Ichthyobodosis (Costiosis, *Ichthyobodo necator Complex*)

- ***Ichthyobodo necator (Costia necatrix*)** is **obligate parasite of skin and gills,** and one of the **smallest ectoparasites** that infest fish (**about the size of a red blood cell**)
- Ichthyobodo is especially dangerous to **young fish** and can attack healthy **fry** and even **eggs**. **In older fish** it is associated with some type of **predisposing stress**
- *Ichthyobodo necator* causes disease over **a wide temperature range (2– 30 °C)**
- While classically a disease of **freshwater fish**, Ichthyobodo can survive transfer to seawater and cause mortality in **marine -adapted salmonids** and also occurs in **purely marine fish**
- Most recently, molecular genetic analysis has confirmed that this taxon is a **multispecies complex** (***Ichthyobodo necator complex***) and contains at least **9 different species** with varying host preferences

Pathogenesis

- **Ichthyobodo exists in two forms:**

➢ **The detached, mobile (free-living) form:** has **two** or **four flagella**, all of which are difficult to see in actively moving parasites, measures **10–15 µm in length** and is usually **oval** or **kidney shaped**

➢ **The attached form:** While the parasite **feeds on the fish**, it is curled into **a pyriform shape** and is attached to and penetrates the epithelium

- **Clinical signs:**

Ichthyobodo can cause **considerable mortalities**, sometimes with little obvious pathology, but other times with **spongiosis** and **epithelial sloughing**. **Tissue irritation** also leads to **epithelial hyperplasia** and **increased mucus production**, giving fish **a bluish cast (slime)**

- **History/Physical Examination:**

typical signs include **pruritus (“ flashing”)**, **dyspnea**, “ **cloudy** ” **skin**, **secondary microbial infections**; **drop in temperature**; **bluish or whitish film on body**

Diagnosis

- **Method of Diagnosis:**

1. Wet mount of skin or gills with parasite
2. Histopathology of skin or gills with parasite

- Diagnosis of the genus Ichthyobodo is easily made from **skin or gill biopsies**
- The free swimming form exhibits a characteristic **flickering motion** when it moves
- Attached parasites are more difficult to detect, but, in heavy infestations, they can be located by focusing up and down at high magnification **on the edge of the gill epithelium**, where they form palisades
- Note that cryptobids and nonpathogenic, ectocommensal bodonid flagellates may also be found on fish skin and gills; these should not be confused with Ichthyobodo

Histopathology

- Histologically, there is a **reduction of mucous cells** early in the infection, while **lamellar hyperplasia** occurs in the recovery phase. Other lesions include **erosive** and **ulcerative dermatitis**

- Gill lesions include **exhaustion of the goblet cells**, **diffuse hyperplasia**, sometimes with characteristic **cavitation**, and **degeneration of epithelial** and **mucous cells**, **fusion of adjacent lamellae** and **cell sloughing**

- Damage to sub-surface cells show **dramatic degeneration of the cytoplasm**, although the nucleus usually remains intact

- In the recovery phase, **large numbers of eosinophilic granular cells** may be seen within the lamellae

Treatment

- Formalin bath
- Formalin prolonged immersion
- Potassium permanganate prolonged immersion
- Raise temperature >30 °C (86° F)
- Salt bath (freshwater only)
- Secnidazole oral
- Triclabendazole
- Metronidazole oral

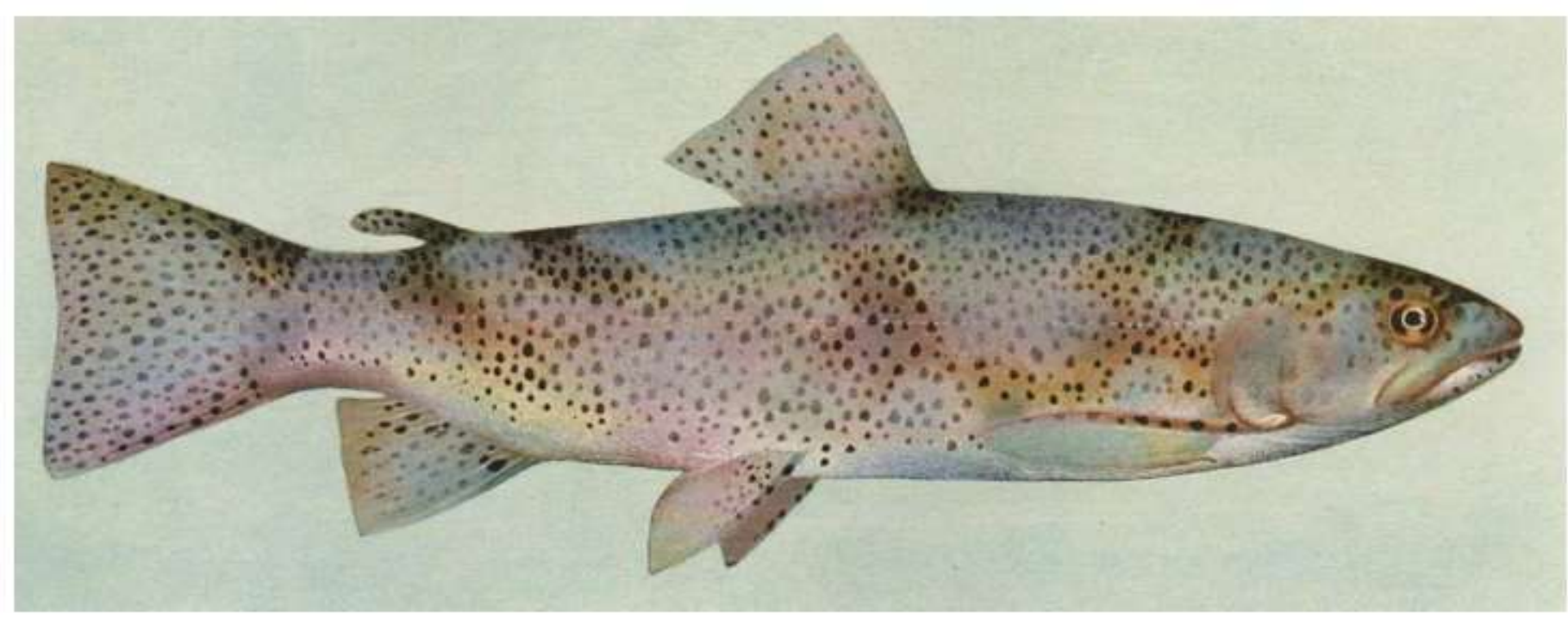
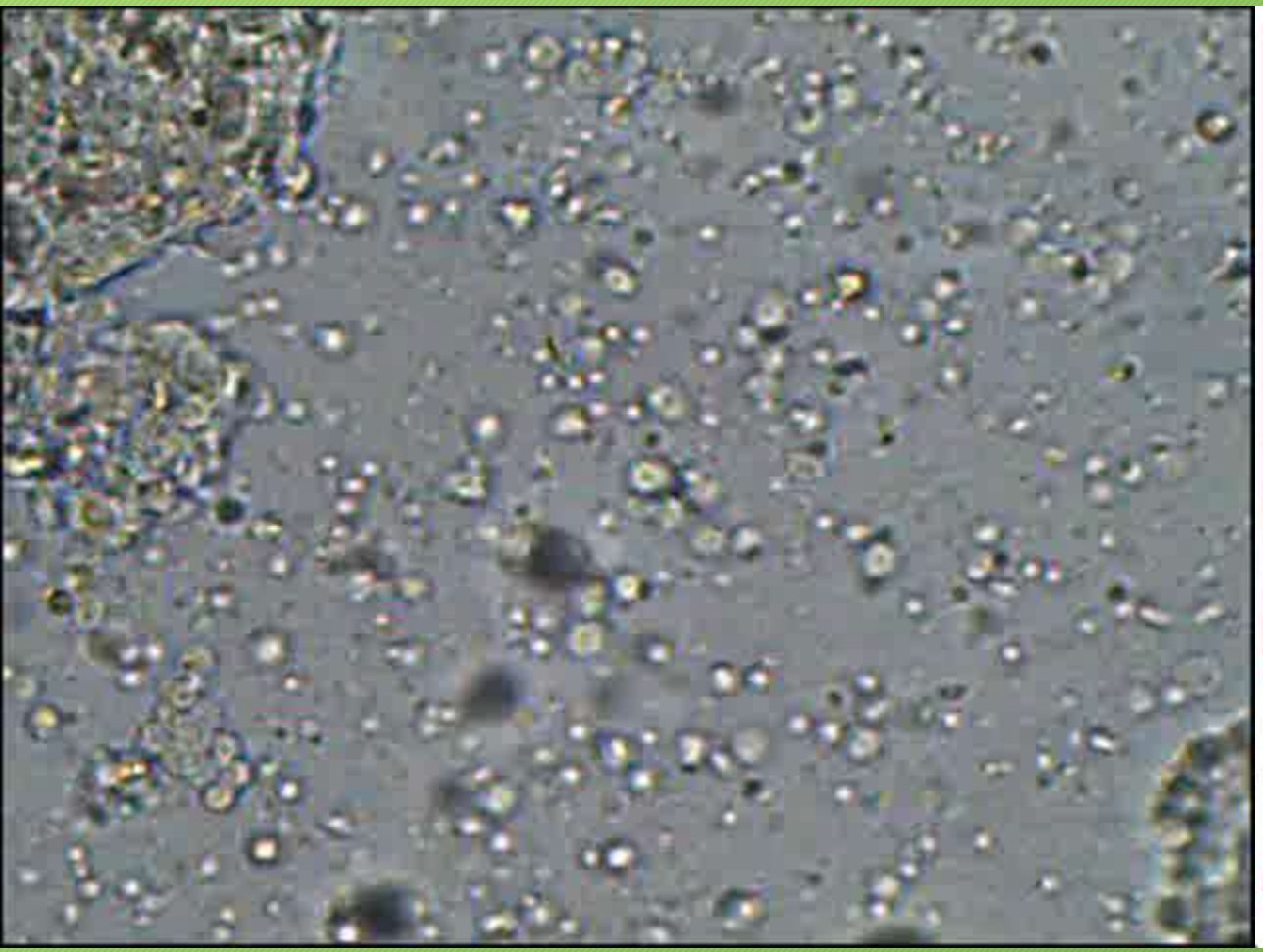


Fig 3. **Rainbow trout** with i**chthyobodosis**, showing typical **blue-grey turbid covering** on the **skin** (from Hofer 1904).

Haemorrhagic lesions caused by *I. necator*

Costia, Ichthyobodo necatrix



Ichthyobodo on a Catfish - photo by Dr. Thomas L. Wellborn, Jr.

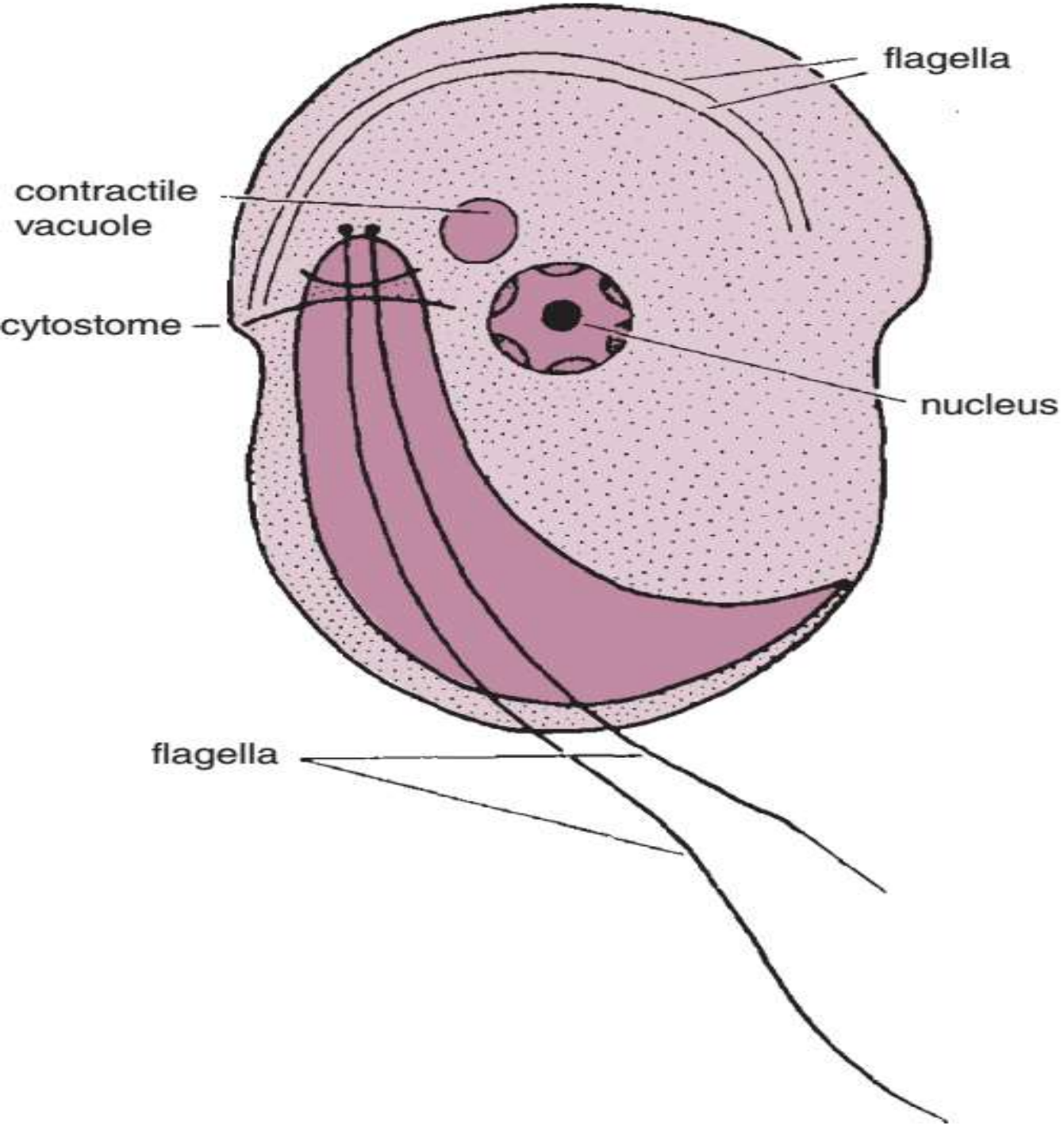


Fig. Ichthyobodo (= Costia) showing biflagellate structure. (After Joyon & Lom 1969.)

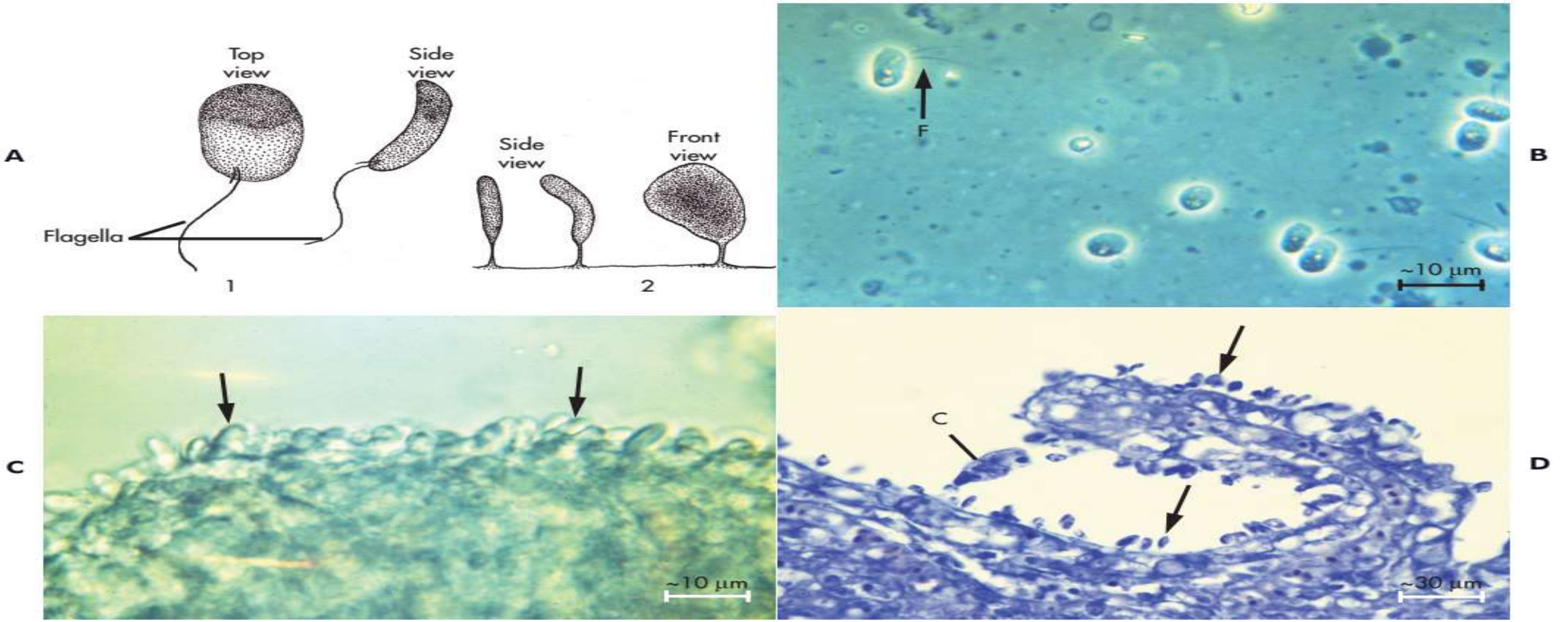
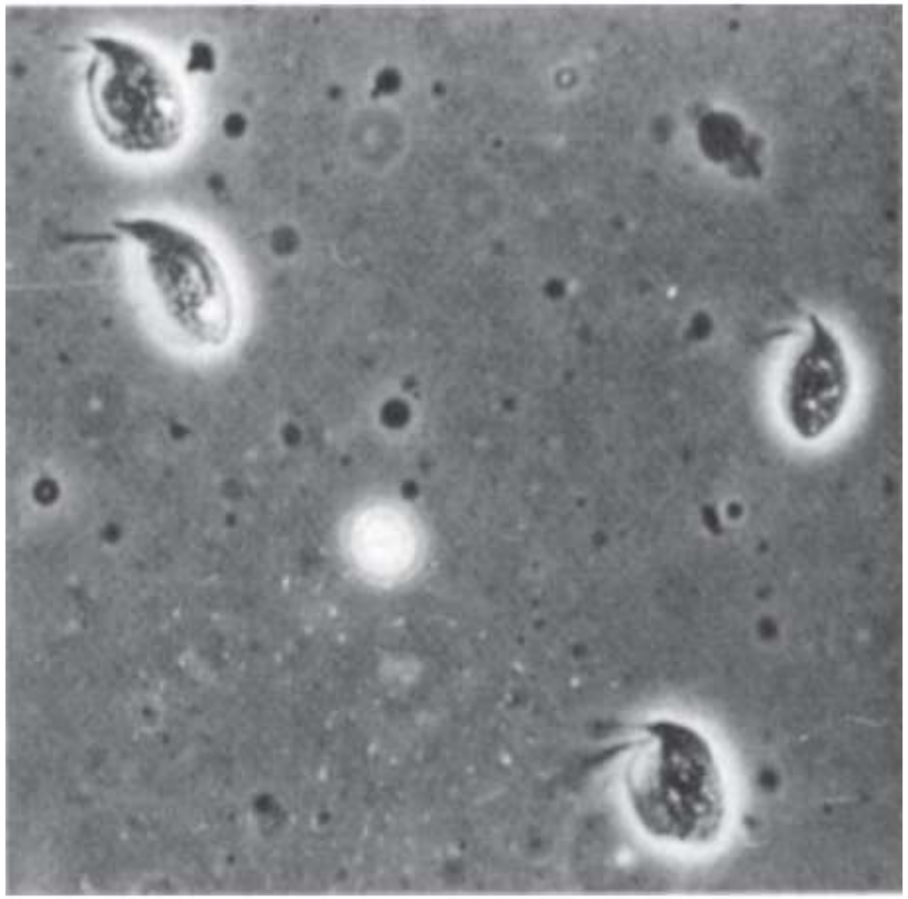
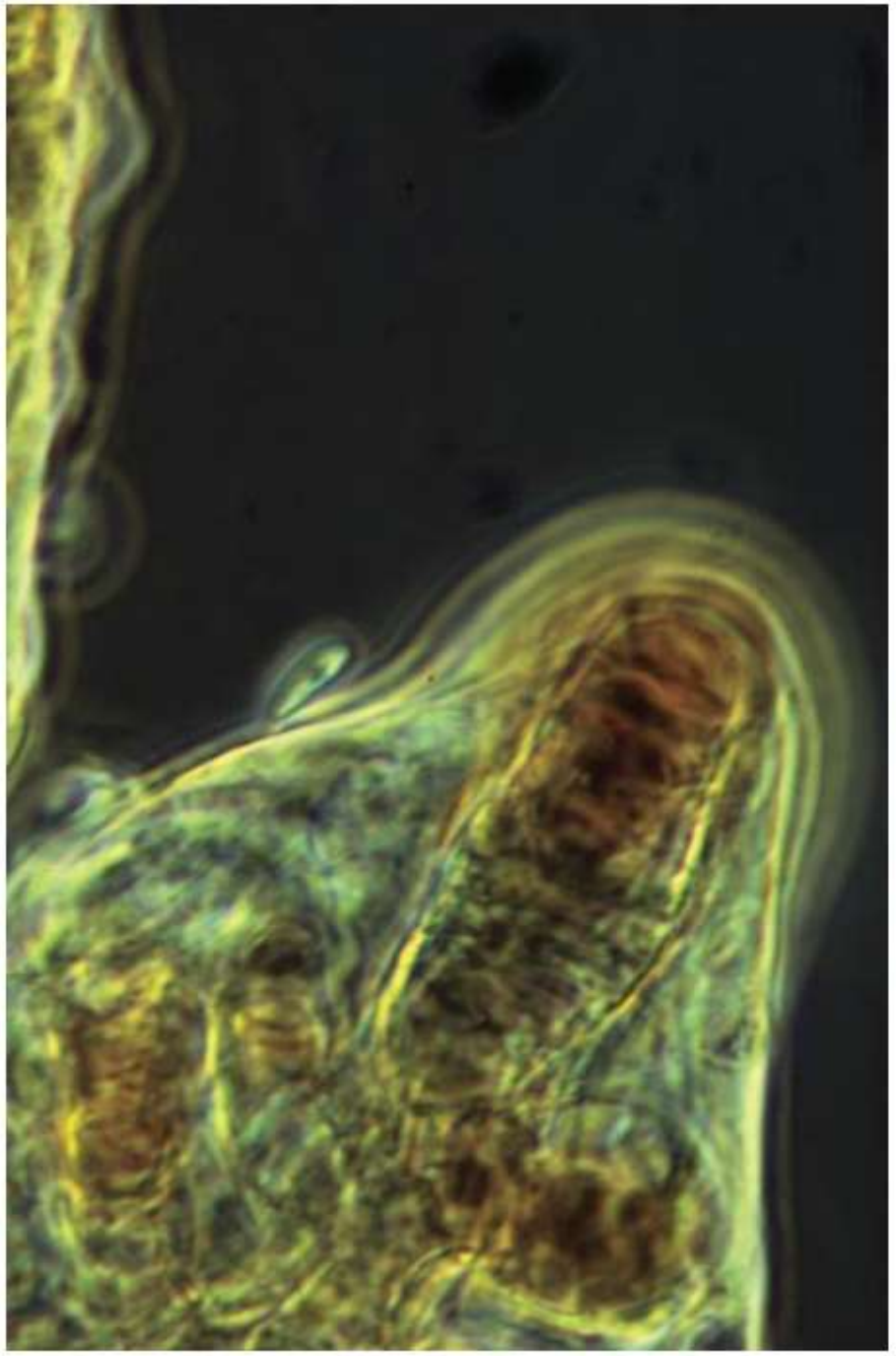


Fig 3. A. **Ichthyobodo**. Diagrams with key characteristics: (1) **Free-swimming stage**: size(~5 – 8 × 10 – 15µm); slightly asymmetrical; oval body on top view; flattened, crescent shape on side view; single or paired flagella directed posterolaterally. (2) **Attached stage**: pyriform shape; flagella are not easily seen when attached. B. **Wet mount of the free-swimming stage** of *I. necator*. F = flagellum. C. **Wet mount of many Ichthyobodo (arrows) attached to the gill epithelium**. D. **Histological section of gill** with a heavy *I. necator* infestation (arrows). Note the pyriform, dorsoventrally flattened shape on side view. A larger, unrelated ciliate (C) is also present. Giemsa. (B and C photographs courtesy of G. Hoffman.).

Fig 4. (a) *Ichthyobodo* (= *Costia*) *necatrix*), **free-swimming flagellated stages** (length about 10µm) from
the **skin** of **Atlantic salmon**. (By courtesy of Mr C.H. Aldridge.)
(b) **Attached stage** of Ichthyobodo on **tip of gill primary lamella** of **Atlantic salmon fry**. Unstained wet preparation ×100.



(a)



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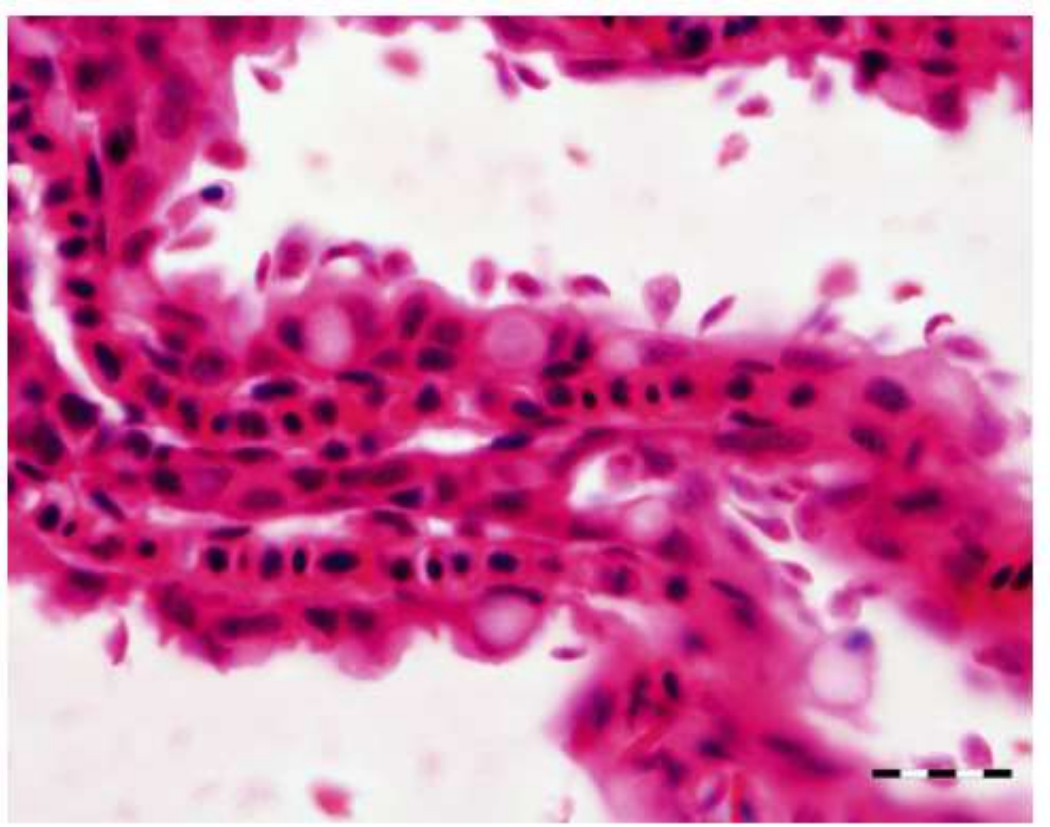


Fig 5. ***Ichthyobodo salmonis*** attached to the **gill epithelium** in **Atlantic salmon**. Bar ¼ 20 µm

Fig 6. ***Ichthyobodo necator*** attached to the **skin of farmed brown trout fry**

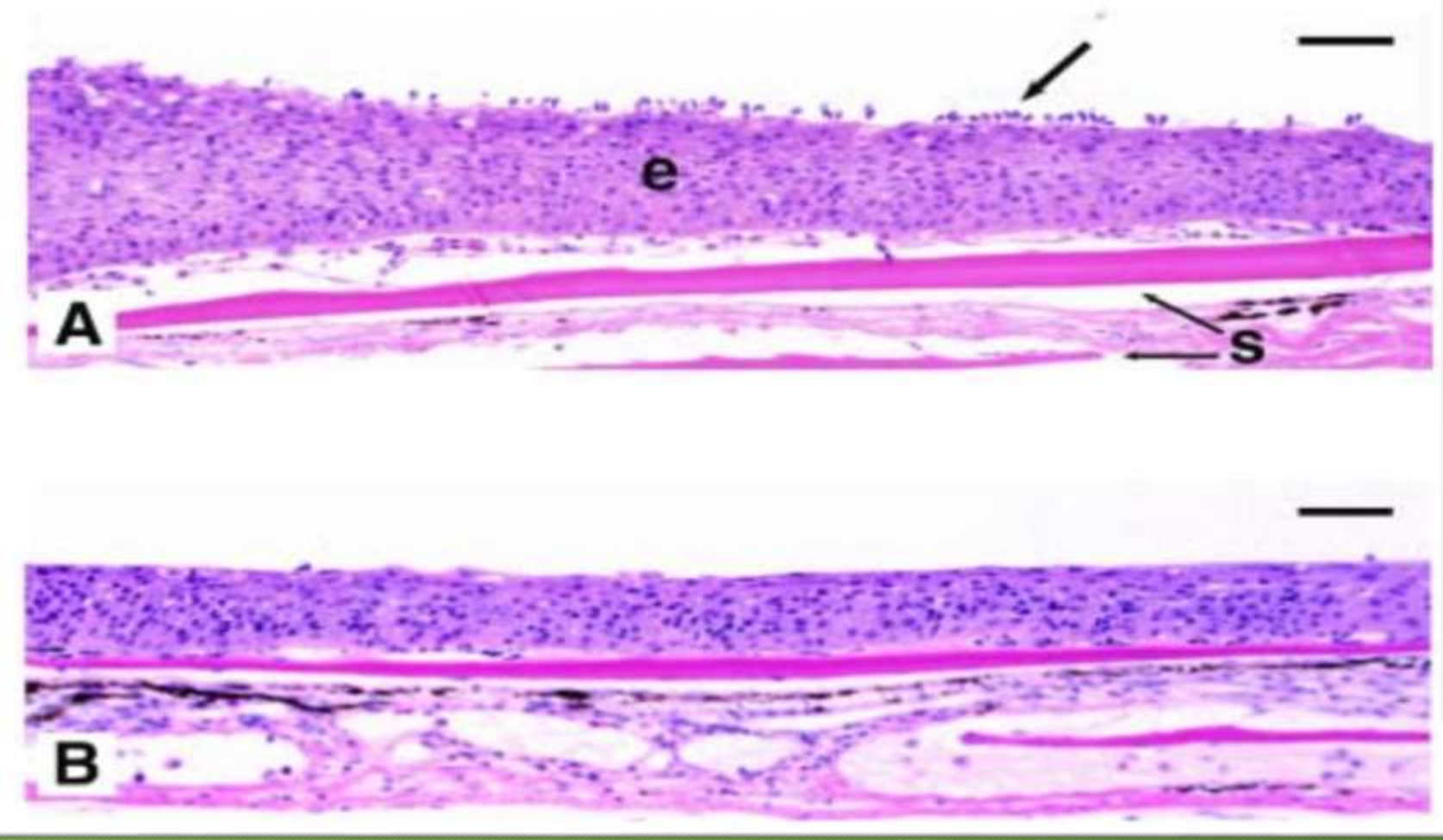


Fig 7. **Histological cross-section of the skin of hybrid bass**.
(a) **Attached *Ichthyobodo necator* trophonts** (**arrow**) after fish were euthanized in buffered tricaine (1,000 + 2,000 mg/L sodium bicarbonate). The **epidermis (e)** and the **scales (s)** are indicated. (b) The absence of ***I. necator* trophonts** after fish were euthanized in unbuffered tricaine (1,000 mg/L) (H&E, Bar = 40 µm).

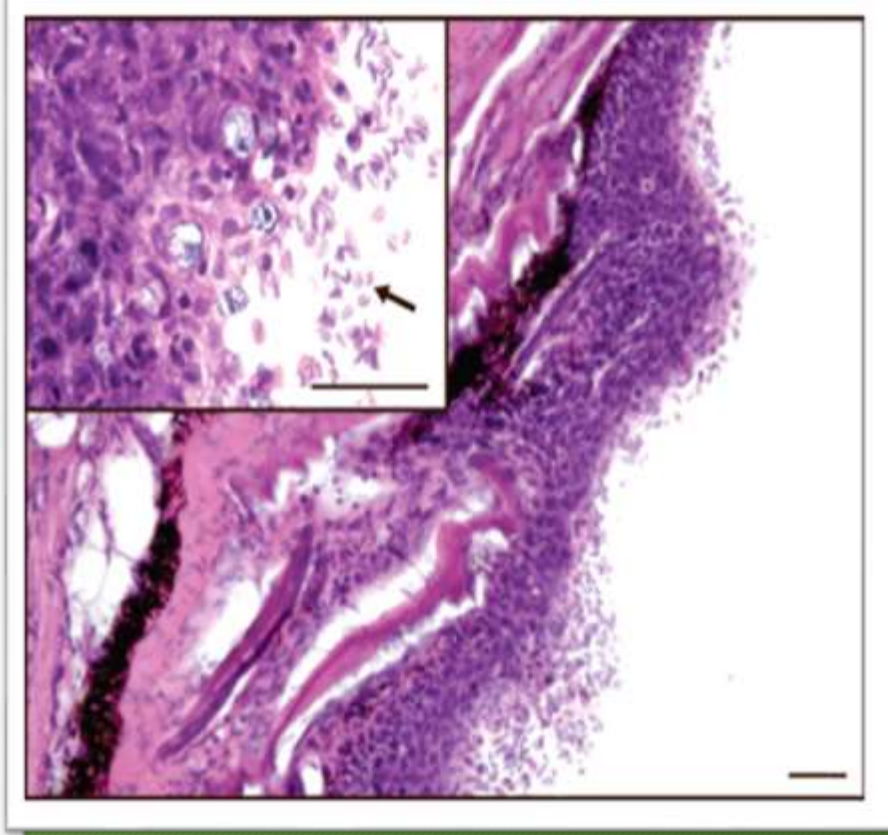


Fig 8. **Rainbow trout epidermis** heavily infected with ***Ichthyobodo necator***. Haematoxylin and eosin stained. Insert
shows a section at higher magnification. Arrow points at parasites. Scale bar 50 lm.

Chilodonella Infestation (Chilodonellosis)

- Chilodonella is a common **holotrich ciliate**, **ectoparasite on a wide range of temperate,** The parasite has a **flattened**, **ovoid shape**, is **up to 80µm in length** and is covered by **rows of cilia** which move it in a steady gliding manner over the **epithelial cells** on which it feeds. Their **oral cytoskeleton** abrades the skin surface causing hyperplasia
- Heavy infections of Chilodonella are often associated with **poor water quality**
- Most Chilodonella species are **free-living**, but two species (***C. piscicola and C. hexasticha***) are **pathogenic** for fish

- ***Chilodonella piscicola*** (formerly *C. cyprini*) infests virtually all **freshwater fish**, **mainly fingerlings**
- ***Chilodonella hexasticha*** is **less widely distributed** but produces **similar lesions**, mainly in **older fish**. Both species can also infest fish in **brackish water** and appear to have been widely **spread throughout the world** via infested fish

Pathogenesis

- Advanced Chilodonella infestations are sometimes associated with **skin ulcers**, which like brooklynellosis, may have a **tattered appearance**. High numbers can cause **secondary bacterial infections** and substantial mortality (**10% per week**)
- Chilodonella elicits a strong cellular response, which suggests that it may **feed directly on epithelium**. It appears to feed by **penetrating the host cells** with its **cytostome** and sucking out the contents

- Chilodonellosis has a **wide temperature tolerance**. For example, outbreaks in **cold water species** often occur at **5– 10 °C**, while **tropical fish** are affected when the temperature **drops to 20°C.** However, outbreaks have been observed at as high as **25°C**
- Some **free-living Chilodonella species** (e.g., *C. cucullulus*, *C. uncinata*) can damage **weakened fish in polluted waters**. They are apparently not as widespread as the two more pathogenic Chilodonella species

Clinical Signs

❑**History/Physical Examination:**

Typical signs of protozoan ectoparasite, especially **whitish or bluish sheen on body**, “ **tattered** ” **appearance to skin**; also, **a drop in temperature** or **previous injury**

❑**Clinical signs:**

Increased mucus, hypoxia and reduced growth. Typical gill lesions include hyperplasia, necrosis and impaired gill function, followed by infiltration of eosinophilic granulocytes. Respiratory failure due to diffuse hyperplasia and inflammation is considered to be the primary cause of fish mortality

❑**Method of Diagnosis:**

1. Wet mount of skin or gills with parasite
2. Histopathology of skin or gills with parasite

Diagnosis

- Chilodonella is easily recognized in **wet mounts** or **histological sections**
- Because of their **tenuous attachment to the tissues**, they are easily lost during fixation. In wet mounts, Chilodonella glides slowly over gill lamellae, sometimes turning in wide circles
- It is differentiated from the **holotrichsich** and **Tetrahymena** by its **flattened shape.** Also characteristic are its **bands of cilia on the ventral surface**, which require **high magnification** to be seen and are best visualized with **silver staining**
- Chilodonella piscicola is 30– 80 × 20 – 60 µm, with 8–11 bands of cilia, while *C. hexasticha* is smaller (30– 65 × 20 – 50 µm), with 5– 9 cilia bands

Treatment

- **Treatment**:

One application of an appropriate treatment usually controls chilodonellosis. *Chilodonella piscicola* produces long-lasting cysts, but whether these are resistant to treatment is not known

1. Formalin bath
2. Formalin prolonged immersion
3. Potassium permanganate prolonged immersion
4. Acetic acid bath
5. Salt bath
6. Copper prolonged immersion

Fig. Chilodonella, a typical ciliophoran, showing some features of ciliate structure and macro and micronucleus. (After Davis 1953.)

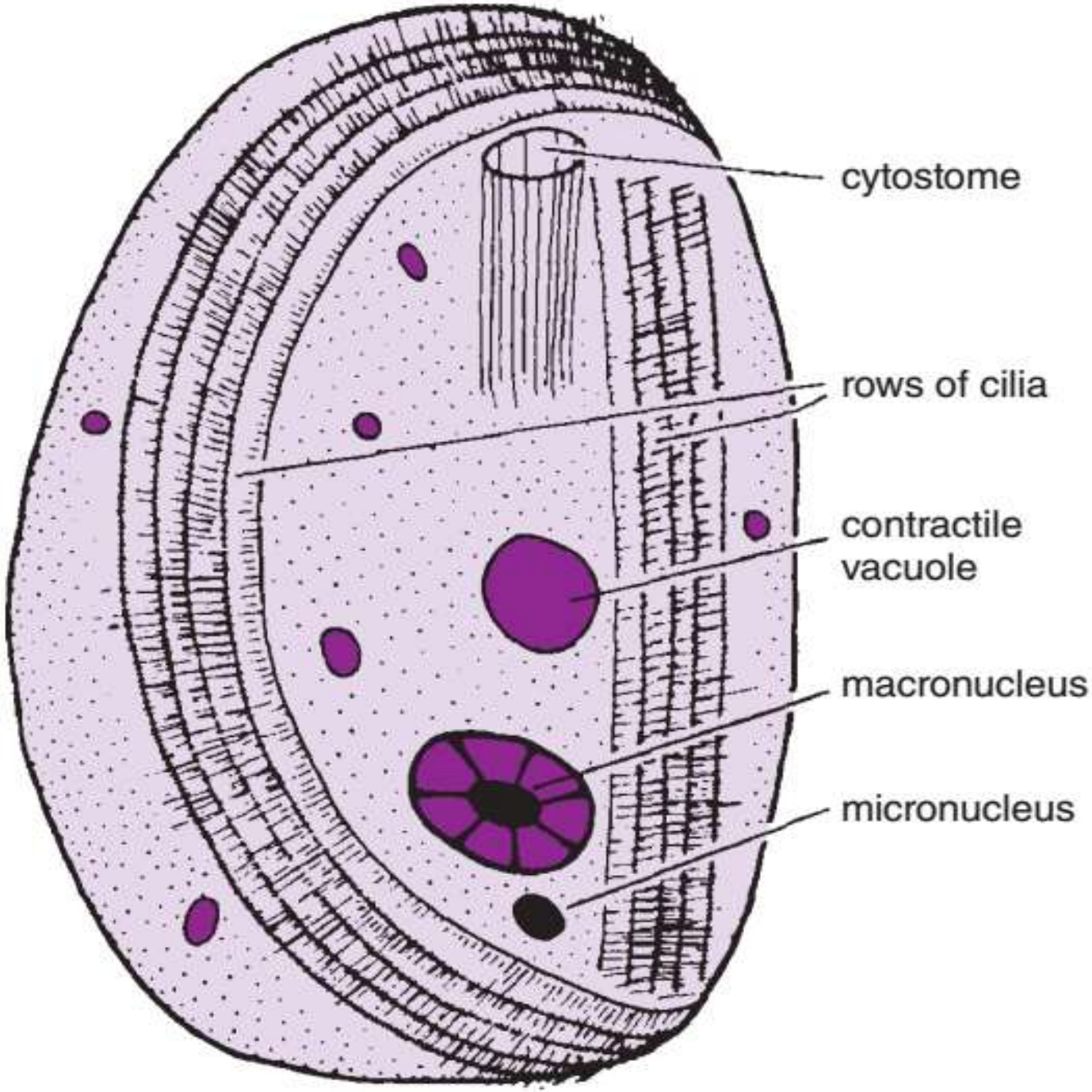


Fig 1. A. Chilodonella. Diagram of key characteristics: size (usually ~40 – 60µm long); bands of cilia; when viewed from above (top view), oval- to - heart -shape, with notched anterior end; parasites are a flattened shape when viewed from the side (side view).
B. Wet mount of *Chilodonella ciprini*.
C. Histological section of gill with Chilodonella (arrows). Giemsa. (B photograph courtesy of G. Hoffman.)

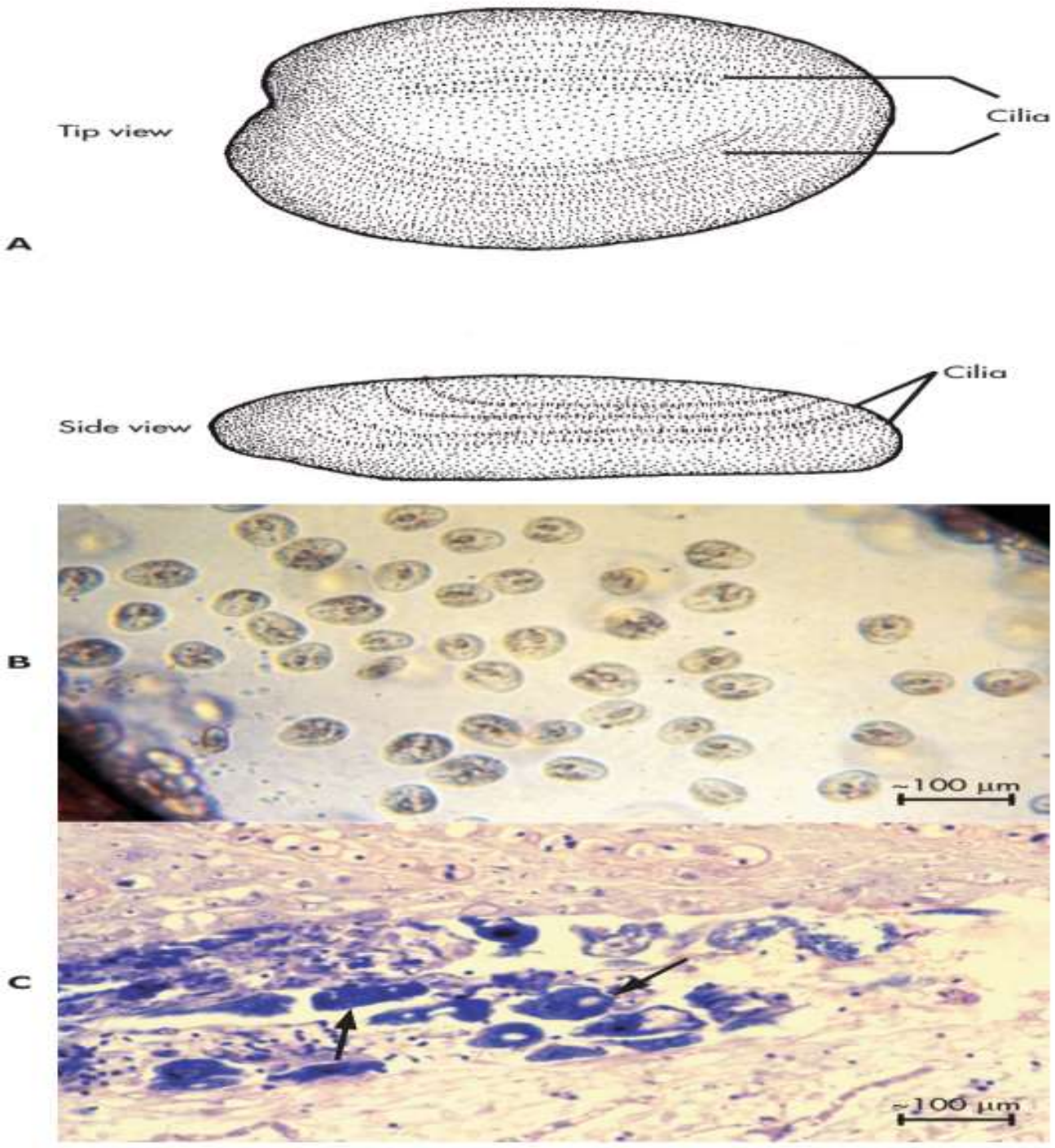


Fig 2. *Chilodonella piscicola*. Silver impregnated specimen showing characteristic **oval shape** and **notch at the posterior end**. High power

Fig 3. *Chilodonella cyprini* from the **skin of Atlantic salmon** (up to 70µm in length). (By courtesy of Mr C.H. Aldridge.)

Fig Gills from a barramundi (*Lates calcarifer*), infected with the ciliate *Chilodonella hexasticha* (a–f).
(a) **Gill filament** with **generalised gill lamellar epithelial hyperplasia** (**thick arrows**).(H&E, 94).
(b) & (c) **Gill filaments** with synechiae of **multiple adjacent gill lamellae** (**arrows**). Note numerous *Chilodonella hexasticha* **parasites** (**arrowheads**), and **inflammation** (***asterisks***) (H&E, 910).
(d)& (f) High magnification of gill filaments showing **petechial haemorrhages** (**large arrowheads**), **inflammation and necrosis** (**asterisks**) of gill epithelium (H&E, 920).
(e) Gill filament with **pseudocyst formation (asterisk)**. Note *Chilodonella hexasticha* **parasites** (**arrowheads**) within pseudocyst and between adjacent gill lamellae. (H&E, 920).

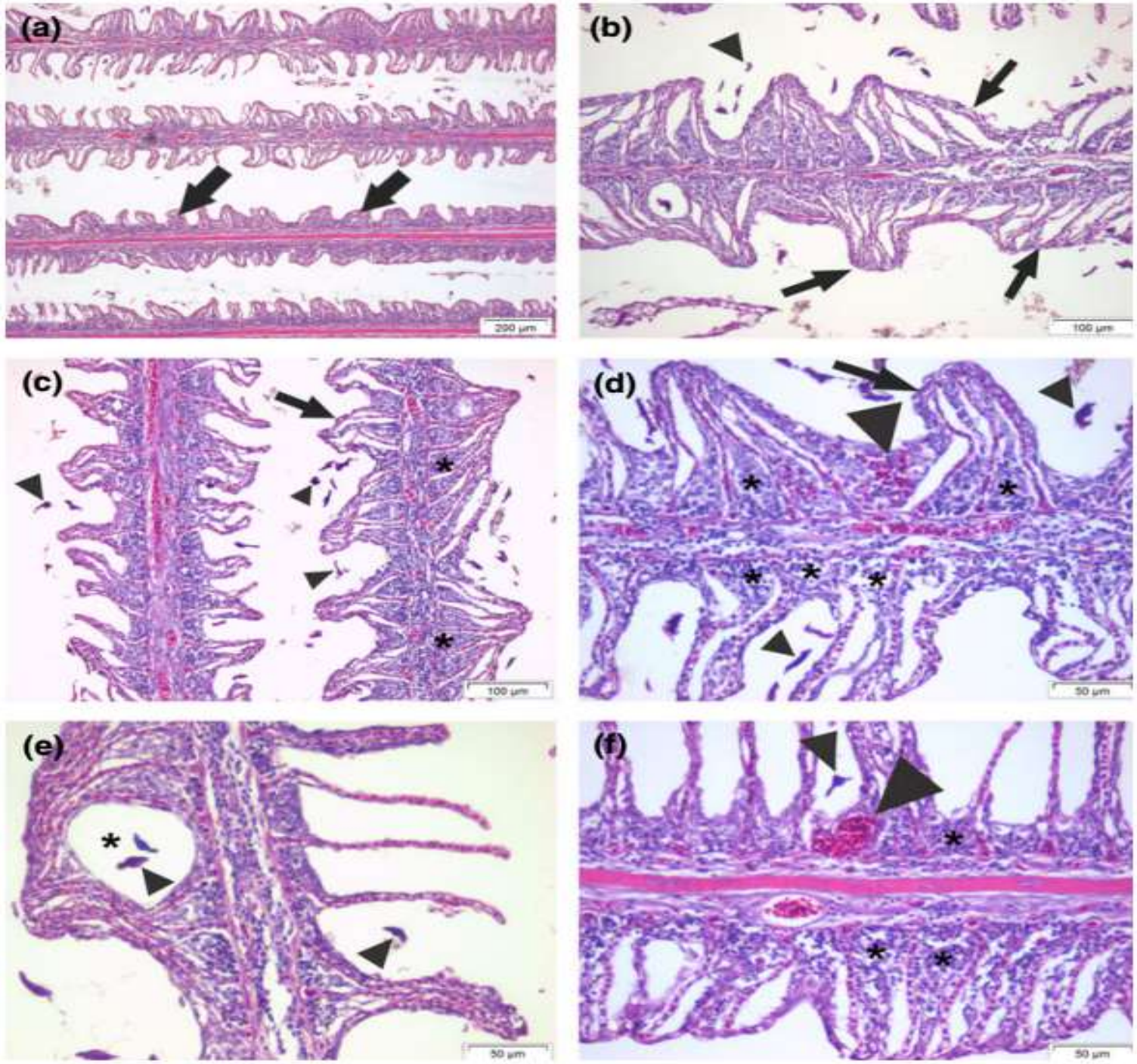
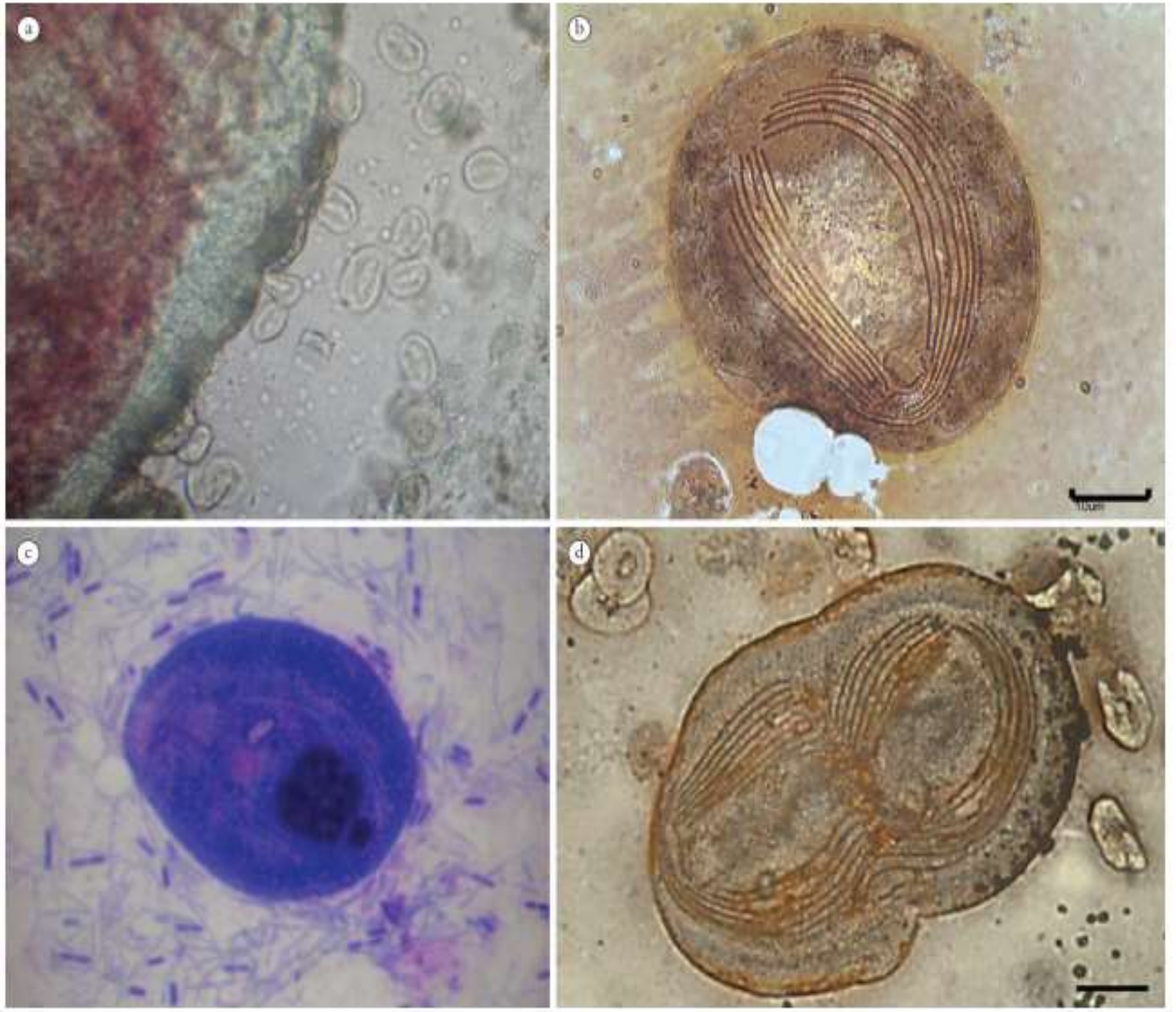


Fig. Chilod*onella hexasticha* observed in fresh-mounted slide from the **gills** of Nile tilapia ***Oreochromis niloticus*** (a), with detail of ciliary kineties in silver nitrate impregnation (b), nuclear apparatus and great amount of bacteria when stained by Giemsa (c), transversal fission of the parasite after silver nitrate impregnation (d). Bar: 10 µm (b,d).



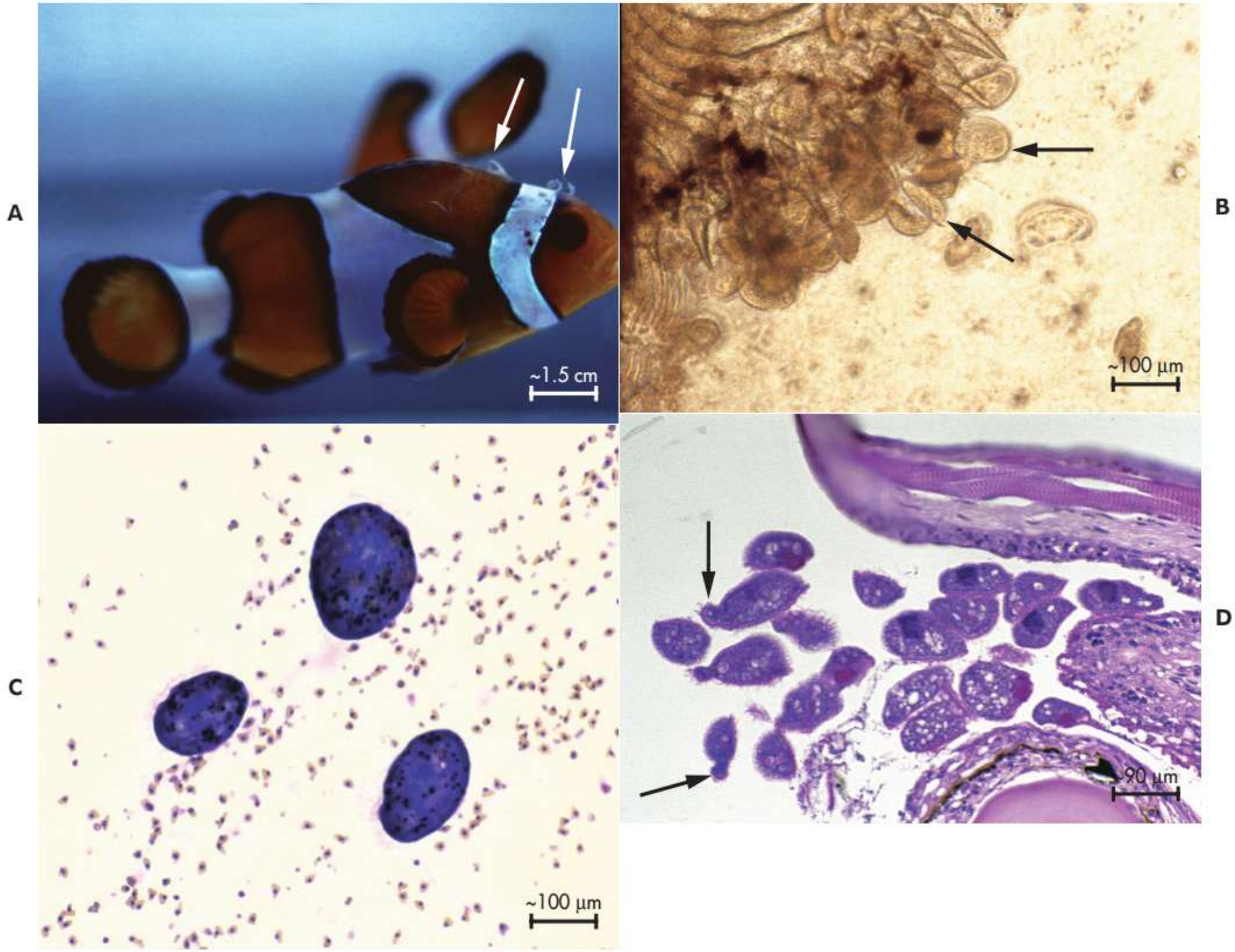
Brooklynella Infestation (Brooklynellosis)

- Brooklynellosis is the marine analogue of chilodonellosis. It has been associated with **acute mortalities of tropical marine fish**
- *Brooklynella hostilis* is morphologically similar to Chilodonella, having an **oval shape** with **more numerous ciliary rows**. Its most easily recognized diagnostic features are **dorsoventral flattening**, **notched anterior end**, size, and slow, Chilodonella- like movement. Its size range is 56– 86 × 32 – 50 µm
- While reported to be only a **gill pathogen**, it can also cause **serious skin lesions**. It commonly occurs after transport stress

- **Treatment**:

Unlike most marine fish ectoparasites, it is often not susceptible to copper, but **formalin baths** are effective

Fig A. A **percula clownfish** with heavy Brooklynella infestation. Note the shreds of **detaching skin** (**arrows**). B. **Wet mount of skin** from a percula clownfish with brooklynellosis. Note **ovoid shape** on top view and **flat shape** on side view (arrows). C**. Modified Wright's stained smear of the skin lesion** in Fig. II-24, A, with three **Brooklynella trophozoites**. D. **Histological section of the skin lesion** in Fig. II-24, A, with many parasites. Key features include **size, shape, and notched anterior end** (**arrows**). (C and D photographs by L. Khoo and E. Noga.).



Pathogenesis

- The less common family **Gnathiidae** includes **~160 species** that have larvae, and male and female adults, which differ in shape and behavior. Only the **larva** (**praniza**) is **parasitic**, living in the **gastric cavity of sea anemones and tunicates** or on the **skin** or **gills** of fish. **Adults** are **nonfeeding**, **live in mud tubes** or **sponges**, and produce infective larvae

- **Because of their large size**, single isopods can cause **considerable damage** with their biting and sucking mouthparts. This may include pressure **necrosis of gill tissue** and **growth retardation**

- However, many have **stable hostparasite relationhips** and as adults cause relatively **little** apparent **harm**

- **Heavy infestations** of parasitic **larvae** or **juveniles** can **kill small fish** when they first attach**. Initial attack** of even **larger fish** by the **larvae** (especially the **manca larvae of *cymothoid flabelliferans***) can be **extremely irritating**, causing **a violent escape reaction** in the fish

Diagnosis/Treatment

❖**History/Physical Examination:**

Isopod grossly visible on body, in mouth, or in gill chamber

❖**Method of Diagnosis:**

Gross observation of parasite in gill chamber or mouth, or on skin. Diagnosis of parasitic isopods is easily made from **morphological characteristics**

❖**Treatment:**

1. Remove parasite with forceps

2. Organophosphate bath

- **Cymothoids** are susceptible to **organophosphates**. **Individuals** can also be removed from fish by using **forceps**. **Placing fish in aquaria** (**without a refuge, such as mud**) **breaks** the **life cycle** of **gnathiid isopods**. **Cleaner shrimp** and **cleaner fish**, such as **the blue -lined cleaner wrasse**, prey on **gnathiids**

Fig. C, a live isopod parasite (***Ceratothoa Italica)*** inside the mouth of its host.

Courtesy of Matthew Gilligan

Fig. ***Ceratothoa imbricata***, the South African relative of the parasite discovered off the Jersey Shore. Photo Credit: Dr. Nico Smit

lownfish with parasitic isopod. Copyright Lea Lee. http://www.flickr.com/photos/critter71/

Cymothoa exigua

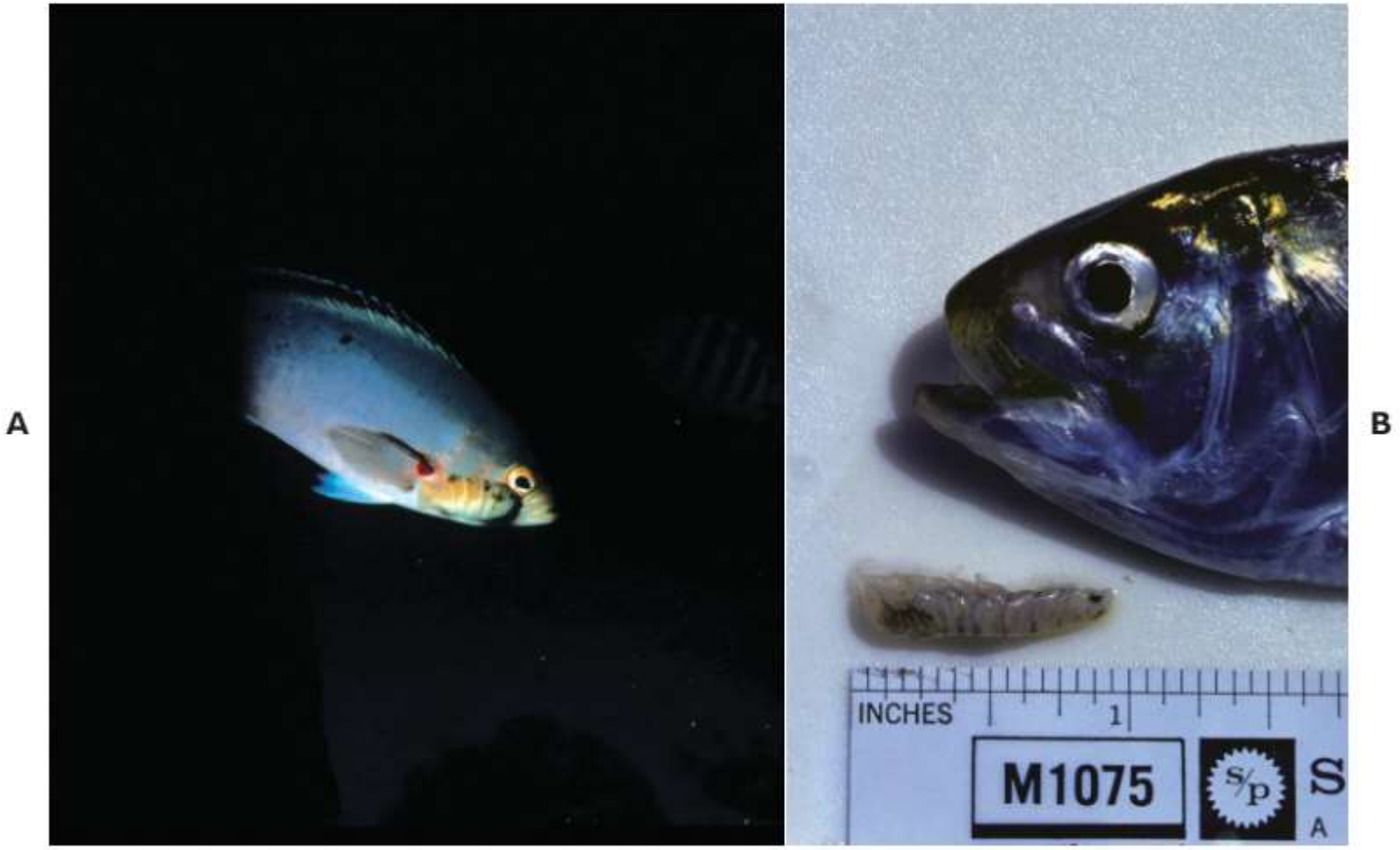


Fig. A. **Flabelliferan isopod** attached to the **cheek** of **a marine reef fish**. B. **Flabelliferan isopod** (***Olencira praegustator***) that resided in the oral cavity of an Atlantic menhaden. Head with eyes on the right (Kroger and Guthrie 1972).

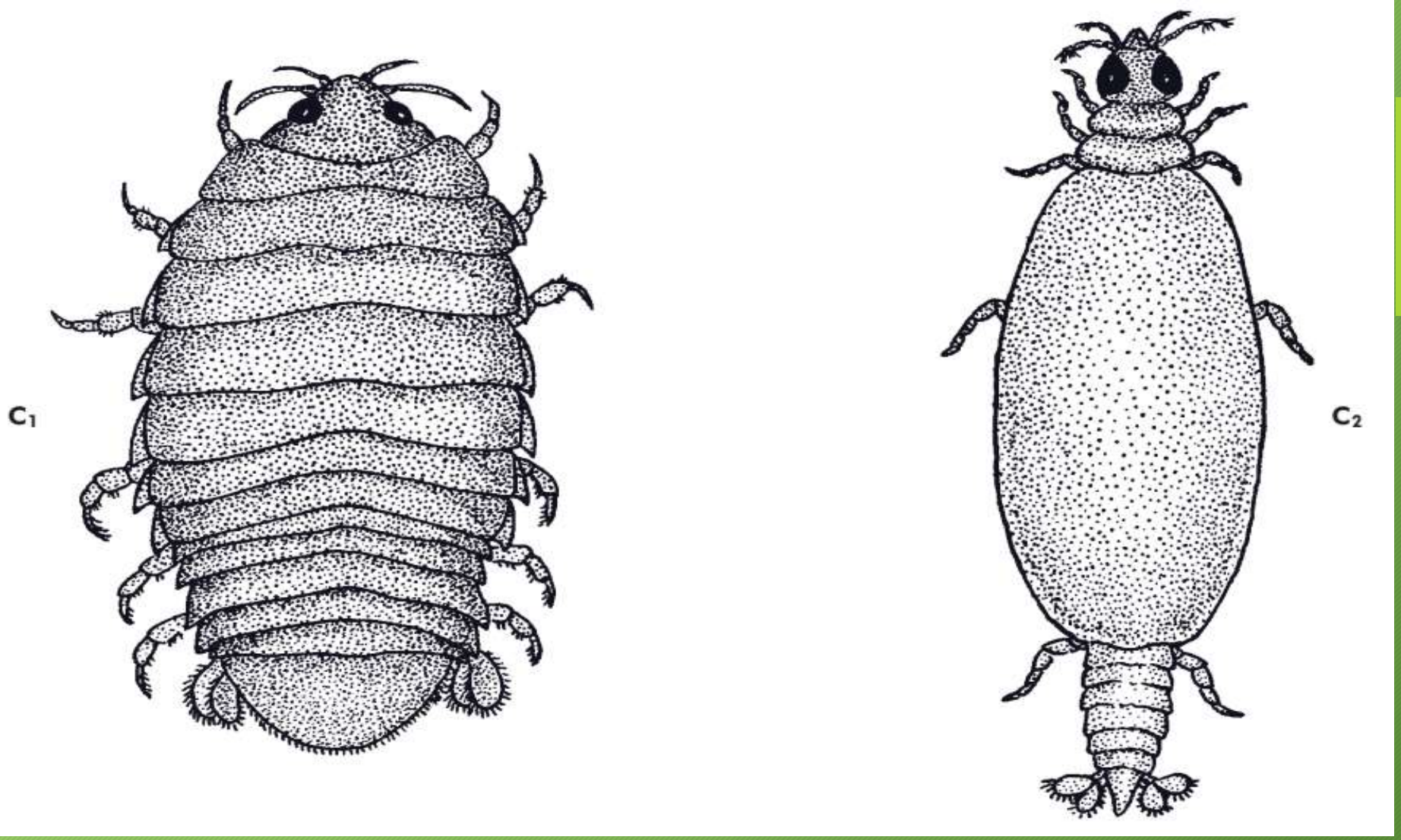


Fig. C. Diagram of **fish-parasitic isopods** showing the following diagnostic features: (1) **Flabelliferans—size** (**several mm to 6cm**), **body segmentation**, **chitinous plates over body segments**, and **paired, segmented appendages**;
(2) **Gnathiid**— **insect -like body**; **lack of segmentation** because of engorgement on **blood**. (A photograph courtesy of S. Spotte.)