
Spinitectus carolini
Spinitectus gracilis
Spinitectus sp.

Family Sciaenidae

Aplodinotus grunniens Rafinesque — Freshwater Drum
Camallanus oxycephalus
Cucullanellus cotylophora
Eustrongylides tubifex
Nematoda gen. sp.
Philometra cylindracea
Philometra sp.
Spinitectus gracilis

Family Embiotocidae

Cymatogaster aggregata Gibbons — Shiner Perch
Anisakis sp.
Contracaecum sp.
Cucullanellus kanabus
Cucullanus sp.
Nematoda gen. sp.

Family Labridae

Tautogolabrus adspersus (Walbaum) — Cunner
Anisakis sp.

Contracaecum sp.
Cucullanellus minutus
Hysterothylacium aduncum
Nematoda gen. sp.
Phocascaris sp.
Pseudoterranova decipiens
Pseudoterranova sp.

Family Bathymasteridae

Ronquilus jordani (Gilbert) — Northern Ronquil
Anisakis sp.
Cucullanus sp.

Family Zoarcidae

Lycodes brevipes Bean — Shortfin Eelpout
Anisakis sp.
Capillaria sp.

Lycodes cortezianus (Gilbert) — Bigfin Eelpout
Capillaria sp.
Contracaecum sp.

Lycodes esmarkii Collett — Greater Eelpout
Hysterothylacium sp.

Lycodes lavalaei Vladykov & Tremblay — Newfoundland Eelpout
Ichthyofilaria canadensis

Lycodes reticulatus Reinhardt — Arctic Eelpout
Pseudoterranova decipiens

Lycodes vahlii Reinhardt — Checker Eelpout
Ichthyofilaria canadensis
Pseudoterranova decipiens

Lycodonus mirabilis Goode & Bean — Chevron Scutepout
Hysterothylacium sp.

Zoarces americanus (Block & Schneider) — Ocean Pout
Anisakis simplex
Ascarophis arctica
Contracaecum sp.
Nematoda gen. sp.
Pseudoterranova decipiens

*"*eelpout*"*
Anisakis simplex
Pseudoterranova decipiens

Family Stichaeidae

Anoplarchus purpurescens Gill	High Cockscomb
Anisakis sp.	
Ascarophis sebastodis	
Clavinema mariae	
Contracaecum sp.	
Pseudoterranova sp.	
Eumesogrammus praecisus (Krøyer)	Fourline Snakeblenny
Pseudoterranova decipiens	
Leptoclinus maculatus (Fries)	Daubed Shanny
Pseudoterranova decipiens	
Lumpenus lumpretaeformis (Walbaum)	Snakeblenny
Pseudoterranova decipiens	
Xiphister atropurpureus (Kittlitz)	Black Prickleback
Clavinema mariae	

Family Cryptacanthodidae

Cryptacanthodes giganteus (Kittlitz)	Giant Wrymouth
Anisakis sp.	
Hysterothylacium aduncum	
Cryptacanthodes maculatus Storer	Wrymouth
Pseudoterranova decipiens	

Family Pholidae

Apodichthys flavidus Girard	Penpoint Gunnel
Anisakis sp.	
Capillaria sp.	
Hysterothylacium magnum	
Pholis gunnellus (Linnaeus)	Rock Gunnel
Ascarophis arctica	
Pholis laeta (Cope)	Crescent Gunnel
Anisakis sp.	
Clavinema mariae	
Contracaecum sp.	
Philometra sp.	
Pseudodelphis oligocotti	
Pholis ornata (Girard)	Saddleback Gunnel
Anisakis sp.	

Clavinema mariae
Contracaecum sp.
Pseudodelphis oligocotti

Rhodymenichthys dolichogaster (Pallas) — Stippled Gunnel
Philometridae gen. sp.

Family Anarhichadidae

Anarhichas lupus Linnaeus — Atlantic Wolffish
Ascarophis morrhuae
Capillaria (Procapillaria) gracilis
Hysterothylacium aduncum
Pseudoterranova decipiens

Family Ammodytidae

Ammodytes dubius Reinhardt — Northern Sand Lance
Anisakis simplex
Hysterothylacium aduncum

Ammodytes hexapterus Pallas — Pacific Sand Lance
Anisakis sp.
Contracaecum sp.

"sand lance"
Pseudoterranova decipiens

Family Icosteidae

Icosteus aenigmaticus Lockington — Ragfish
Anisakis sp.

Family Gobiesocidae

Gobiesox maeandricus (Girard) — Northern Clingfish
Clavinema mariae
Nematoda gen. sp.
Philometridae gen. sp.
Pseudodelphis oligocotti

Family Gobiidae

Rhinogobiops nicholsii (Bean) — Blackeye Goby
Contracaecum sp.

Family Scombridae

Scomber scombrus Linnaeus	Atlantic Mackerel
Anisakis simplex	
Anisakis sp.	
Hysterothylacium aduncum	
Hysterothylacium sp.	
Thunnus alalunga (Bonnaterre)	Albacore
Anisakis sp.	
"mackerel"	
Contracaecum sp.	

Family Xiphiidae

Xiphias gladius Linnaeus	Swordfish
Anisakis simplex	
Hysterothylacium aduncum	
Hysterothylacium corrugatum	
Hysterothylacium incurvum	
Hysterothylacium reliquens	
Nematoda gen. sp.	
Oncophora melanocephala	

Family Stromateidae

Peprilus triacanthus (Peck)	Butterfish
Anisakis simplex	
Pseudoterranova decipiens	

ORDER PLEURONECTIFORMES

Family Scophthalmidae

Scophthalmus aquosus (Mitchill)	Windowpane
Anisakinae gen. sp.	
Anisakis simplex	
Contracaecum sp.	
Pseudoterranova decipiens	
Pseudoterranova sp.	

Family Paralichthyidae

Citharichthys sordidus (Girard)	Pacific Sanddab
Anisakis sp.	
Citharichthys stigmaeus Jordan & Gilbert	Speckled Sanddab

Anisakis sp.
Contracaecum sp.

Family Pleuronectidae

Atheresthes stomias (Jordan & Gilbert) — Arrowtooth Flounder
Anisakis simplex
Anisakis sp.
Hysterothylacium aduncum
Pseudoterranova decipiens
Pseudoterranova sp.
Spirurida gen. sp.

Eopsetta jordani (Lockington) — Petrale Sole
Anisakis sp.
Contracaecum sp.
Hysterothylacium aduncum

Glyptocephalus cynoglossus (Linnaeus) — Witch Flounder
Anisakinae gen. sp.
Anisakis simplex
Anisakis sp.
Ascarophis morrhuae
Contracaecum osculatum
Contracaecum sp.
Contracaecum sp. and/or *Phocascaris* sp.
Hysterothylacium aduncum
Nematoda gen. sp.
Pseudoterranova decipiens
Pseudoterranova sp.

Glyptocephalus zachirus Lockington — Rex Sole
Anisakis sp.
Hysterothylacium aduncum

Hippoglossoides elassodon Jordan & Gilbert — Flathead Sole
Anisakis sp.
Contracaecum sp.
Hysterothylacium aduncum

Hippoglossoides platessoides (Fabricius) — American Plaice
Anisakinae gen. sp.
Anisakis simplex
Anisakis sp.
Ascarophis arctica
Capillaria (Procapillaria) gracilis
Contracaecinea gen. sp.
Contracaecum osculatum
Contracaecum sp.
Contracaecum sp. and/or *Phocascaris* sp.
Hysterothylacium aduncum

Nematoda gen. sp.
Pharurus pallasii (EX)
Phocascaris sp.
Pseudoterranova decipiens
Pseudoterranova sp.

Hippoglossus hippoglossus (Linnaeus) — Atlantic Halibut
Anisakidae gen. sp.
Anisakinae gen. sp.
Anisakis simplex
Anisakis sp.
Capillaria (Procapillaria) gracilis
Contracaecum osculatum
Contracaecum sp.
Cucullanus cirratus
Hysterothylacium aduncum
Pseudoterranova bulbosa
Pseudoterranova decipiens
Pseudoterranova sp.

Hippoglossus stenolepis Schmidt — Pacific Halibut
Anisakis simplex
Ascarophis filiformis
Capillaria (Procapillaria) margolisi
Contracaecum sp.
Cucullanus heterochrous
Hysterothylacium aduncum
Nematoda gen. sp.
Paracapillaria (Paracapillaria) parophrysi
Pseudoterranova decipiens
Spiruridae gen. sp.

Isopsetta isolepis (Lockington) — Butter Sole
Anisakis sp.

Lepidopsetta bilineata (Ayres) — Rock Sole
Anisakis sp.
Capillaria sp.
Clavinema mariae
Cucullanus sp.
Philometridae gen. sp.

Limanda ferrugineus (Storer) — Yellowtail Flounder
Anisakinae gen. sp.
Anisakis simplex
Contracaecum sp. and/or *Phocascaris* sp.
Contracaecum sp.
Cucullanus heterochrous
Hysterothylacium aduncum
Pseudoterranova decipiens
Pseudoterranova sp.

Lyopsetta exilis (Jordan & Gilbert)	Slender Sole
Anisakis sp.	
Contracaecum sp.	
Microstomus pacificus (Lockington)	Dover Sole
Anisakis sp.	
Ascarophis sebastodis	
Cucullanus annulatus	
Hysterothylacium aduncum	
Pseudoterranova decipiens	
Spirurida gen. sp.	
Paraplagusia bilineata (Bloch)	Doublelined Tonguesole
Anisakis sp.	
Capillaria sp.	
Clavinema mariae	
Cucullanus sp.	
Philometridae gen. sp.	
Parophrys vetulus (Girard)	English Sole
Anisakis sp.	
Ascarophis sebastodis	
Capillaria sp.	
Clavinema mariae	
Contracaecum sp.	
Cucullanus annulatus	
Cucullanus sp.	
Hysterothylacium aduncum	
Paracapillaria (Paracapillaria) parophrysi	
Platichthys stellatus (Pallas)	Starry Flounder
Anisakis sp.	
Clavinema mariae	
Contracaecum sp.	
Cucullanus annulatus	
Cucullanus sp.	
Nematoda gen. sp.	
Philometra sp.	
Philometridae gen. sp.	
Pleuronectes putnami (Gill)	Smooth Flounder
Anisakinae gen. sp.	
Contracaecum sp.	
Pseudoterranova sp.	
Psettichthys melanostictus Girard	Sand Sole
Anisakis sp.	
Pseudopleuronectes americanus (Walbaum)	Winter Flounder
Anisakinae gen. sp.	
Anisakis simplex	
Ascarophis arctica	

Contracaecum osculatum
Contracaecum sp.
Contracaecum sp. and/or *Phocascaris* sp.
Cucullanus heterochrous
Hysterothylacium aduncum
Nematoda gen. sp.
Phocascaris sp.
Pseudoterranova decipiens
Pseudoterranova sp.

Reinhardtius hippoglossoides (Walbaum) Greenland Halibut
Anisakidae gen. sp.
Anisakis simplex
Anisakis sp.
Ascarophis arctica
Ascarophis filiformis
Ascarophis sp.
Contracaecinea gen. sp.
Contracaecum sp.
Contracaecum sp. and/or *Phocascaris* sp.
Hysterothylacium aduncum
Nematoda gen. sp.
Phocascaris sp.
Pseudoterranova bulbosa
Pseudoterranova decipiens

“flatfish”
Hysterothylacium sp.

"flounder"
Nematoda gen. sp.

UNSPECIFIED FISH

"fish"
Anisakis simplex
Anisakis sp.
Contracaecum osculatum
Contracaecum sp.
Eustrongylides tubifex
Pseudoterranova decipiens
Pseudoterranova sp.
Spiruridae gen. sp.

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