

This page has been included to facilitate review of the pamphlet in a two-page PDF viewing mode. It is best viewed with two pages on screen at once.

This pamphlet has been designed for A5 size paper (5.8" x 8.3").

# Guide to Common Parasites of Food Fish Species in the Northwest Territories and Nunavut



N. Zabel, H. Swanson, & G. Conboy

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Prepared by N. Zabel & Dr. H. Swanson, Wilfrid Laurier University, and reviewed by Dr. G. Conboy (DVM, PhD, DACVM), Atlantic Veterinary College, University of Prince Edward Island. Preparation of this guide was supported by **Northern Water Futures** (Global Water Futures; Canada First Research Excellence Fund). Reviews, photographs, and expert guidance was received as in-kind support from several individuals, and we gratefully acknowledge these important contributions.

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**Front Cover:** Arctic Grayling (*Thymallus arcticus*);

Image: US Fish and Wildlife Service, Mountain-Prairie Region.

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# Regional Map



Map: Wikimedia Maps

## Fish Species Covered in this Guide

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**Arctic Charr** (*Salvelinus alpinus*): Omble Chevalier, Omble Rouge, Truite Rouge, Dhik'ii, Iqalukpik, Iqaluk, Tariungmiutaq, Łiwezqò dek'oo



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**Arctic Cisco** (*Coregonus autumnalis*): Herring, Cisco Arctique, Treeluk, Qaaktaq



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**Arctic Grayling** (*Thymallus arcticus*): Grayling, Bluefish, Ombre Arctique, Ts'ánt'l/ts'ajt'in, Cahcahkinosêw, Srijja, Sulukpauqaq, T'áe, Ts'ét'jah, Ts'étjã



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**Atlantic Salmon** (*Salmo salar*): Saumon Atlantique, Sama



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**Broad Whitefish** (*Coregonus nasus*): Round-nosed Whitefish, River Whitefish, Corégone Tschir, Łu, Łuk zheii/Łuk dagaii, Anaakliiq



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**Bull Trout** (*Salvelinus confluentus*): Mountain Charr, Omble à Tête Plate



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**Burbot** (*Lota lota*): Freshwater Cod, Ling, Loche, Methe, Moira, Lotte, Queue d'Anguille, Tjtel, Chehluk, Tiktaaliq, Nqhkwa, Nqhtthie, Nqhkwee



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**Chinook Salmon** (*Oncorhynchus tshawytscha*): King Salmon, Blackmouth, Saumon Chinook, Łuk choo



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**Chum Salmon** (*Oncorhynchus keta*): Dog Salmon, Saumon Keta, Shii, Paiirluq





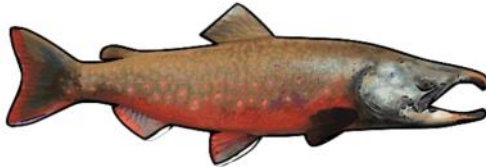
## Fish Species Covered in this Guide (continued)

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**Coho Salmon** (*Oncorhynchus kisutch*): Silver Salmon, Saumon Coho



**Dolly Varden** (*Salvelinus malma*): Dolly Varden, Dhik'ii, Iqalukpik



**Fourhorn Sculpin** (*Myoxocephalus quadricornis*): Chaboisseau à quatre cornes, Kanajuq, Kanayuq



**Inconnu** (*Stenodus leucichthys*): Coney, Sheefish, Sruh, Inconnu, Beghúle, Sryuh, Siiraq, Siho, Mewúli, Wiile



**Lake Cisco** (*Coregonus artedii*): Lake Herring, Freshwater Herring, Tulibee, Tulabee, Cisco du Lac, Łuek'áta, Treeluk, Iqalusaq, Łuehyaa, Edhíh, Łihtsoa



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**Lake Trout** (*Salvelinus namaycush*): Touladi, Truite Grise, Truite de Lac, Omble Gris, Łezané, Namêkos, Vit, Ihuuqiq, Isiuralittaak, Iqaluaqpak (brackish), Singayuriaq (freshwater), Sahba, Łezq, Łiwezqò



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**Lake Whitefish** (*Coregonus clupeaformis*): Humpback Whitefish, Crookedback, Grand Corégone, Poisson Blanc, Pointu, Łu, Dalts'an, Pikuktung, Lú, Łih



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**Least Cisco** (*Coregonus sardinella*): Lake Herring, Cisco Sardinelle, Treeluk, Iriqpaligaurat



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**Longnose Sucker** (*Catostomus catostomus*): Red Sucker, Meunier Rouge, Dëldële, Namêpiy/Namêpiń, Daats'at, Milugiaq, Dehdele, Dedeli, Dehdoo



## Fish Species Covered in this Guide (continued)

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**Mountain Whitefish** (*Prosopium williamsoni*): Ménomini de Montagnes



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**Northern Pike** (*Esox lucius*): Jackfish, Jack Grand Brochet, Brochet Commun, ᓄulday, Iyinito-kinosêw, Eltin, ᓄhda, Udaa, Iᓄdaa



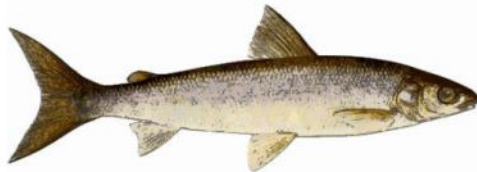
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**Pink Salmon** (*Oncorhynchus gorbuscha*): Humpback Salmon, Humpy, Saumon Rose, Siulik



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**Round Whitefish** (*Prosopium cylindraceum*): Ménomini Rond, Łu, Łih



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**Sockeye Salmon** (*Oncorhynchus nerka*): Kokanee Salmon, Saumon Rouge



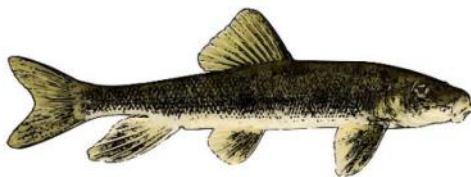
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**Walleye** (*Sander vitreus*): Pickerel, Doré jaune, Doré blanc, ʔełch'úe, Okâw, ʔéhch'úe, Ehch'úe, Ehts'ee/Ehch'èe



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**White Sucker** (*Catostomus commersonii*): Meunier Noir, Dëldële, Namêpiy/Namêpiń, Daats'at, Milugiaq, Dehdele, Dedeli, Kwiezhi



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### Common Fish Names

**Salmon/Trout/Charr:** Łuezánk'ozé, Sôsâsiw, Mistamek, Misiwâpamek, Iqaluk, Łue metth'è detsılı

**Suckers:** Dëldële, Namêpiy/Namêpiń, Daats'at, Milugiaq, Dehdele, Dedeli

**Whitefish:** Łu, Atihkamêk, Kapihilik, Aanaakhiiq, Łuewá, Łúah, Łih

Fish names in English, French, Chipewyan (Denesuline), Northern Cree, Plains Cree, Gwich'in, Inuinnaqtun, Inuktitut, Inuvialuktun, North Slavey, South Slavey, and Tłıchq included, as available at the time of writing.

See pages 45 – 46 for references used.

Arctic Cisco, Broad Whitefish, Least Cisco: University of Guelph; Arctic Char, Arctic Grayling, Chum Salmon, Pink Salmon, Sockeye Salmon: Y. Nagashima (Web Dictionary of Salmon and Eels); Fourhorn Sculpin: NOAA Great Lakes Environmental Research Laboratory; Longnose Sucker: Great Lakes Environmental Research Laboratory; Lake Cisco, Round Whitefish, White Sucker: New York State Department of Environmental Conservation.

# Where is the Parasite in the Female Fish?

See Spiny-headed Worms pg. 20-21  
 see Tapeworms pg. 22-25  
 see Roundworms pg. 32-35

see Spiny-headed Worms pg. 20-21  
 see Tapeworms pg. 22-25  
 see Roundworms pg. 32-35

## Gut Surface

see Roundworms pg. 32-35  
 see Flukes pg. 36-37

## Liver

## Kidney

see Flukes pg. 36-37

## Eye

**Mouth**  
 see Fish Lice pg. 26-27  
 see Leeches pg. 28-29  
 see Flukes pg. 36-37

## Gills

see Fish Lice pg. 26-27  
 see Leeches pg. 28-29  
 see Monogeneans pg. 30-31  
 see Roundworms pg. 32-35

## Heart

see Roundworms pg. 32-35  
 see Flukes pg. 36-37

## Pylorus, Stomach, Intestine

see Spiny-headed Worms pg. 20-21  
 see Tapeworms pg. 22-25  
 see Roundworms pg. 32-35  
 see Flukes pg. 36-37

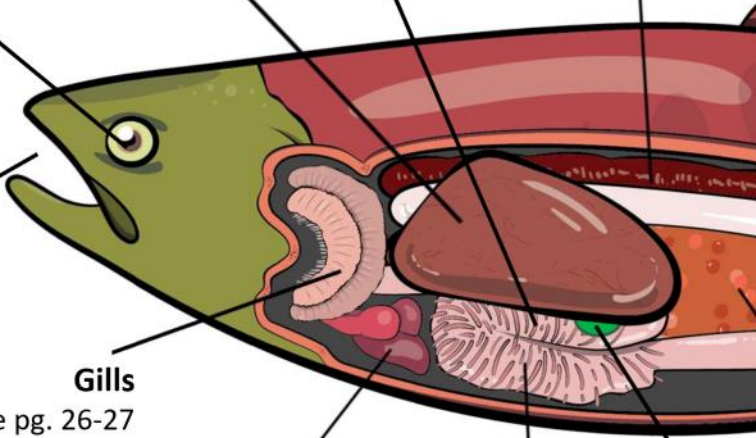
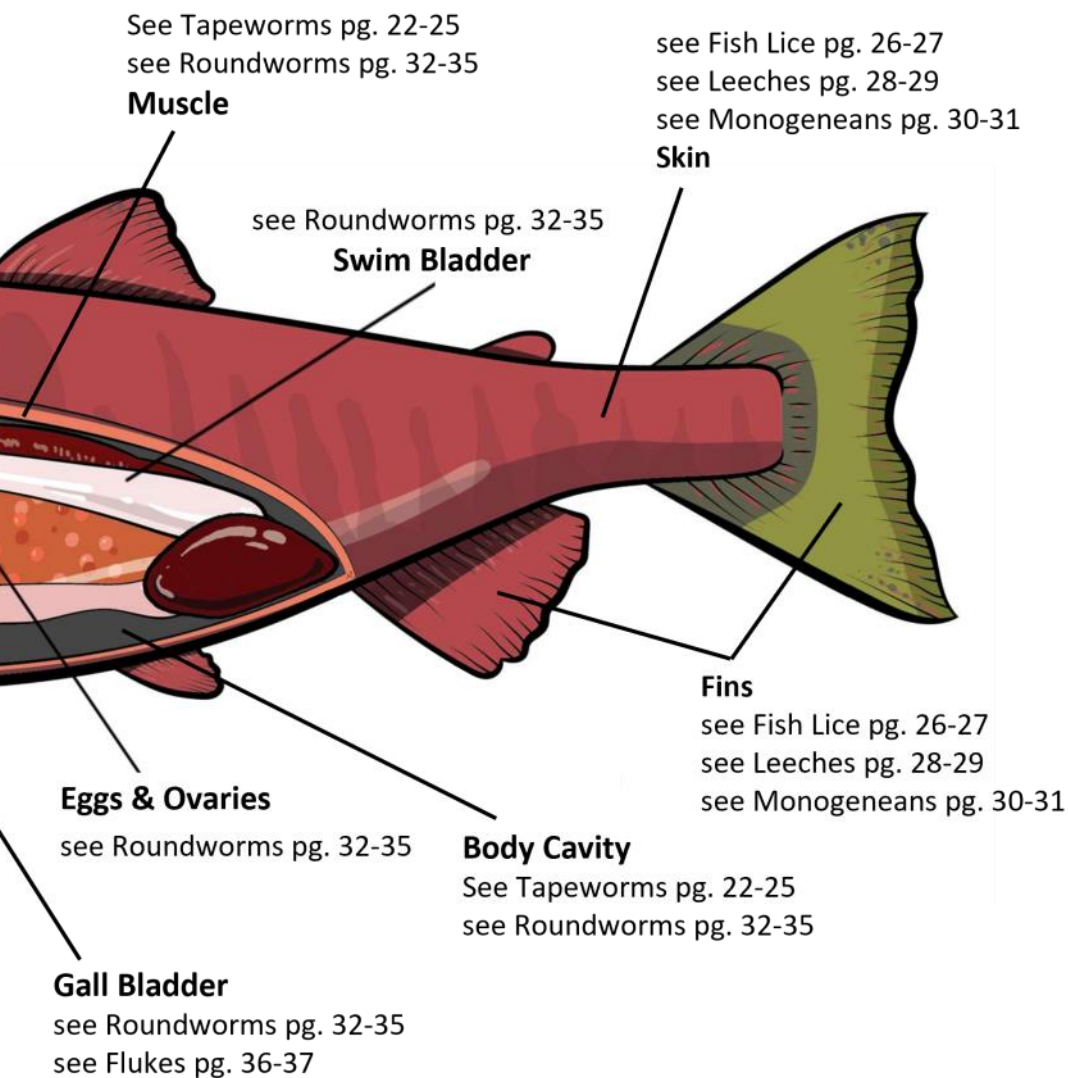


Image: Pacific Salmon Foundation; Illustrator: A. Parekh



# Where is the Parasite in the Male Fish?

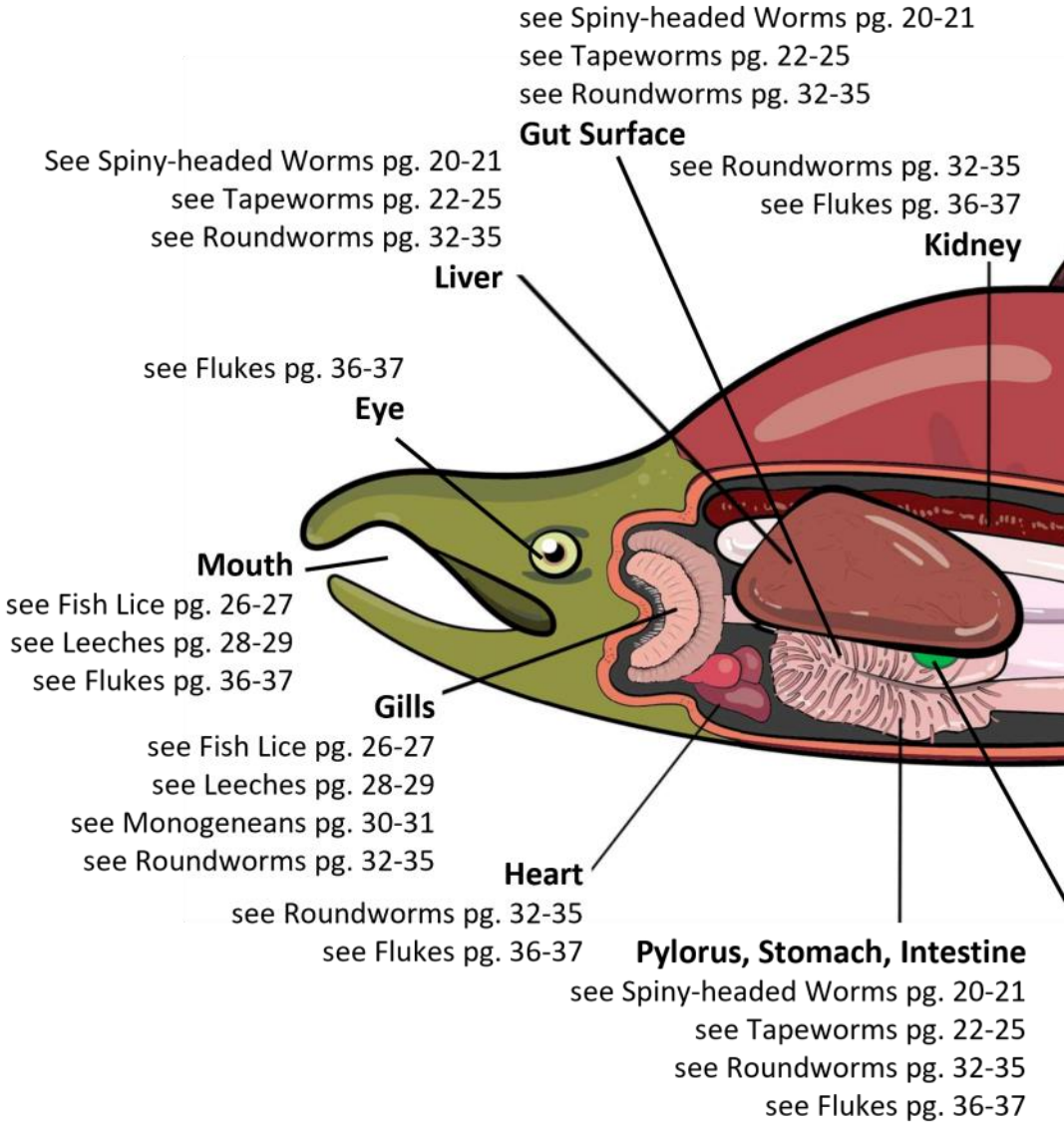
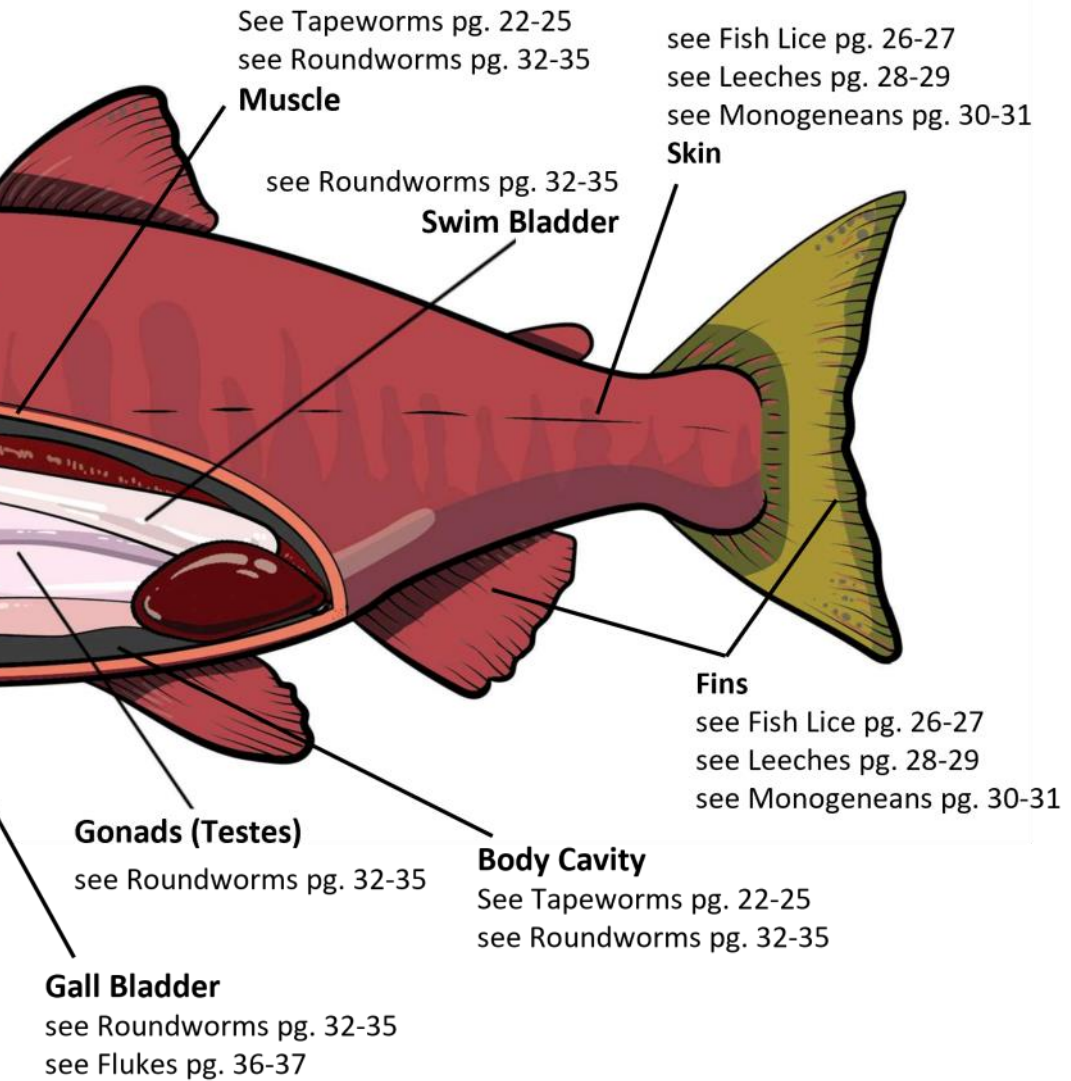


Image: Pacific Salmon Foundation; Illustrator: A. Parekh





## Where is the Parasite in the Fish?

### 1. On the skin or fins?

- A. On the fins? ..... see Fish Lice (pg. 26)  
..... see Leeches (pg. 28)  
..... see Monogeneans (pg. 30)
- B. On the skin? ..... see Fish Lice (pg. 26)  
..... see Leeches (pg. 28)  
..... see Monogeneans (pg. 30)

### 2. In the eyes? ..... see Flukes (pg. 36)

- ### 3. In/around the gills? ..... see Fish Lice (pg. 26)
- ..... see Leeches (pg. 28)
  - ..... see Monogeneans (pg. 30)
  - ..... see Roundworms (pg. 32)
  - ..... see Flukes (pg. 36)

- ### 4. In/around the mouth? ..... see Fish Lice (pg. 26)
- ..... see Leeches (pg. 28)
  - ..... see Flukes (pg. 36)

- ### 5. Inside the body cavity? ..... see Tapeworms (pg. 22)
- ..... see Roundworms (pg. 32)

- ### 6. In the stomach, pylorus, or intestine? .....
- ..... see Spiny-headed Worms (pg.20)
  - ..... see Tapeworms (pg. 22)
  - ..... see Roundworms (pg. 32)
  - ..... see Flukes (pg. 36)

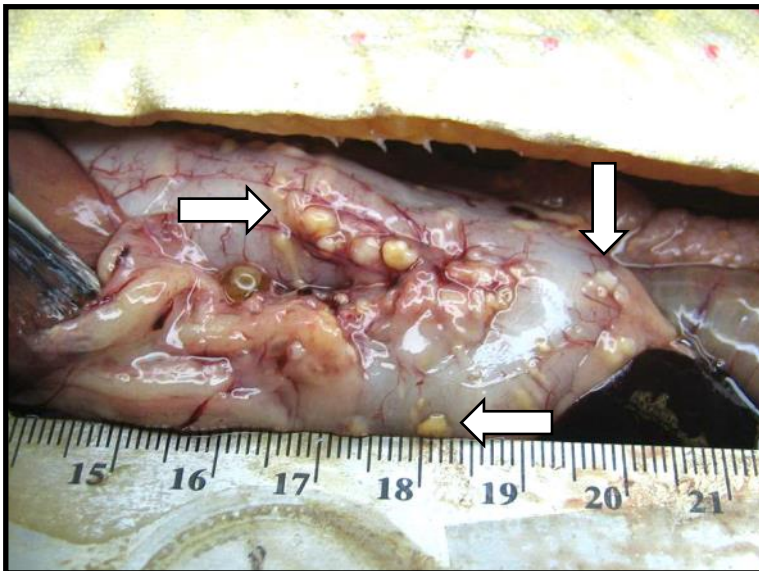
- ### 7. On the surface of the guts? .....
- ..... see Tapeworms (pg. 22)
  - ..... see Roundworms (pg. 32)

8. In the gall bladder? ..... see Roundworms (pg. 32)  
..... see Flukes (pg. 36)
9. In/on the eggs or testes? ..... see Roundworms (pg. 32)
10. In/on the heart or kidney? ..... see Roundworms (pg. 32)  
..... see Flukes (pg. 36)
11. In/on the liver? ..... see Spiny-headed Worms (pg. 20)  
..... see Tapeworms (pg. 22)  
..... see Roundworms (pg. 32)
12. In the swim bladder? ..... see Roundworms (pg. 32)
13. In the muscle? ..... see Tapeworms (pg. 22)  
..... see Roundworms (pg. 32)

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## Table of Parasite Groups

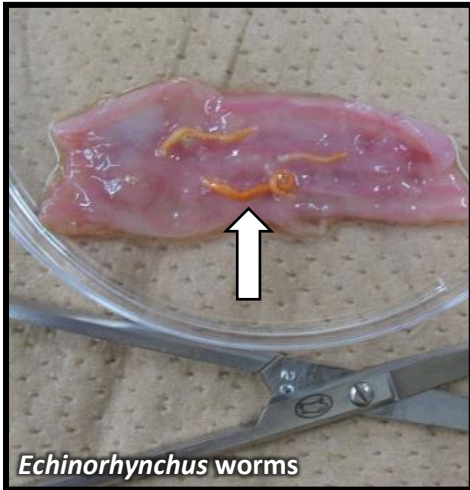
Spiny-headed Worms (Acanthocephala) .....	20
Tapeworms (Cestoda).....	22
Fish Lice (Copepoda).....	26
Leeches (Hirudinea).....	28
Monogeneans (Monogenea) .....	30
Roundworms (Nematoda) .....	32
Flukes (Trematoda).....	36



Multiple Cestoda or Tapeworm parasites (pg. 22) inside a trout: *Diphyllobothrium* cysts in the body cavity and on the organs.

Image: C. Banner, Fishpathogens.net, ODFW/OSU

# Spiny-headed Worms: Acanthocephala



## Parts of fish affected

Found on the gut surface, and in the stomach, pylorus, intestines, and liver.

## Species Affected

Arctic Charr, Arctic Cisco, Arctic Grayling, Atlantic Salmon, Broad Whitefish, Bull Trout, Chinook, Chum, Coho, Dolly Varden, Fourhorn Sculpin, Lake Cisco, Lake Trout, Lake Whitefish, Longnose

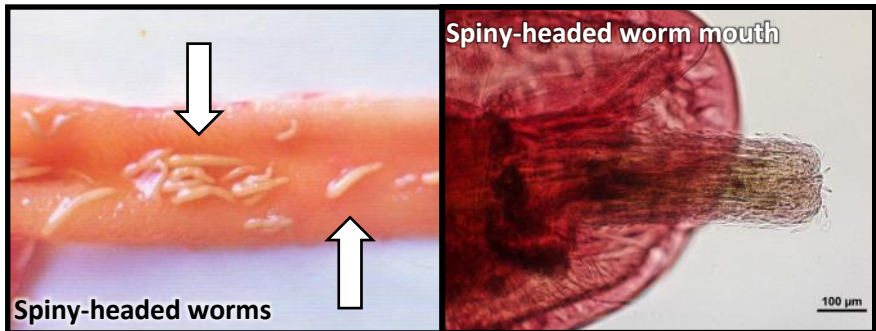
Sucker, Northern Pike, Pink Salmon, Round Whitefish, Sockeye, Walleye, White Sucker.

## Description

Spiny-headed worms are **small**, light-coloured worms, sometimes having a large-looking 'head' end that they use to attach to the guts of the fish. There are two kinds of spiny-headed worms found in this region: *Corynosoma* and *Echinorhynchus*. *Corynosoma* only affects sea-run fish species.

## Safe to Eat? Safe for Pets?

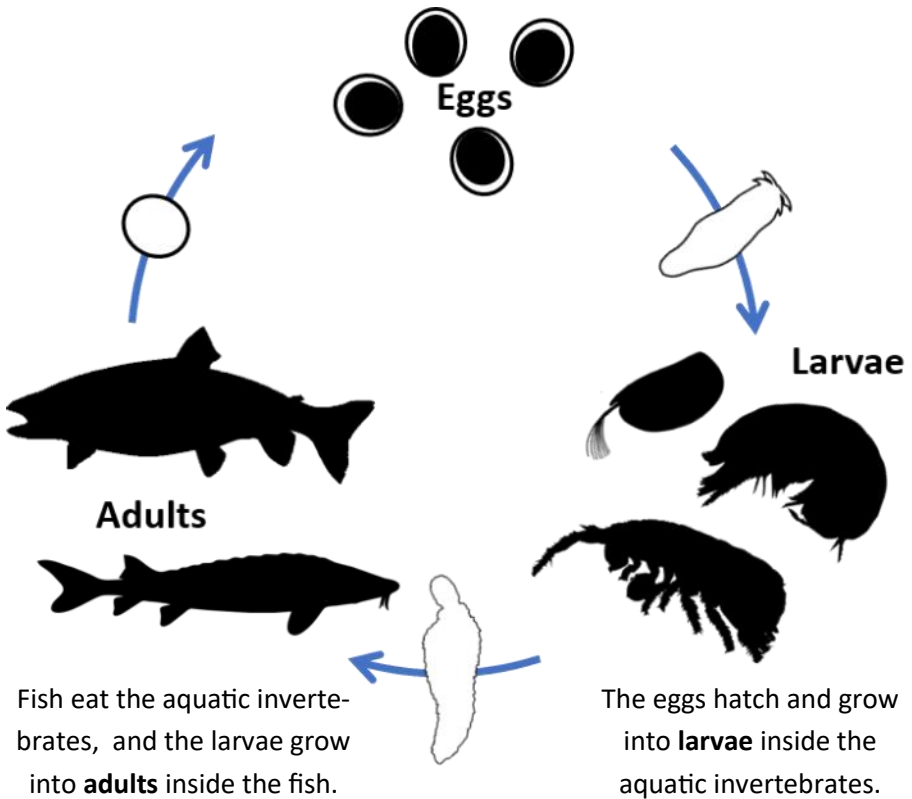
These parasites DO NOT affect people and DO NOT affect pets.



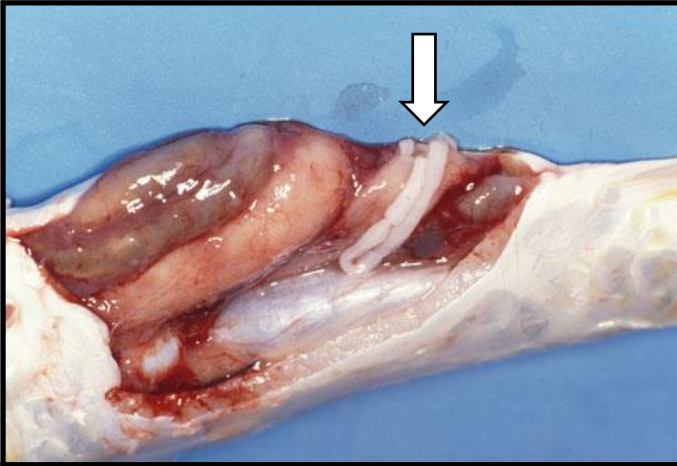
Images—Top: K. Yamada, *Database of Parasites of Fish and Diseases (Japan)*; Bottom Left: K. Nagasawa, *Database of Parasites of Fish and Diseases (Japan)*; Bottom Right: G. Conboy.

# Spiny-headed Worms: Acanthocephala — Life Cycle

Spiny-headed worm **eggs** are released into the water through fish feces. The eggs are then eaten by aquatic invertebrates.

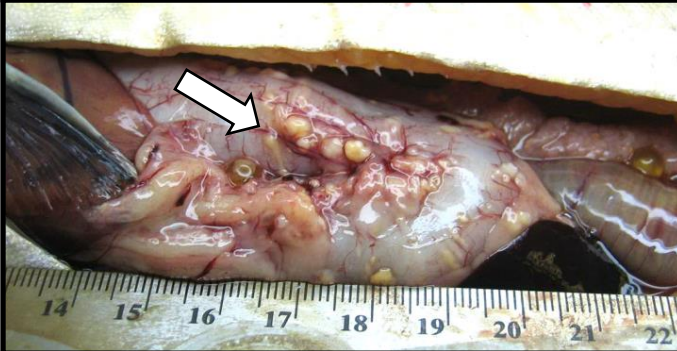


# Tapeworms: Cestoda



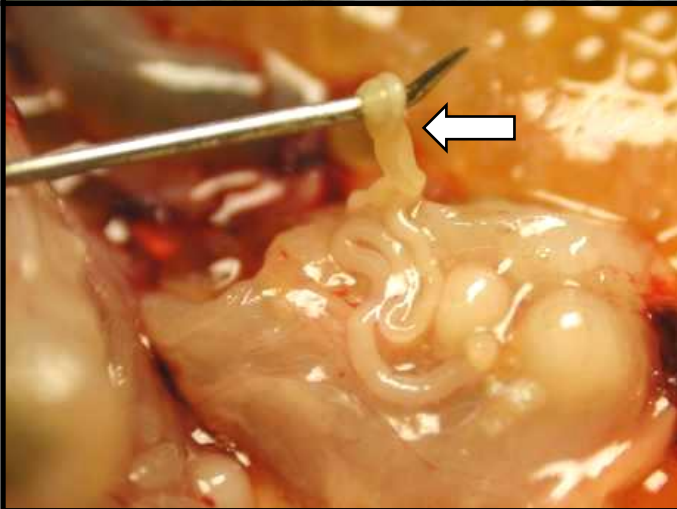
*Bothriocephalus*  
tapeworm

*Image: K. Yamada, Database of Parasites of Fish and Diseases (Japan)*



*Diphyllobothrium*  
cysts on the intestine

*Image: S. Atkinson, Fish-pathogens.net, ODFW/OSU*



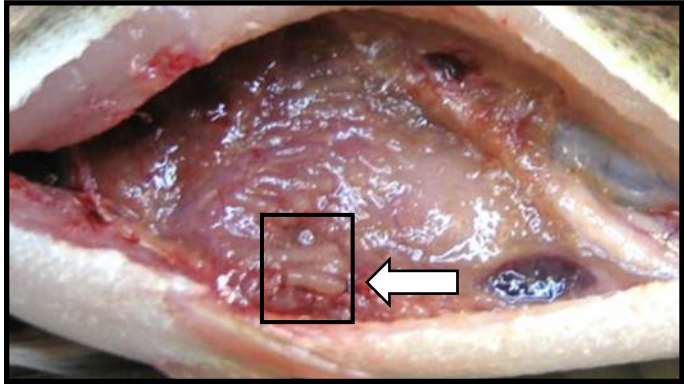
*Diphyllobothrium*  
tapeworms

*Image: Laboratory of Aquatic Pathobiology, Årko Akademi*

## Tapeworms: Cestoda (continued)

*Proteocephalus*  
tapeworms

Image: C. Banner, Fish-pathogens.net, ODFW/OSU



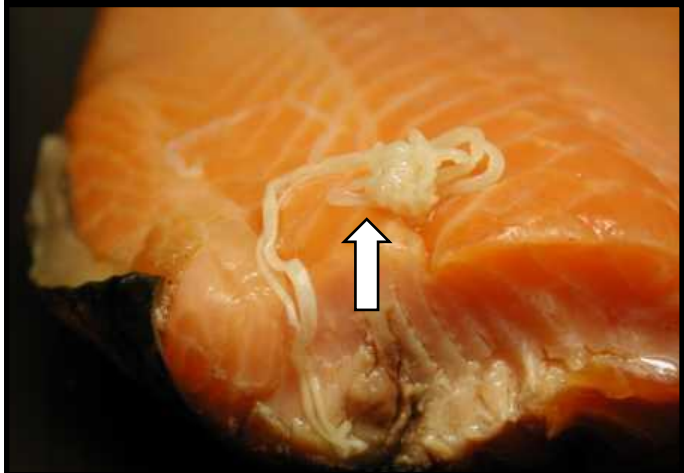
*Schistocephalus*  
tapeworms

Image: Laboratory of Aquatic Pathobiology, Åbo Akademi



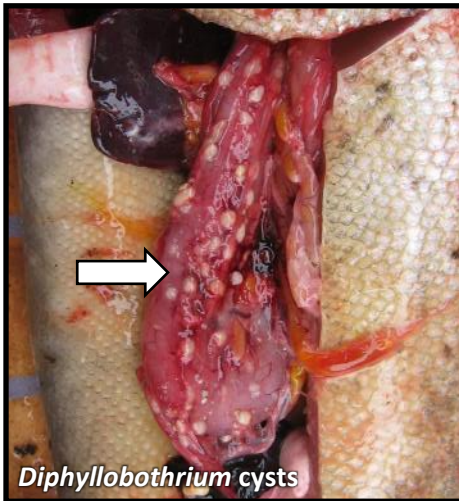
*Triaenophorus*  
tapeworms in  
muscle

Image: L. Lönnström, Laboratory of Aquatic Pathobiology, Åbo Akademi





## Tapeworms: Cestoda



### Parts of fish affected

Found in the body cavity, gut surface, stomach, pylorus, intestine, liver, and muscle.

### Species Affected

Arctic Charr, Arctic Cisco, Arctic Grayling, Atlantic Salmon, Broad Whitefish, Bull Trout, Burbot, Chinook, Chum, Coho, Dolly Varden, Fourhorn Sculpin, Inconnu, Lake Cisco, Lake Trout, Lake Whitefish,

Longnose Sucker, Mountain Whitefish, Northern Pike, Pink Salmon, Round Whitefish, Sockeye, Walleye, White Sucker.

### Description

Tapeworms have a complex life cycle, and can be found in various stages inside fish. Generally, adult tapeworms are long, stringy, and white/light beige in colour. Larval tapeworms usually form cysts inside a fish, which look like small white or beige-coloured balls or round lumps. There are many kinds of tapeworms, but they usually only infect certain kinds of fish.

### Safe to Eat? Safe for Pets?

**SOME** kinds of tapeworms can affect people and pets: *Diphyllobothrium* can infect humans. It is found in freshwater fish species, especially fish-eating species like Northern Pike and Walleye.

### Getting Rid of Tapeworms in Food

If there are tapeworms in the muscle or organs of the fish, they can be killed by thoroughly cooking (to 63°C) or freezing the fish to -20°C for at least 7 days. Smoking **does not** kill this parasite. *Diphyllobothrium* cysts look like roundworm cysts: however, roundworm cysts are perfectly round and smaller than *Diphyllobothrium* cysts.

# Tapeworms: Cestoda — Life Cycle

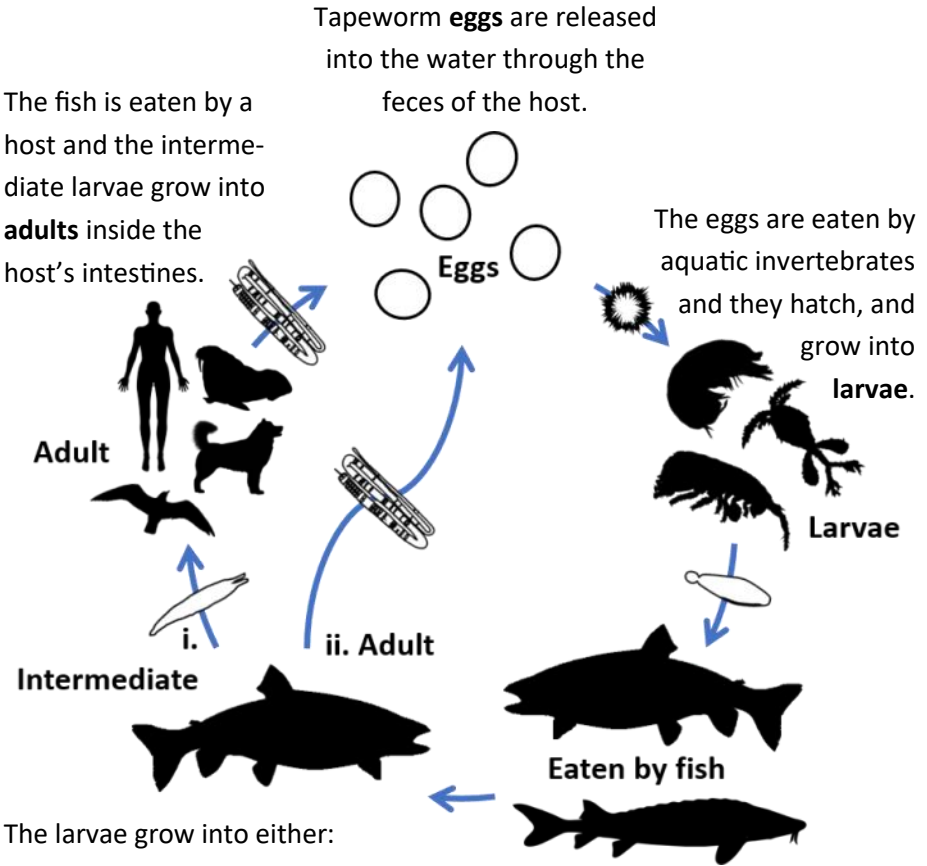
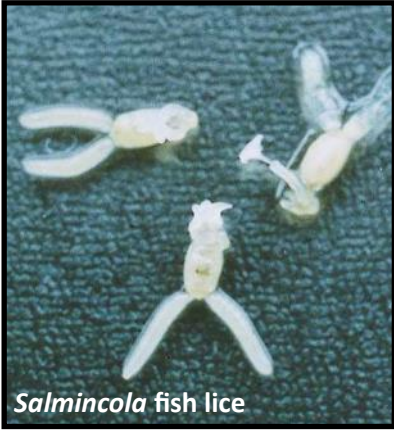


Image (Top): S. Atkinson, Fishpathogens.net, ODFW/OSU

# Fish Lice: Copepoda



## Parts of fish affected

Found on the fins, skin, gills/gill cavity, mouth.

## Species Affected

Arctic Charr, Arctic Cisco, Arctic Grayling, Atlantic Salmon, Broad Whitefish, Bull Trout, Burbot, Coho, Dolly Varden, Inconnu, Lake Cisco, Lake Trout, Lake Whitefish, Mountain Whitefish, Pink Salmon, Round Whitefish, Sockeye.

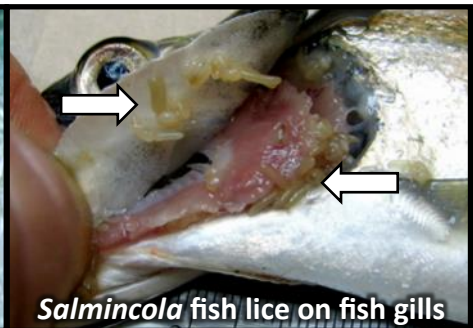
## Description

Fish lice are small, clear to white to brown, lice-looking parasites, often with long egg sacs attached to their bodies. There are two kinds of fish lice found in this region: *Coregonicola* and *Salmincola*. *Coregonicola* often have one long egg sack and are found on sea-run whitefish, while *Salmincola* has two shorter egg sacks. Fish lice are sometimes called ‘anchor worms’, but they are not worms!

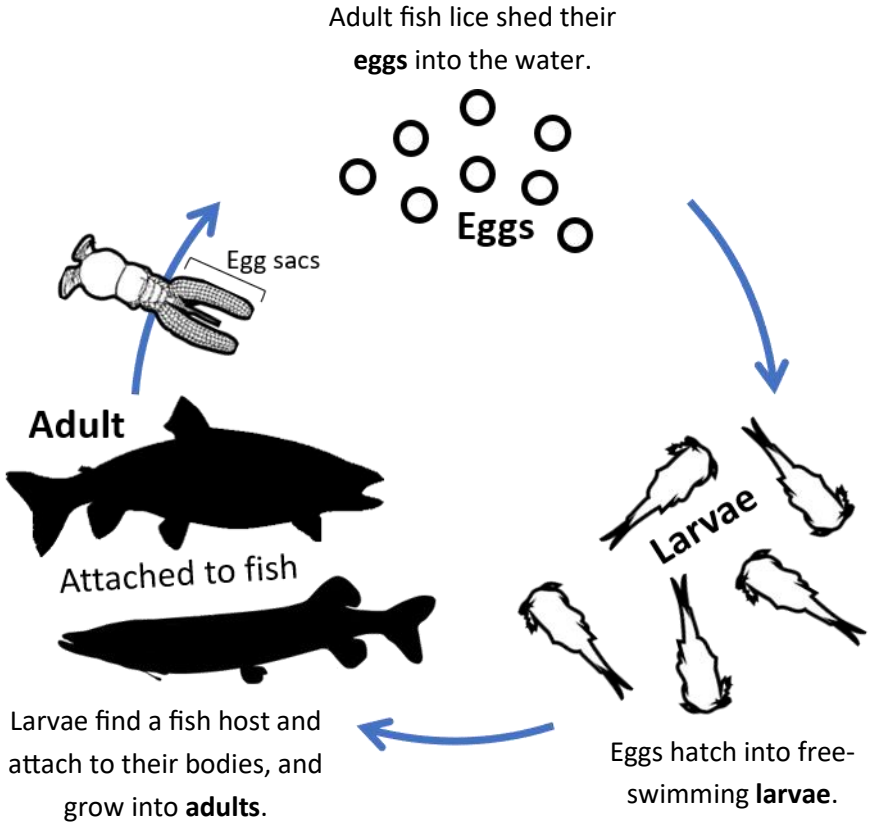
Only adult female fish lice are parasites: the adult males and the juveniles are free-living.

## Safe to Eat? Safe for Pets?

These parasites DO NOT affect people and DO NOT affect pets.



# Fish Lice: Copepoda — Life Cycle



Opposite images—Top: T. Awakura, *Database of Parasites of Fish and Diseases (Japan)*;  
Bottom Left: J. D. Reist; Bottom Right: C. Banner, *Fishpathogens.net*, ODFW/OSU

# Leeches: Hirudinea



### Parts of fish affected

Found on the fins, skin, mouth.

### Species Affected

All species of fish can be affected by leeches. They have been found on:

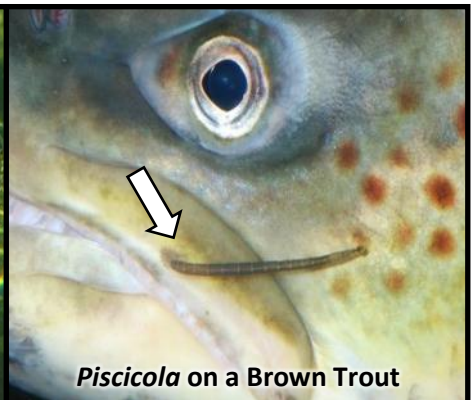
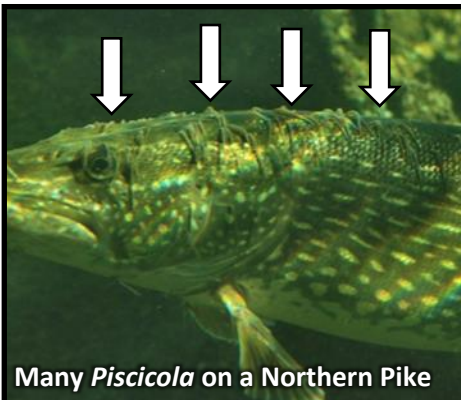
Broad Whitefish, Burbot, Coho, Inconnu, Lake Trout, Lake Whitefish, Mountain Whitefish, Northern Pike, Round Whitefish, Sockeye, Walleye.

### Description

Leeches are slender, worm-like parasites, between 2—3 cm long, and are usually clear to light brown with horizontal bands. Two kinds of Leeches are found in this region: *Cystobranchus* and *Piscicola*. They can leave small red bumps on fish when they fall off.

### Safe to Eat? Safe for Pets?

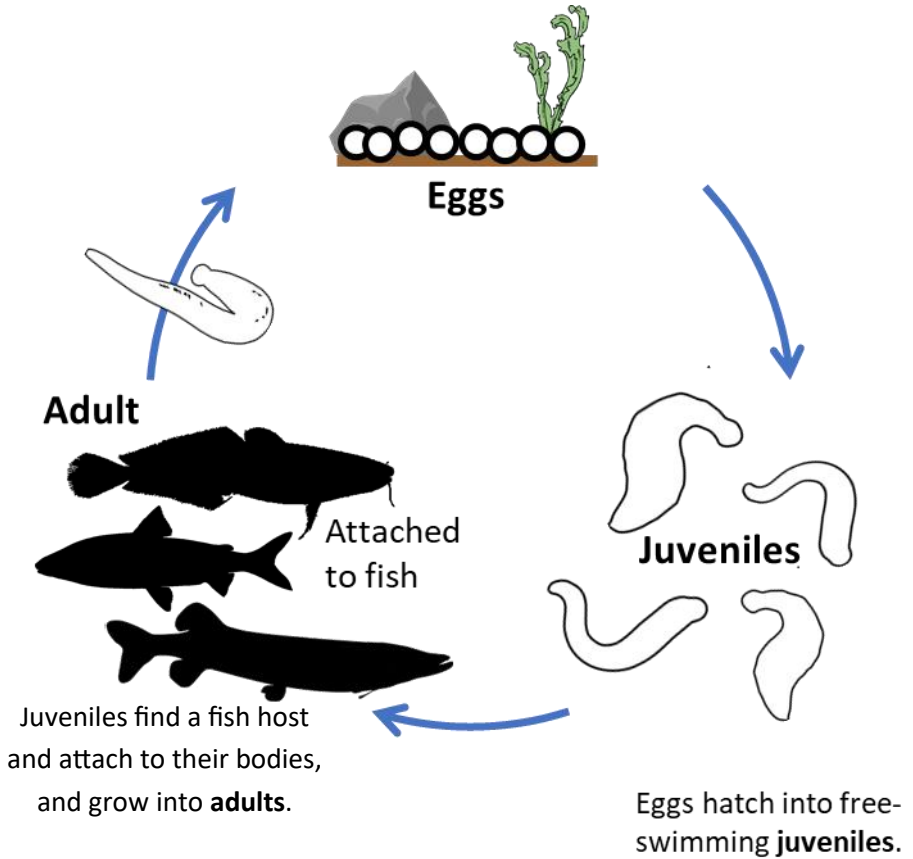
These parasites DO NOT affect people and DO NOT affect pets, although they may try to attach to your skin or your pet when handling a fresh fish.



Images—Top: Hundsbuckler (WikiMedia); Left: J. C. Chou, Biopix; Right: N. Sloth, Biopix

# Leeches: Hirudinea — Life Cycle

Adult leeches detach from their fish hosts and lay **eggs** on the bottom of a river or lake.



## Monogeneans: Monogenea



### Parts of fish affected

Found on the fins, gills/gill cavity.

### Species Affected

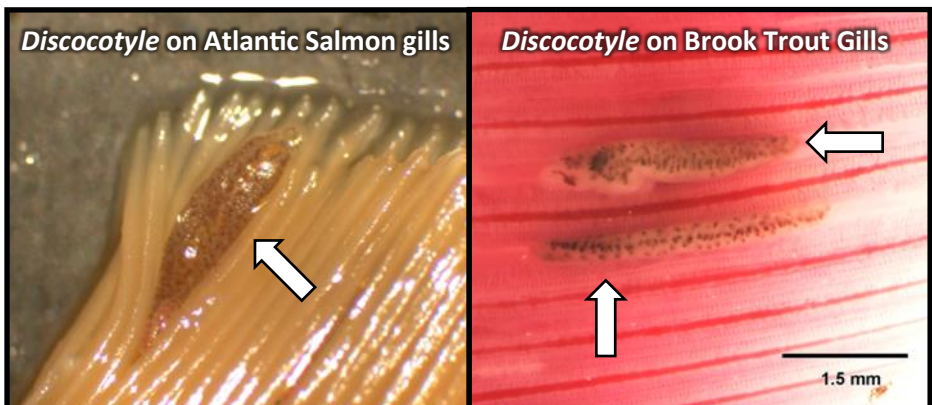
Arctic Charr, Arctic Grayling, Atlantic Salmon, Broad Whitefish, Bull Trout, Coho, Dolly Varden, Lake Cisco, Lake Trout, Lake Whitefish, Least Cisco, Longnose Sucker, Mountain Whitefish, Northern Pike, Round Whitefish, White Sucker.

### Description

Monogeneans are very **small** (less than 1 cm), clear/white worm-like parasites, sometimes with spots. They are not common and **often hard to see** on fish. They are found on the fins and/or gills of fish. Three kinds of monogeneans have been found in this region: *Anonchhaptor*, *Discocotyle*, and *Tetraonchus*.

### Safe to Eat? Safe for Pets?

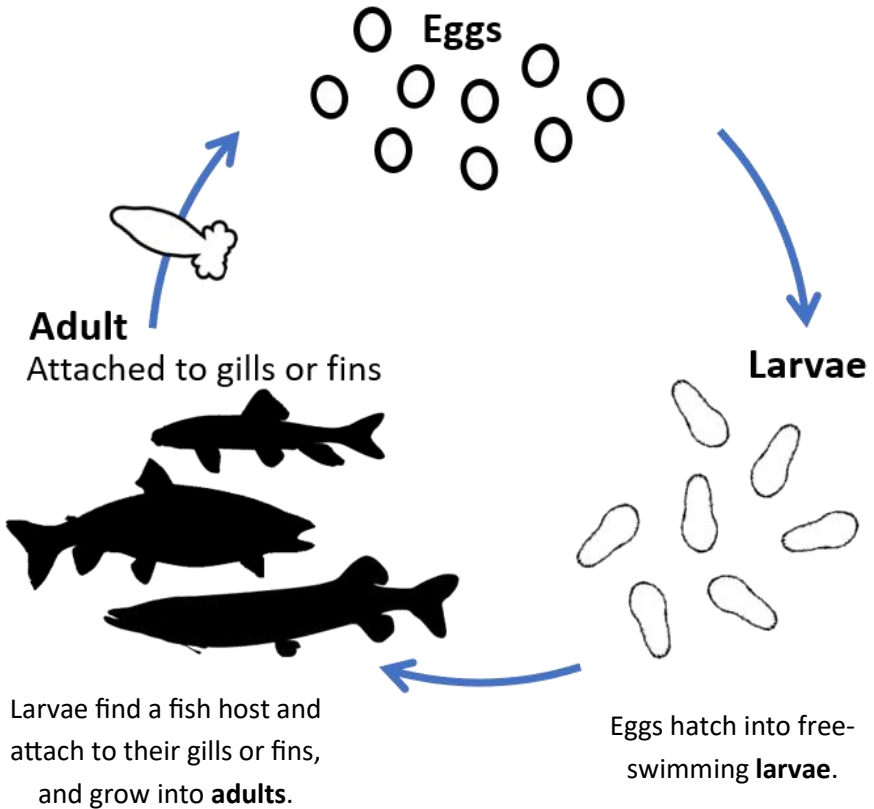
These parasites DO NOT affect people and DO NOT affect pets.



Images—Top: K. Okagawa, Database of Parasites in Fish and Shellfish; Left & Right: C. Blonar, Flickr.

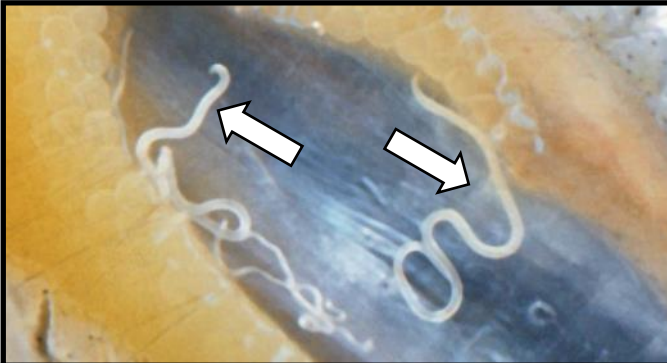
# Monogeneans: Monogenea — Life Cycle

Adult monogeneans shed their **eggs** directly into the water.



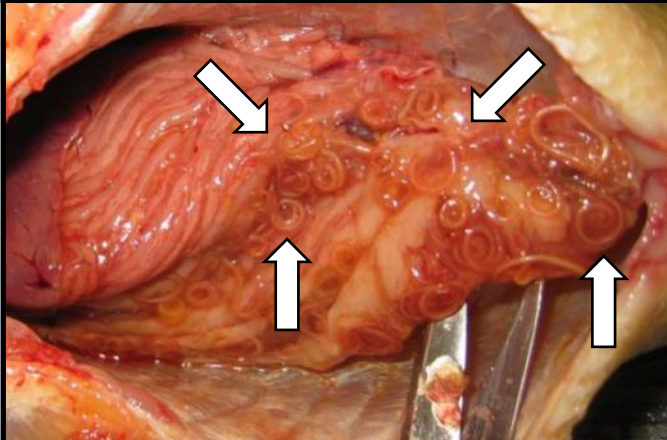


## Roundworms: Nematoda



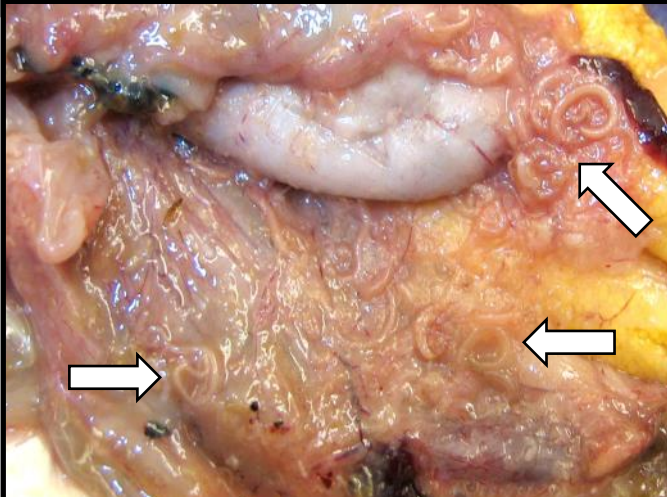
*Cystidicola* roundworms in the swim bladder

Image: C. Banner, Fish-pathogens.net, ODFW/OSU



*Hysterothylacium* roundworms in the body cavity

Image: C. Banner, Fish-pathogens.net, ODFW/OSU



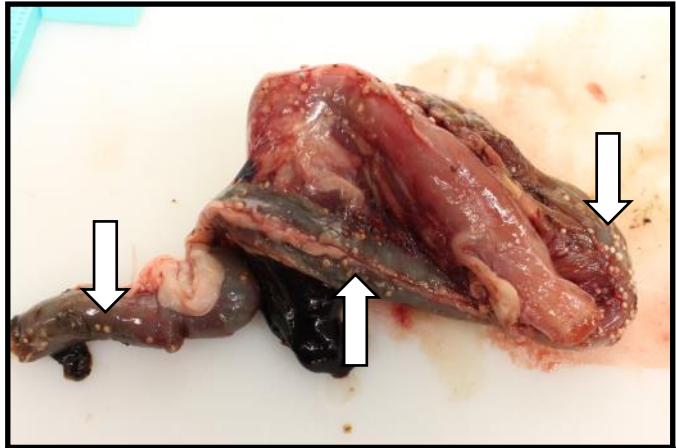
*Hysterothylacium* inside the body cavity

Image: C. Banner, Fish-pathogens.net, ODFW/OSU

## Roundworms: Nematoda (continued)

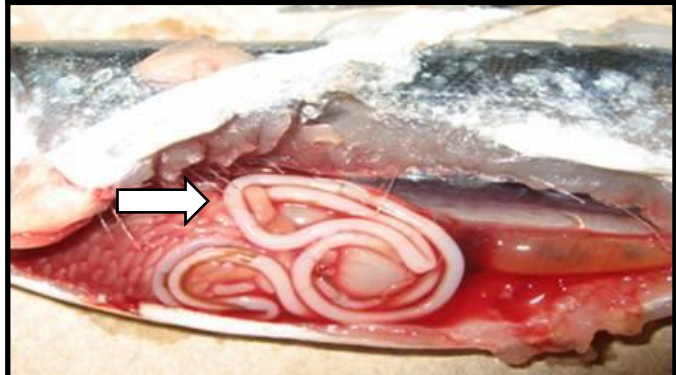
*Raphidascaris*  
roundworms  
cysts on the di-  
gestive tract

Image: D. Goldsmith  
(Diagnostic Service Unit,  
Faculty of Veterinary Medi-  
cine, University of Calgary)



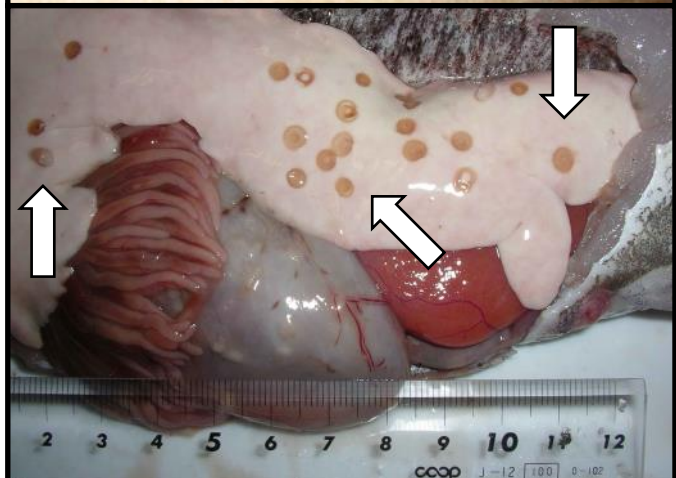
*Philonema* round-  
worms in the  
body cavity

Image: C. Banner, Fish-  
pathogens.net, ODFW/  
OSU

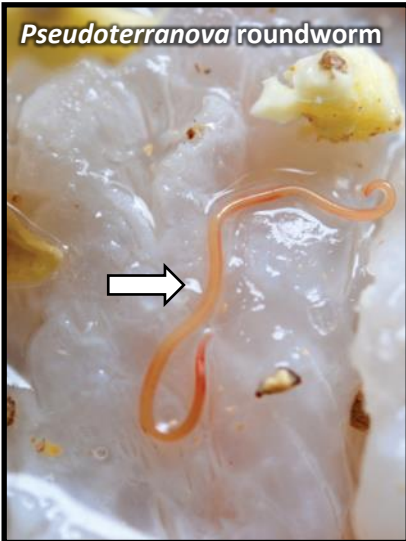


*Anisakis* round-  
worms in the liver

Image: S. Urawa, Database  
of Parasites of Fish and  
Diseases (Japan)



## Roundworms: Nematoda



### Parts of fish affected

Found in the body cavity, gut surface, stomach, pylorus, intestine, sex organs, liver, swim bladder, heart, kidney and muscle. Rarely in the eyes, gills/gill cavity, gall bladder.

### Species Affected

Arctic Charr, Arctic Grayling, Atlantic Salmon, Broad Whitefish, Bull Trout, Burbot, Chinook, Chum, Coho, Dolly Varden, Lake Cisco, Lake Trout, Lake Whitefish, Least Cisco, Longnose Sucker, Mountain Whitefish, Northern Pike, Pink

Image—P. Burgess.

Salmon, Round Whitefish, Sockeye, Walleye, White Sucker.

### Description

Roundworms are clear, white, pink, or flesh-coloured round parasitic worms. Adults can be long (20 cm+) and are not segmented. Larval cysts are often white, hard, perfectly round, and small – smaller than tapeworm cysts (pg. 22). Ten kinds of roundworms are found in this region.

### Safe to Eat? Safe for Pets?

SOME kinds of roundworms can affect people and pets: **Anisakis** and **Pseudoterranova** can affect humans and cause **Anisakidosis**, a sickness that can cause abdominal pain, nausea, and vomiting. Roundworms can also make pets sick. *Anisakis* and *Pseudoterranova* are only found in marine fish. No other roundworms found in this region can affect people or pets.

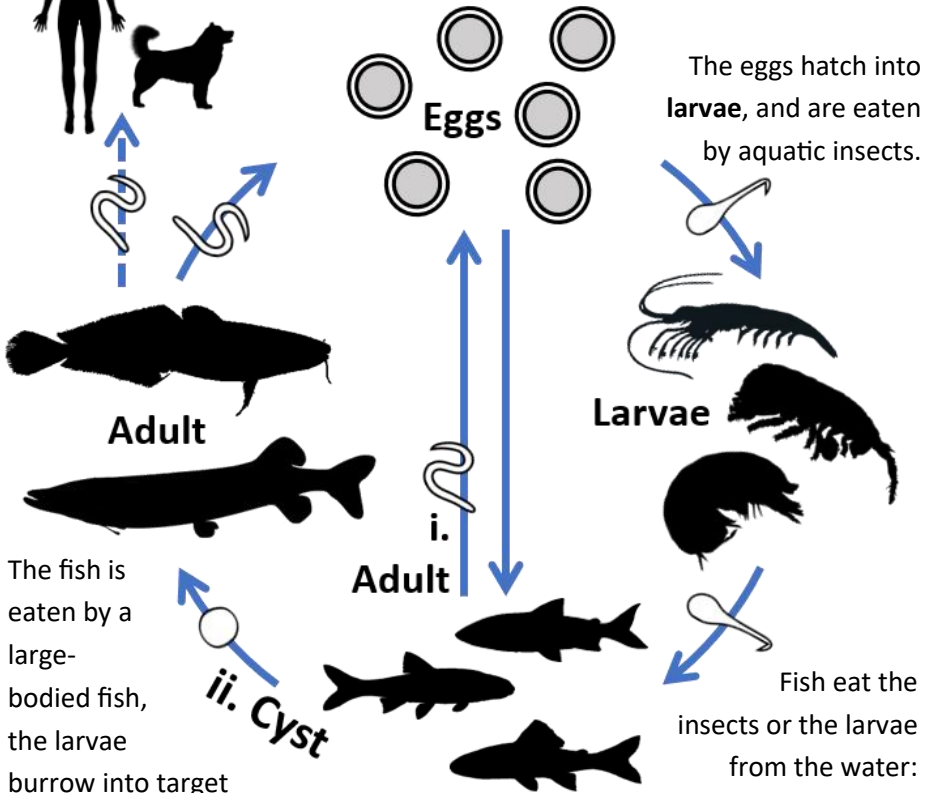
### Getting Rid of Round Worms in Food

If there are *Anisakis* or *Pseudoterranova* roundworms in the muscle or organs of the fish, they can be killed by thoroughly cooking (to 63°C), or freezing the fish to -20°C for 7+ days. Smoking **does not** kill these parasites.

# Roundworms: Nematoda — Life Cycle

SOME kinds of roundworms can make people and pets sick if they're eaten.

Roundworm **eggs** are released by adults inside the host, and transported to the water via feces.



The eggs hatch into **larvae**, and are eaten by aquatic insects.

**Larvae**

**Adult**

**Adult**

Fish eat the insects or the larvae from the water:

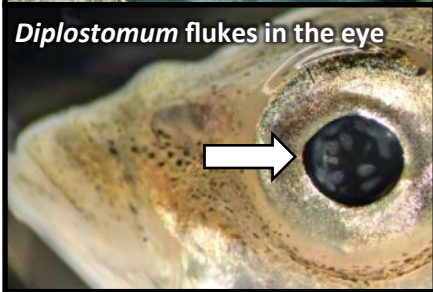
The fish is eaten by a large-bodied fish, the larvae burrow into target organs and grow to **adults**.

- i) the larvae burrow into target organs, and grow to **adults**; OR
- ii) the larvae form **cysts** inside the fish, waiting for it to be eaten by a large-bodied fish.

## Flukes: Trematoda



*Diplostomum* flukes in the eye



*Diplostomum* flukes in the eye

### Parts of fish affected

Found in the eyes, body cavity, stomach, pylorus, intestine, and gall bladder. Occasionally in/on the mouth, heart, and kidneys.

### Species Affected

**All food fish species:** Arctic Charr, Arctic Cisco, Arctic Grayling, Atlantic Salmon, Broad Whitefish, Bull Trout, Burbot, Chinook, Chum, Coho, Dolly Varden, Lake Cisco, Lake Trout, Lake Whitefish, Least Cisco, Longnose Sucker, Mountain Whitefish, Northern Pike, Pink, Round Whitefish, Sockeye, Walleye, White Sucker.

### Description

Flukes are small, worm-looking parasites. They are **not often seen** or noticed because of their **small size**. Adults attach to their host using suckers on their head and belly. Seven kinds of flukes are found in this region.

Adult *Diplostomum* flukes infect the eyes of fish and can cause cataracts. Flukes also form cysts inside some hosts: the cysts are **tiny**.

### Safe to Eat? Safe for Pets?

These parasites DO NOT affect people and DO NOT affect pets.



Flukes in the eye causing cataracts in a Burbot

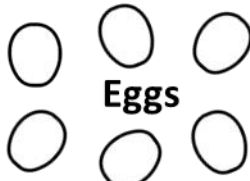
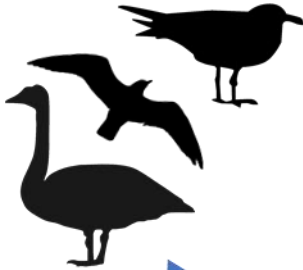
Images—Upper: Fish Vet Group; Lower: N. Erin; Bottom Right: J. Harms, Yukon Environment.

# Flukes: Trematoda — Life Cycle

Fluke **eggs** are released inside the host, and transported to the water via feces.

The fish is eaten by a bird, and the cysts grow into **adults** in the gut of the bird.

**Adult**



**Eggs**

The eggs hatch into free-swimming **larvae (I)**, and infect snails and clams.

**Larvae I**



**Larvae II**

The larvae grow into free-swimming secondary larvae (II) and leave the snail/clam host.

**i. Adult**



**ii. Cyst**



Fish become infected by the secondary larvae, and:

i) the larvae burrow into target organs, and grow to **adults**; OR

ii) form **cysts**, waiting for the fish to be eaten by a bird.

## Parasites & People—Cooking and Food Safety

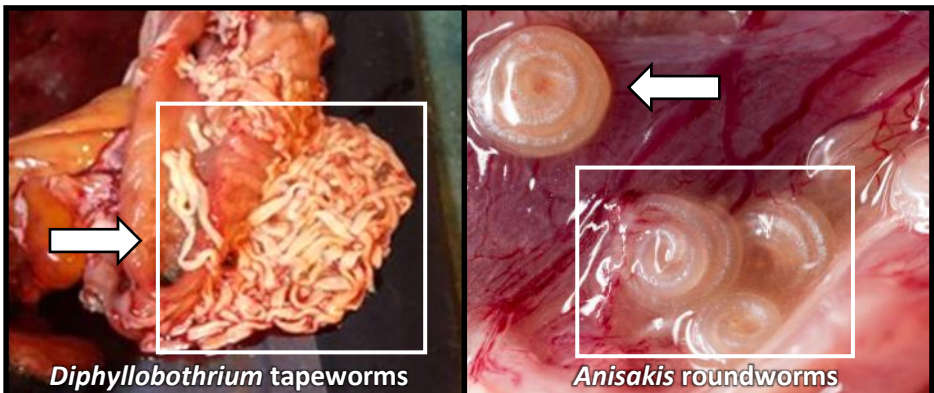
Parasites are a natural part of the environment and are found in all water-bodies, both freshwater and saltwater. They can be found in clean water and polluted water. Ecosystems that are rich in parasites are often healthy ones. Parasites are generally not a problem for people or for pets: parasite-related diseases are relatively rare.

You can avoid parasites in fish in several ways:

1. By catching and eating younger or smaller fish. Parasites accumulate and grow over time, so a younger and/or smaller fish may have fewer parasites.
2. By eating certain kinds of fish. Some parasites grow to adults inside large, fish-eating species like Northern Pike or Lake Trout.
3. By eating different species from different lakes and rivers.

For the few parasites that can infect people or pets (roundworms including *Anisakis* & *Pseudoterranova*, tapeworms including *Diphyllobothrium*), the fish can be made safe by cleaning the fish thoroughly after being caught, freezing the fish to  $-20^{\circ}\text{C}$  for at least 7 days, and thoroughly cooking the fish (to at least  $63^{\circ}\text{C}/145^{\circ}\text{F}$ ).

Smoking, salting/salt curing, or marinating fish **will not** kill any parasites. Thoroughly cooking and/or freezing **will** kill any parasites in the fish.



Images—Left: J.M. Johnson; Right: Alamy.

## Parasites & Climate Change

Climate change is expected to have profound effects on the environment of the North. Changes in local climate, water temperature, amount and extent of winter ice cover, and nutrient levels in water bodies are expected, which will have complicated effects on fishes and the parasites which affect them.

Parasites are sensitive to changes in environmental conditions, particularly temperature, as these changes can influence their life cycles. Life cycles of parasites are tied to the life cycles and timing of their hosts. Climate change may change the overlap between parasites and their hosts: decreased overlap may cause decreases or even local disappearance of some parasite species. On the other hand, warmer water temperatures may increase parasite growth rate and maturation, and could lead to shorter generation times and therefore greater frequency and prevalence of parasitic infections.

Climate change, and human actions, may result in the introduction of exotic or non-native fish species, that bring associated parasites with them. These parasites could then infect new hosts that are not used to dealing with them and may have lower resistance to infection. The effects of climate change combined with the added stress of competing with new exotic fish species could result in changes in fish populations and associated parasites.

Warmer waters could also result in the northern movement of parasites, with southern parasites possibly being found in northern ecosystems. However, as parasites are sensitive to temperature, climate change might result in parasites having a similar sized range but just further north. Continued climate changes may even result in smaller ranges for species that prefer colder temperatures.

The overall effect of climate change on parasites and parasite-host relationships is complex and difficult to predict. It is likely that increased parasite loads may be found in northern fish species, and that there will be changes in what parasite species are present or absent, as parasites and hosts both respond to environmental changes.



## List of Parasite Genera in the NWT and Nunavut

### **Acanthocephala**—Spiny-headed Worms

Corynosoma

Echinorhynchus

### **Cestoda**—Tapeworms

Bothrimonus

Bothriocephalus

Cyathocephalus

Diphyllobothrium

Eubothrium

Glaridacris

Protecocephalus

Schistocephalus

Triaenophorus

### **Copepoda**—Fish Lice

Coregonicola

Salmincola

### **Hirudinea**—Leeches

Cystobranchnus

Piscicola

### **Monogenea**—Monogeneans

Anonchohaptor

Discocotyle

Tetraonchus

**Nematoda**—Roundworms

Anisakis

Cystidicola

Haplonema

Hysterothylacium

Philonema

Pseudocapillaria

Pseudoterranova

Raphidascaris

Salmonema

Truttaedacnitis

**Trematoda**—Flukes

Allocreidium

Brachyphallus

Crepidostomum

Derogenes

Diplostomum

Ichthyocotylurus (syn. Cotylurus)

Lecithaster

Prosorhyncoides

## References – Parasites

- Adlard, R. D., Miller, T. L., & Smit, N. J. (2015). The butterfly effect: parasite diversity, environment, and emerging disease in aquatic wildlife. *Trends in Parasitology* 31 (4), 160 – 166.
- Arai, H. P., & Smith, J. W. (2016). Guide to the Parasites of Fishes of Canada. Part V. Zootaxa 4185. Magnolia Press: Auckland, New Zealand. 274 pp.
- Bruno, D. W., Noguera, P. A., & Poppe, T. T. (2013). *Metazoa*. In: A Colour Atlas of Salmonid Diseases. Springer: Dordrecht.
- Canadian Cooperative Wildlife Health Centre. (2012). Safety Manual for Harvesters of Fish & Wildlife in Nunavut. An illustrative guide to common diseases and parasites. 281 pp.
- Canadian Cooperative Wildlife Health Centre. (2012). Safety Manual for Harvesters of Fish & Wildlife in Nunavut. An illustrative guide to common diseases and parasites. Supplemental Information on Disease. 167 pp.
- Government of Yukon. (2014). Yukon Fish Health Handbook. 52 pp.
- Government of Yukon. (n.d.). Common parasites of Yukon Freshwater Fishes. *Fisheries Section, Fish & Wildlife Branch, Department of Renewable Resources*. 24 pp.
- Health Canada. (2011). *Food Safety for First Nations People of Canada: A Manual for Healthy Practices*. Minister of Health, Health Canada. 158 pp.
- Hoffman, G. L. (1967). *Parasites of North American Freshwater Fishes*. University of California Press: Berkeley and Los Angeles, USA. 486 pp.
- Jerônimo, G. T., de Pádua, S. B., de Andrade Belo, M. A., Chagas, E. C., Taboga, S. R., Maciel, P. O., & Martins, M. L. (2017). *Neoechinorhynchus buttnerae* (Acanthocephala) infection in farmed *Colossoma macropomum*: a pathological approach. *Aquaculture* 469, 124–127.
- Karvonen, A., Kristjánsson, B. K., Skúlason, S., Lanki, M., Rellstab, C., & Jokela, J. (2013). Water temperature, not fish morph, determines parasite infections of sympatric Icelandic threespine sticklebacks (*Gasterosteus aculeatus*). *Ecology and Evolution* 3(6), 1507 – 1517.

- Macnab, V. & Barber, I. (2012). Some (worms) like it hot: fish parasites grow faster in warmer water, and alter host thermal preferences. *Global Change Biology* 18, 1540—1548.
- Marcogliese, D. J. (2001). Implications of climate change for parasitism of animals in the aquatic environment. *Canadian Journal of Zoology* 79(8), 1331 – 1352.
- Marcogliese, D. J. (2008). The impact of climate change on the parasites and infectious diseases of aquatic animals. *Scientific and Technical Review of the Office International des Epizooties* 27(2), 467 – 484.
- Margolis, L. & Arthur, J. R. (1979). *Synopsis of the Parasites of Fishes of Canada. Bulletin 199*. Department of Fisheries and Oceans. Thorn Press Limited: Ottawa, Canada. 270 pp.
- Margolis, L., & Kabata, Z. (eds). (1984). Guide to the parasites of fishes of Canada. Part I. Can. Spec. Publ. Fish. Aquat. Sci. 74, 209 pp.
- Margolis, L., & Kabata, Z. (eds). (1988). Guide to the parasites of fishes of Canada. Part II. Can. Spec. Publ. Fish. Aquat. Sci. 101, 184 pp.
- Margolis, L., & Kabata, Z. (eds). (1989). Guide to the parasites of fishes of Canada. Part III. Can. Spec. Publ. Fish. Aquat. Sci. 107, 95 pp.
- Margolis, L., & Kabata, Z. (eds). (1996). Guide to the parasites of fishes of Canada. Part IV. Can. Spec. Publ. Fish. Aquat. Sci. 124, 373 pp.
- McDonald, T. E. & Margolis, L. (1995). Synopsis of the Parasites of Fishes of Canada: Supplement (1978 – 1993). Can. Spec. Publ. Fish. Aquat. Sci. 122, 265 pp.
- Mohamed, A. E.-M. H., Mohamed, M. H., & Mahmoud, M. A. (2017). Infestation of some marine fish species with red worm *Philometra*. *Arab Gulf Journal of Scientific Research* 28(3), 137—146.
- Pufall, E. L., Jones-Bitton, A., McEwan, S. A., Brown, T. M., Edge, V. L., Rokicki, J., Karpiej, K., Peregrine, A. S., & Simard, M. (2012). Prevalence of zoonotic anisakid nematodes in Inuit-harvested fish and mammals from the eastern Canadian Arctic. *Foodborn Patholog Dis.* 9(11): 1002–1009.

## References – Parasites (continued)

- Rahel, F. J. & Olden, J. D. (2008). Assessing the effects of climate change on aquatic invasive species. *Conservation Biology* 22(3), 521 – 533.
- Sándor, D., Molnár, K., Gibson, D. I., Székely, C., Majoros, G., & Cech, G. (2017). An investigation into the host-specificity of metacercariae of species of *Apophallus* (Digenea: Heterophyidae) in freshwater fish using morphological, experimental, and molecular methods. *Parasitology Research* 116(11), 3065–3076.
- Stewart, D. B. & Bernier, L. M. J. (1999). *Common parasites, diseases and injuries of freshwater fishes in the Northwest Territories and Nunavut [pamphlet]*. Department of Fisheries and Oceans, Central and Arctic Region. 41 pp.
- Williams, H. H. (1968). The taxonomy, ecology and host-specificity of some Phyllobothriidae (Cestoda: Tetraphyllidae), a critical revision of *Phyllobothrium* Beneden, 1849 and comments on some allied genera. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences* 253(786), 231 – 307.

## References – Fish Names

Alberta Language Technology Lab (ALT Lab). (2019). Itwêwina – Plains Cree Dictionary. Accessed from: <https://itwewina.altlab.app/>

Ayha, A. & Takazo, A. (eds). (2012). Sahtúot'jine Dictionary. Dialect of the North Slavey Language. Accessed from: <http://www.sahtudec.ca/documents/general/Deline%20TLC%20Sahtuotine%20Kede.pdf>

Dogrib Divisional Board of Education. (1996). A Dogrib Dictionary. Rae-Edzo, NWT. Accessed from: [https://www.tlicho.ca/sites/default/files/A\\_Dogrib\\_Dictionary.pdf](https://www.tlicho.ca/sites/default/files/A_Dogrib_Dictionary.pdf)

Gwich'in Renewable Resources Board (GRRB). (n.d.). Fish Species of the Gwich'in Settlement Area. Access from: [https://www.grrb.nt.ca/fisheries\\_species.htm](https://www.grrb.nt.ca/fisheries_species.htm)

Gwich'in Social & Cultural Institute. (2009). Gwich'in Topical Dictionary. Teet'it Zhe, NWT. Accessed from: [https://gwichin.ca/sites/default/files/gsci\\_gsci\\_2009\\_gwichin\\_topical\\_dictionary.pdf](https://gwichin.ca/sites/default/files/gsci_gsci_2009_gwichin_topical_dictionary.pdf)

Hart, E. J. & Amos, B. (2004). Tariurmiutuakun Qanuq Atuutiviksaitlu Ilitchuriyaqput Ingilraan Inuvialuit Qulianginnin. Learning About Marine Resources and Their Use Through Inuvialuit Oral History. Inuvialuit Cultural Resource Center. Accessed from: <https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/279627.pdf>

Kitikmeot Heritage Society. (n.d.). Inuinaqtun to English Dictionary. Cambridge Bay, NU. Accessed from: [http://en.copian.ca/library/learning/nac/nac\\_dictionary/nac\\_dictionary.pdf](http://en.copian.ca/library/learning/nac/nac_dictionary/nac_dictionary.pdf)

Miyo Wahkohtowin Community Education Authority (MWCEA) (n.d.). Nehiyaw Masinahkin. Online Cree Dictionary. Accessed from: <http://www.creedictionary.com/>

Papik, R., Marschke, M., & Ayles, G. B. (2003). Inuvialuit Traditional Ecological Knowledge of Fisheries in Rivers West of the Mackenzie River in the Canadian Arctic. Canada/Inuvialuit Fisheries Joint Management Committee.

South Slave Educational Council. (2012). Dëne Dédliné Yatré. ?ereht'íscho. Denínu Kuę Yatré. Chipewyan Dictionary. Fort Smith, NWT. Accessed from: <http://www.ssdec.nt.ca/ablang/ablanguaje/chiptionary/Chipewyan%20Dictionary.pdf>

## References – Fish Names (continued)

South Slave Educational Council. (2009). Dene Yatíé K'ée Ahsíi Yats'uuzi Gha Edjhtl'éh Kátí'odeche. South Slavey Topical Dictionary Kátí'odeche Dialect. Fort Smith, NWT. Accessed from: <http://www.ssdec.nt.ca/Dictionary/dictionary.pdf>

Wek'èezhii Renewable Resources Board. (2014). Common Fish in the Tłı̄cho Region. Accessed from: [https://www.wrrb.ca/sites/default/files/Tlı̄cho%20Fish%20Guide%205%20Jul%202012-2\\_0.pdf](https://www.wrrb.ca/sites/default/files/Tlı̄cho%20Fish%20Guide%205%20Jul%202012-2_0.pdf)





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