3.2.13 Gill Maggot Disease (Genus *Salmincola*)

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A. Name of Disease and Etiological Agent

Gill maggot of salmon and trout is also called fish louse or gill louse.

1. *Salmincola salmoneus*

2. *Salmincola californiensis*
   Synonyms include: *Salmincola bicauliculata, Salmincola carpenteri,* and *Salmincola falculata*.

3. *Salmincola edwardsii*
   Synonyms include: *Lernaeopoda edwardsii, Lernaeopoda arcturi,* and *Salmincola exsanguinata*.

B. Known Geographical Range and Host Species of the Disease

1. Geographical Range
Circumpolar, occurring in freshwater habitats of the northern hemisphere.

a. *Salmincola salmoneus*
   Natural distribution straddles Atlantic Ocean and is found in North America and Europe.

b. *Salmincola californiensis*
   Natural distribution straddles Pacific Ocean and is found in North America and Asia.

c. *Salmincola edwardsii*
   Natural distribution includes eastern and central North America and Europe.

2. Host Species
Found in fish of the Family *Salmonidae*.

a. *Salmincola salmoneus*

Found in Atlantic salmon (*Salmo salar*).

b. *Salmincola californiensis*
Reported on coho salmon *Oncorhynchus kisutch*, sockeye salmon *Oncorhynchus nerka*, pink salmon *Oncorhynchus gorbuscha*, chum salmon *Oncorhynchus keta*, chinook salmon *Oncorhynchus tshawytscha*, rainbow trout *Oncorhynchus mykiss*, and cutthroat trout *Oncorhynchus clarki*. Also reported on dolly varden *Salvelinus malma*, lake trout *Salvelinus namaycush*, and mountain whitefish *Prosopium williamsoni*.

c. *Salmincola edwardsii*
Reported on brook trout *Salvelinus fontinalis*, arctic char *Salvelinus alpinus*, lake trout *Salvelinus namaycush*, and dolly varden *Salvelinus malma*. Also reported on mountain whitefish *Prosopium williamsoni*. Fingerlings of Atlantic salmon *Salmo salar*, brown trout *Salmo trutta*, and rainbow trout *Oncorhynchus mykiss* have been experimentally infected but the copepods were unable to survive and develop to maturity (D. C. Conley, unpublished data).

C. Epizootiology

Infections leading to epizootics may occur when unfiltered surface waters containing infected fish are used for fish culture or when infected fish are concentrated into high densities. Temperature and intensity of infection are directly related such that higher temperatures accelerate egg development and shorten the generation time. Heavy infections usually occur in mid to late summer and result in impaired respiration and host mortality.

D. Disease Signs

1. Behavioral Changes Associated with the Disease

No particular signs in light to moderate infections (i.e. adults on mature fish). Heavily infected fish will "flash" or jump, trying to rid themselves of the parasite. Rubbing along the surfaces of solid objects, such as the sides and bottom of tanks, is common; frayed or completely eroded fins may be observed. Fish may become darker and stay near the surface or congregate near inlets, outlets, or aeration devices, especially when water temperatures rise above optimal ranges. Rate of opercular movement may increase, accompanied by flaring of the opercula, and fish may exhibit fatigue in swiftly flowing waters. Fish may also go off their feed and become listless or solitary. Culture tanks may develop a scum on the surface due to excessive production of fish mucus. Salinity tolerance is reduced, and mortality may occur following transfer of infected fish to salt water.

2. External Gross Signs

Adult females (Figure 3) are conspicuous and readily observed on the gills and fins of hosts. They are pale yellowish, normally with two egg sacs dangling from the trunk or posterior region. Egg sacs of adults attached to gill filaments may be observed streaming from behind gill covers. Adult size ranges from 2.5 to 8 mm total length, depending on species and age. The infective copepodid stage (Figure 1) and juvenile stages (chalimus I-IV; Figure 2) range between 0.5 and 1.5 mm in size and may be detected by using a dissecting microscope. Secondary bacterial and fungal infections are sometimes present.

3. Internal Gross Signs

None reported.

4. **Histopathological Changes Associated with the Disease**
   The bulla or frontal filament and feeding of the copepod elicit an epithelial hyperplasia at the site of attachment. Hypertrophy of gill epithelium tissue leads to fusion of adjacent lamellae and gill filaments. Hemorrhages and/or "blood blisters" may occur near the site of attachment, which may lead to anemia in severe infections. Infected gill filaments become pale and swollen or "clubbed" in appearance. The gills become mucous coated and ragged looking or "crypted" due to atrophy or growth inhibition of affected filaments. Respiration, excretion, and osmoregulation may be impaired.

E. Disease Diagnostic Procedures

1. **Presumptive Diagnosis**
   Presence of adult female copepods and/or juvenile stages on gills, in gill chambers, and on fins and skin of the hosts.

2. **Confirmatory Diagnosis**
   Salmincola can be identified using fish disease texts with good illustrative drawings and photos (e.g. Kabata 1988). For expert diagnosis to the species level, remove the copepods from fish and place in a glass or plastic vial with 70% alcohol or 5% formalin and forward to a fish parasitologist.

F. Procedures for Detecting Subclinical Infections

Sampling of fish populations or lots using a sample size adequate to detect a 5% level of prevalence (see Ossiander and Wedemeyer 1973). The infective stage (copepodid) and juvenile stages (chalimus I-IV) may be detected by using a dissecting microscope with objectives 6 to 12X.

G. Procedures for Determining Prior Exposure to the Etiological Agent

Removal of the operculum and examination of gill filaments using a dissecting microscope may reveal tissue damage or crypting due to previous infections. Frontal filaments (of juveniles) and bullae (of adults) may sometimes be distinguished from surrounding tissue. Gill tissues may recover after a light to moderate infection thus obscuring signs of a prior infection. There are no serological tests available at this time to determine prior exposure.

H. Procedures for Transportation and Storage of Samples to Ensure Maximum Viability and Survival of the Etiological Agent

Live or fresh fish (on wet ice) are preferred. If transport of whole fish is inconvenient, use forceps to remove the adults from infected gills, fins, or skin, and place the copepods in cold water in a plastic bag or suitable container and ship on wet ice. The copepods may live up to several days when kept cold.

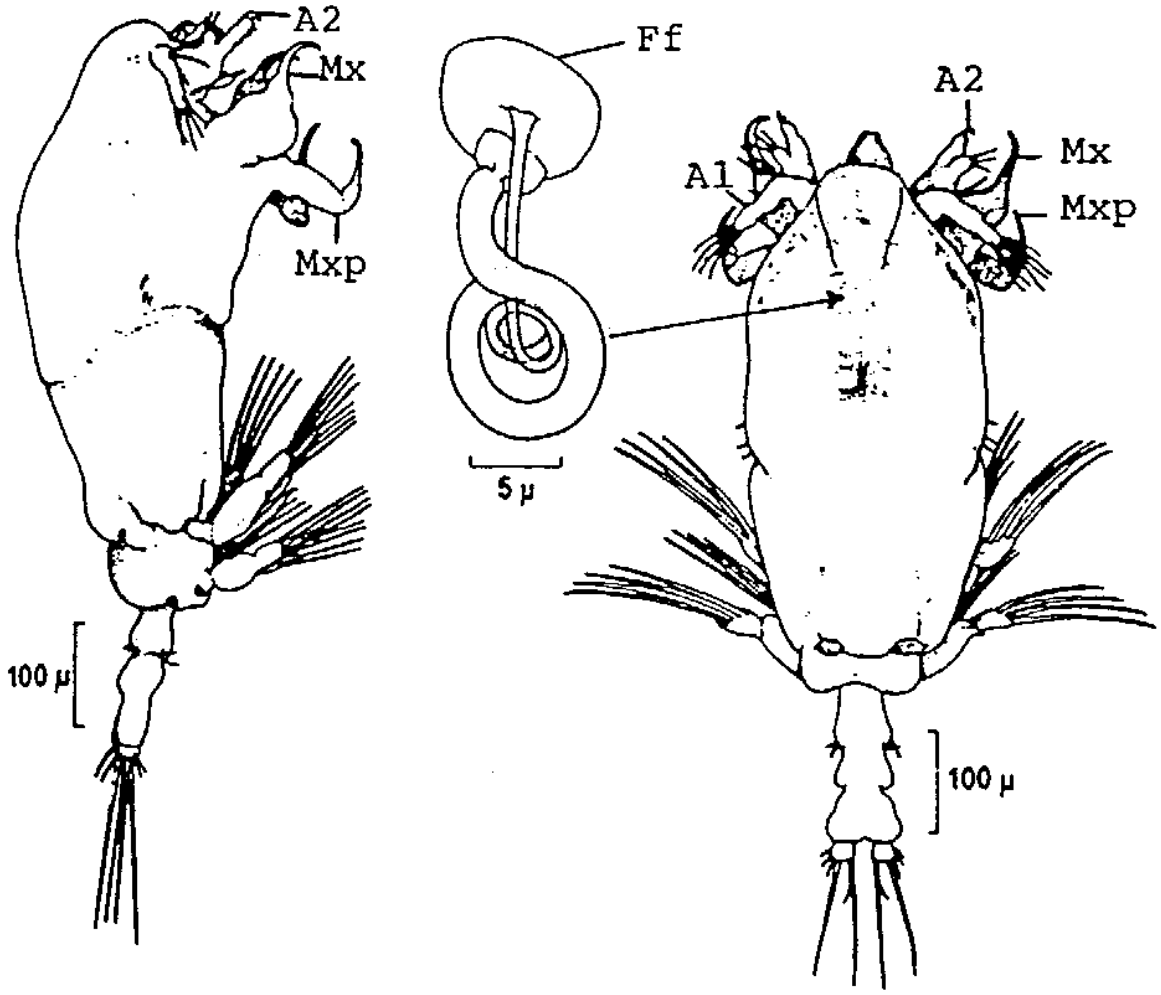

Figure 1. *Salmincola*, copepodid (infective stage). A1 - antennule. A2 - antenna. Mx – Maxilla. Mxp – maxilliped. Ff – frontal filament. (From Kabata and Cousins 1973).

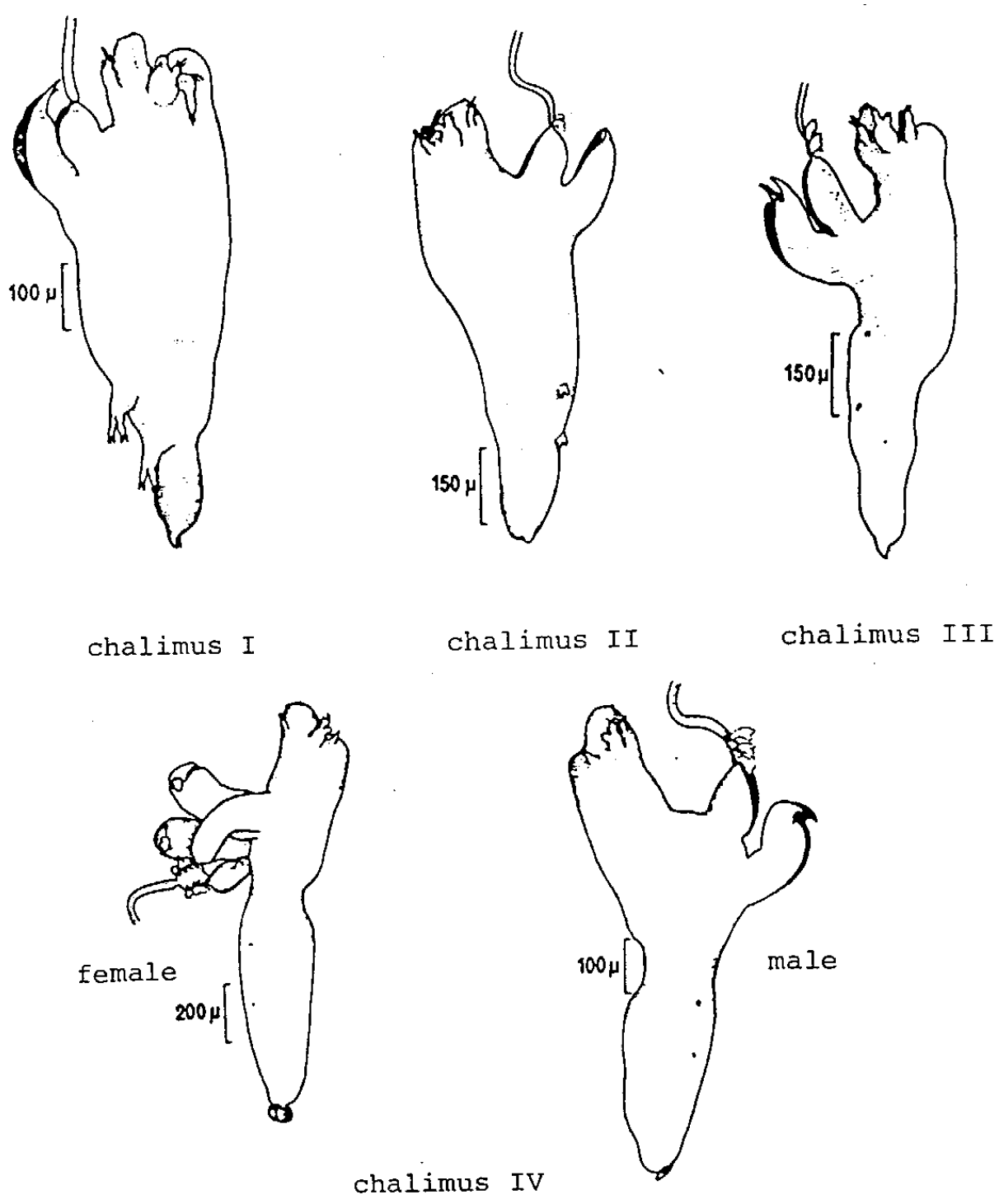

Figure 2. *Salmincola*, chalimus stages (attached by frontal filament). (From Kabata and cousins 1973).

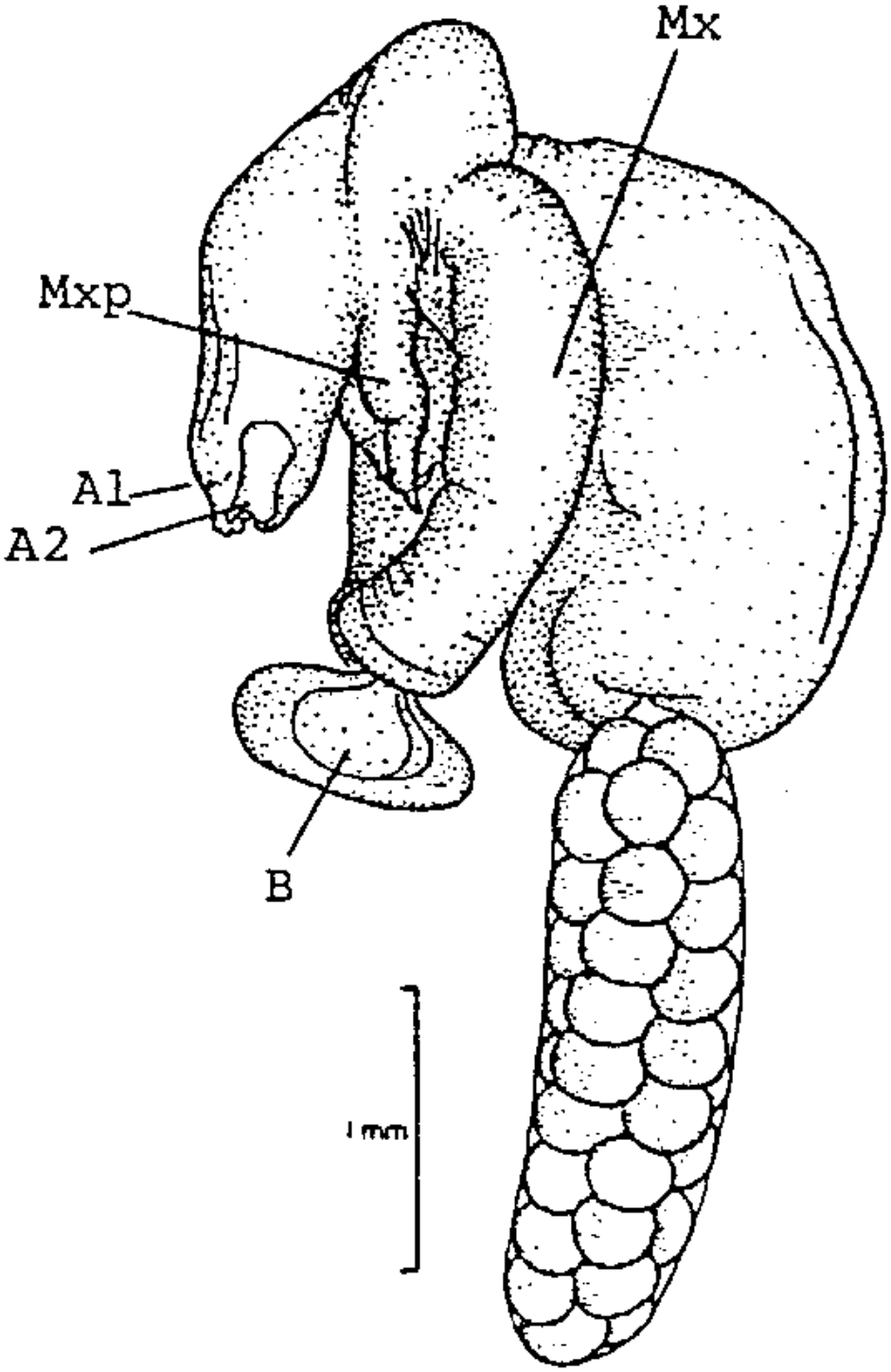

Figure 3. Salmincola, adult female. A1 – antenna. Mx – maxilla. Mxp – maxilliped. B – bulla. (From G. Fryer 1981).

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