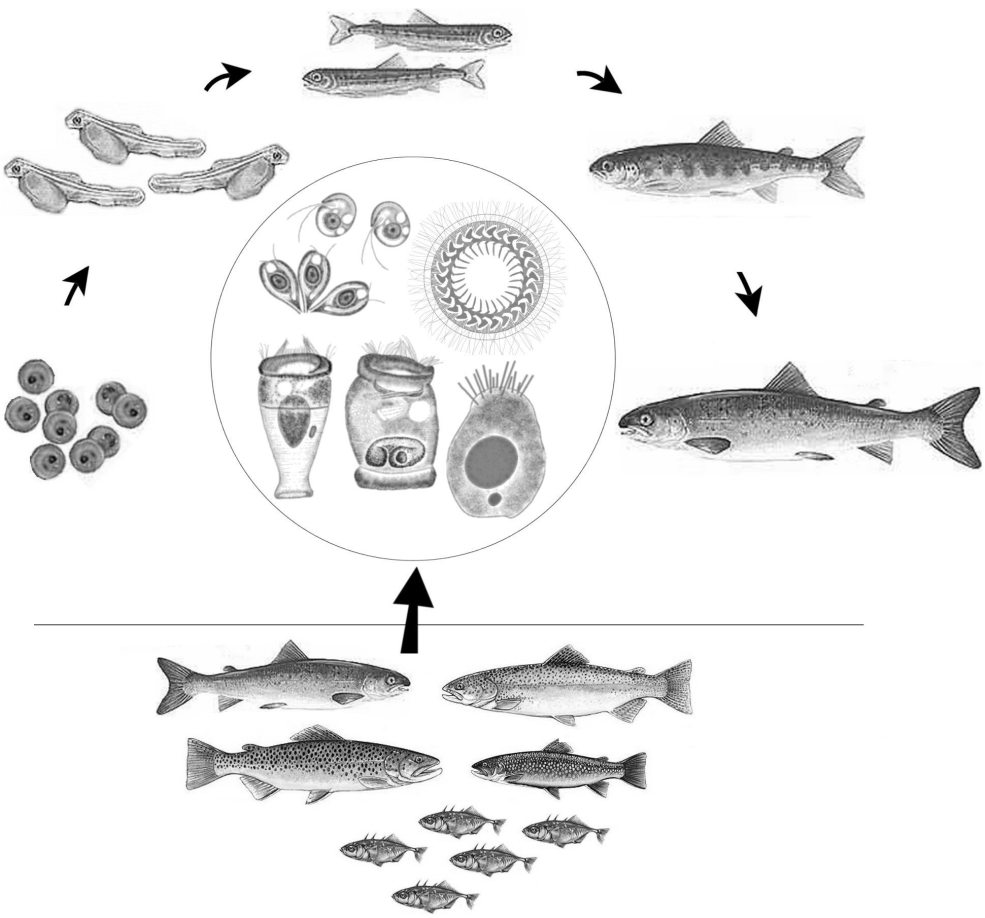
Protozoan ectosymbionts on Atlantic salmon (*Salmo salar* L.) in a hatchery in Hordaland, western Norway: Morphology and epizootiology



Thesis in fish health for the degree of *Candidatus scientiarum*

Trond Einar Isaksen

Department of Fisheries and Marine Biology
University of Bergen, Norway
December 2003

Acknowledgements

I am deeply grateful to Sævareid Fiskeanlegg A/S for providing the salmon and laboratory facilities, and to all the employees at this fish farm for good advice and consultations on accomplishment of the experimental set up.

For guidance, help and support under all parts of this work, I am very thankful to my advisors professor Are Nylund and Egil Karlsbakk at the Department of Fisheries and Marine Biology, University of Bergen. I am especially grateful to Are Nylund, Egil Karlsbakk, and Heidrun Plarre for constructive comments on the manuscript, and to Egil Karlsbakk for all the help and advises regarding statistic methods and aspects of parasitology.

I would like to thank my fellow student Glenn Sundnes for excellent collaboration in sampling and measurements of the fish during this study, and I am grateful to Gro Anita Fonnes for assistance and consultative issues regarding bacteria counts with the use of the DAPI method.

Thanks to Jan Arvid Todal for the co-operation regarding works in the morphology of *Ichthyobodo*, and to Kuninori Watanabe for assistance with the use of scanning electron microscopy. I am also grateful to the excellent anglers Frode Fridell and Per Kjetil Fanavoll for their assistance in catching wild fish.

And last but not least, I would like to thank Vibeke and our children, Roald and Malene, for all the patience, support and encouragement during my thesis work.

Bergen, December 2003 Trond Einar Isaksen

Table of contents

ABSTRACT

Protozoan ectosymbionts are commonly found on salmonids in Norwegian lakes and rivers. Salmon in hatcheries supplied with water from such watercourses are often infected with such organisms. Despite extensive salmon production, little is known about the infection dynamics of these symbionts on hatchery-reared salmon in Norway. The aim of this work was to study this in a fish farm located in Hordaland, western Norway.

Eyed eggs, alevins, fry, parr and pre-smolt were collected approximately bi-weekly in the period January - November, year 2000 (n=2106). In addition, a total of 131 wild fish (salmon, brown trout, rainbow trout, charr and sticklebacks) were caught in the watercourse serving as a water supply to the hatchery, and examined for protozoan ectosymbionts.

Five genera of protozoan symbionts were observed on the skin or gills of the farmed salmon.

Ichthyobodo sp. (likely *Ichthyobodo necator* (Henneguy, 1883)) occurred on skin and gills of the farmed salmon. Infections occurred on fry in March (maximum prevalence of infection 38 %), parr in August (23 %) and parr/pre-smolt in September (54 %).

Trichodina sp. (likely *T. kamchatika* Konovalov, Shevlyakov et Krasin, 1970) occurred at low density on the skin of the farmed salmon. It was detected in June (18 %) and again in September-November (4 %).

The most commonly observed symbionts were the sessiline peritrich ciliates, *Apiosoma piscicola* (Blanchard, 1885) and *Riboscyphidia* sp. (Pickering, Strong et Pollard, 1985), which occurred on the skin (rarely gills), and the suctorian ciliate *Capriniana piscium* (Bütschli, 1889) that infected the gill lamella (rarely skin). Heavy infections with these ciliates occurred in July, with prevalence of infections equal or close to 100%. *Apiosoma* infections declined markedly in mid-August, coinciding with an increase in the intensity of *Riboscyphidia* infection that stayed high during autumn (September-November).

Wild salmonids are probably the most important source of ciliate infections to the farmed salmon, while sticklebacks appear to be a reservoir host of *Ichthyobodo*.

No significant mortalities could be ascribed to any of the detected symbionts. Clinical signs like “flashing” and greyish mucus on the body surface were mostly observed among the parr and pre-smolt in the periods when heavy infections of *Ichthyobodo* and *Riboscyphidia* occurred. In addition, *Ichthyobodo* infections were associated with small skin ulcers and areas of scale loss, and correlated negatively with host condition and hematocrit.

The sessilines and *Capriniana piscium* seem to be harmless commensals, and may be useful indicators of aspects pertaining to water quality.

INTRODUCTION

A range of different ectoparasites may cause severe damages to fish cultured in tanks or net pens. Wild fish in lakes and rivers are known to serve as reservoirs of symbionts, infecting salmonids in hatcheries supplied with water from such watercourses (Wootten & Smith 1980, Bristow 1993a, 1993b, Rintamaki-Kinnunen 1997). The most common protozoan ectosymbionts known from wild and cultured salmonids in freshwater in Norway are flagellates belonging to genus *Ichthyobodo* and the ciliates of the genera *Trichodina, Apiosoma, Epistylis, Riboscyphidia, Chilodonella,* and *Capriniana* (Bristow 1993b, Karlsbakk *et al.* 1999, Sterud 1999, Larsen & Lund 2000). Some species in these genera have been reported as disease agents of salmonid fishes. Among well-known protozoan pathogens is the flagellate *Ichthyobodo necator* (Henneguy, 1883) that is associated with disease and mortalities of juvenile salmonids world wide (Robertson 1979, Wood 1979, Ocvirk & Bravnicar 1985, Castillo *et al.* 1991, Rintamaki-Kinnunen & Valtonen 1997). Also ciliates like *Trichodina* spp. (Richardson 1937/38, Pottinger *et al.* 1984, Urawa 1992c, Bristow 1993b), *Apiosoma* sp. (Bristow 1993b), *Riboscyphidia* sp. (Pottinger *et al*. 1984), *Chilodonella hexasticha* (Rintamaki-Kinnunen & Valtonen 1997) and *Capriniana piscium* (Bristow, 1993b) that have been reported as harmful to salmonids in freshwater.

In the wild, the fish may avoid these potential pathogens by modifying behaviour, but under cultured conditions the host is left to rely upon the immune defence system. Epidermal structure and function change during the salmon life cycle from juvenile stages till sexual maturation in freshwater and sea (Pickering & Richards 1980). The epidermis and its mucus form a physical and chemical barrier between the fish and the external environment. The mucus that coats a fish contains various chemical substances that discourage invaders of skin and gill (Buchmann & Bresciani 1998). In addition, mucus are continually sloughed off and renewed making it difficult for many parasites to establish and proliferate (Robertson *et al.* 1981).

Stress may reduce the immunocompetence of the fish (Patino *et al.* 1986, Barton & Iwama 1991), hence increase the susceptibility to infectious diseases (Meyer 1970, Snieszko 1974, Pickering 1992). Certain protozoan parasites often cause more damage to hosts that are stressed (MacMillan 1991, Heckmann 1996). In Atlantic salmon parr, mixed infection with *Apiosoma* sp. and *Chilodonella cyprini* caused mortality only when the hosts were stressed (Bristow, 1993b).

High stocking density may induce low levels of dissolved oxygen that is stressfull to fish (Urawa 1995, Eklöv *et al.* 1999). Further more, an increased release of metabolic products (faeces and excretions) cause deterioration of the water quality, notably ammonia, nitrites and carbondioxide that can accumulate to toxic levels and give increased oxygen demand (Snieszko 1974, Noble & Summerfelt 1996). Also, crowding may increase the exposure to infective disease agents and directly cause stress to the fish (Rogers & Gaines 1975, Woo 1994). Outbreaks of diseases are likely to take place if stress coincides with the presence of pathogens, and the danger of such outbreaks is proportional to crowding (Snieszko 1974). The environment is of vital importance in the spread of diseases and maintaining a good water quality in a fish farm may be one of the best prophylactic efforts in keeping the fish healthy (Fig. 1).

The environment in ponds or tanks is continuously affected with faeces, uneaten food and other detritus. Dead fish may act as pollutants and as a source of infection if not removed. High levels of organic matter or concentrations of bacteria in the water are biotic factors that cause some microparasites, such as ciliates that feed on bacteria, to flourish. Hence, positive correlations between the level of organic matter in the water and intensity of infection with ciliates on fish have been reported (Wood 1979, Madsen *et al.* 2000a).

Abiotic factors like water temperature and pH (and inorganic contents) affects the metabolic rate and the immune responses of the fish (McLeay & Gordon 1977, Pickering 1992). In addition to influencing the host immunocompetence, water temperature may also affect growth and proliferation of pathogens and parasites (Mo 1992, Appleby & Mo 1997, Buchmann & Bresciani 1997, Rintamaki-Kinnunen & Valtonen 1997, Schisler *et al.* 1999).

Handling of the fish, such as grading and vaccination, are common stress factors in a hatchery. Barton (1991) listed handling to be the condition, among other stressors, that evokes highest elevations in plasma epinephrine concentrations (hormonal response to stress) in rainbow trout.

Fish recovered from protozoan infection are often resistant to subsequent challenges (Woo 1997). Susceptibility to parasites and immunocompetence varies between fish species, age and maturation. Young fish seems to be more vulnerable than older fish with respect to susceptibility to disease agents, and some fish species are more likely to be infected than others (Robertson 1979, Wood 1979, Pickering *et al.* 1985, Castillo *et al.* 1991, Rintamaki-Kinnunen 1997, Zapata *et al.* 1997).

Studies of protozoan ectosymbionts on cultured salmonids in freshwater over extended time periods have been done in Canada (Hare & Frantsi 1974), Scotland (Robertson 1979, Wootten

& Smith 1980), England (Poynton & Bennett 1985), Finland (Valtonen & Koskivaara 1994, Rintamaki-Kinnunen & Valtonen 1997), and Denmark (Buchmann *et al.* 1995, Buchmann & Bresciani 1997). Despite the extensive production, little is known about the infection dynamics of these symbionts on hatchery-reared salmon in Norway.

The purpose of this study was to examine the acquisition of ectoprotozoans on juvenile salmon throughout the freshwater phase from eyed eggs and hatching to parr and pre-smolt under standard rearing conditions.

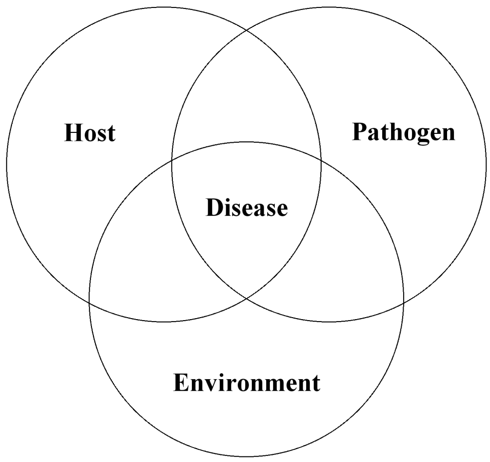


Figure 1 Diseases occur if there is a sufficient relationship between the host, pathogen and environmental condition (Snieszko 1974).

The principal questions raised are:

- Which ectosymbionts occur and what is the source of infection?
- When do the symbionts occur on the host (at which fish age/size and period of the year)?
- Why do the symbionts occur when they do and what problems are they able to cause?

MATERIAL AND METHODS

LOCATION

Protozoan ectosymbionts on juvenile Atlantic salmon (*Salmo salar* L.) were examined at a hatchery in Hordaland, Western Norway. The hatchery is located in Sævareid (Fig. 2) and supplied with water from Lake Henangervatn (2.63 km^2), which is part of the Sævareid watercourse (125 km^2). This fish farm also rears fish in net pens (Fig. 2) in Lake Skogseidvatn (5.28 km^2), which is part of the same watercourse.

The salmon production capacity of this farm was 3 500 000 – 4 000 000 smolt a year when this study was done, and the amount of water required for the tank-reared fish was 300 000 – 500 000 litres/minute.

At the end of Lake Henangervatn, by the hatchery, there is a short river stretch between the watercourse and the sea, including a waterfall (dam) preventing wild salmonids entering from the sea.

Wild and feral fishes known from these lakes are Atlantic salmon (*Salmo salar* L.), brown trout (*Salmo trutta* L.), rainbow trout (*Oncorhynchus mykiss* Walbaum), Arctic charr (*Salvelinus alpinus* L.), three-spined stickleback (*Gasterosteus aculeatus* L.), and eel (*Anguilla anguilla* L.).

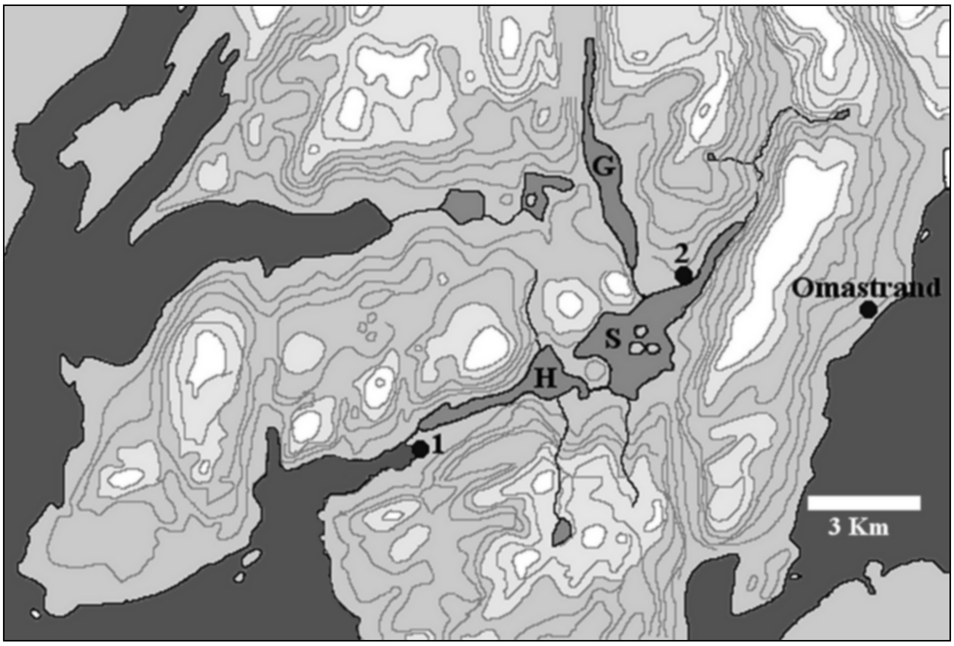


Figure 2 Map of collection localities for farmed and wild fish. The watercourse consists of three large lakes: Lake Gjønavatn (G) is located at the highest altitude, connected to Lake Skogseidvatn (S) in the middle and Lake Henangervatn (H) at the end. The local meteorological metering station is placed in Omastrand. **1.** Location of the hatchery where most of the fish are reared. **2.** Location of the fish pens belonging to this hatchery.

FACILITIES FOR THE STUDY

All aspects regarding rearing of fish were routinely carried out by the employees at the fish farm, who also participated in practical and consultative issues for the accomplishment of the study.

Salmon collected in the period February to August (2000) were studied freshly killed in a laboratory at the hatchery, while eyed eggs in January and pre-smolt in September and November (2000) were transported alive to the University of Bergen (Department of Fisheries and Marine Biology) and examined, following the same procedures as at the hatchery. The travelling time between the hatchery and the University is maximum 3 hours by car.

STUDY LAYOUT AND REARING CONDITIONS

The aim of this study was to examine acquisition and accumulation of protozoan ectosymbionts on salmon that were routinely reared in the hatchery. Figure 3 summarises the layout of this study with emphasis on handling of the fish. One cohort of fish (i.e. an age group; those individuals of a stock hatched in the same spawning season) of the same breeding stock was chosen for this study, to avoid possible inherited variations in susceptibility to infections.

The eggs and hatchery-reared fish examined in the period from January to mid-August were reared in fibreglass tanks (hatching trough, tank A, B1-B2 and C1-C4), while salmon examined in September and November were collected from a net pen (P). The latter fish were transferred from the hatchery on July 1st for further rearing in Lake Skogseidvatn (Fig. 2).

The fish were fed on commercial pelleted food from automatic feeders. The fish were sorted by size (grading) as they grow, and the pellet size adjusted accordingly. Dead fish (if any) were counted and removed as a daily routine. Overcrowding was avoided by transferring the fish of a densely populated tank into two new tanks (thinning, events shown in Fig. 3). Fish in the control tanks (tank C1 – C4) were not exposed to grading and thinning.

Precipitation and air temperature were obtained from the Norwegian Meteorological Institute, which daily logged climatic data for the region at a local weather station in Omastrand (Fig. 2). These parameters affect water-temperature and pH values in the water source of the hatchery, and thereby affecting the waterquality and rearing conditions in the hatchery. The employees at the fish farm routinely logged watertemperature, pH and oxygen. The oxygen level in the water was regarded as acceptable with a saturation of 85%, and any necessary adjustments in this matter were done by regulating the water flow into the tanks, or by adding oxygen (g) to the inlet water.

The inlet water (from Lake Henangervatn) was filtered before entering the tanks in the first period (January till mid-April), using filters with 60 µm pore size (UNIK-filter) and 40 µm pore size (Hydrotech-filter) for the sections of the hatchery that contained the control tanks (C1 and C2) and the main tank (A), respectively. The filters were used in order to avoid tapeworm-infected zooplankton (copepods) entering the fish tanks.

The fish were also routinely treated for protozoan parasites by adding a 35% solution of formaldehyde (equal to 100% formalin) at a ratio of 1:4000 directly to the water in the fish tanks. The formalin is diluted over time due to the water flow rate in the tanks, with a half-life ($t_{1/2}$) of approximately 25 minutes in the tanks. In this study, only tank A was treated with formalin. The first treatment of the fish in this tank was done on March 10th, and again during summer on June 16th, July 21st and August 1st.

Fish in tank B2 were light-manipulated in the period July 3rd to August 7th with an artificial light regime of 12 hours light (day) and 12 hours dark (night) on the first day, which was followed by increasing the day length with 20 minutes each day until 24 hours light. All other fish in this study were reared in a 24-hour light regime.

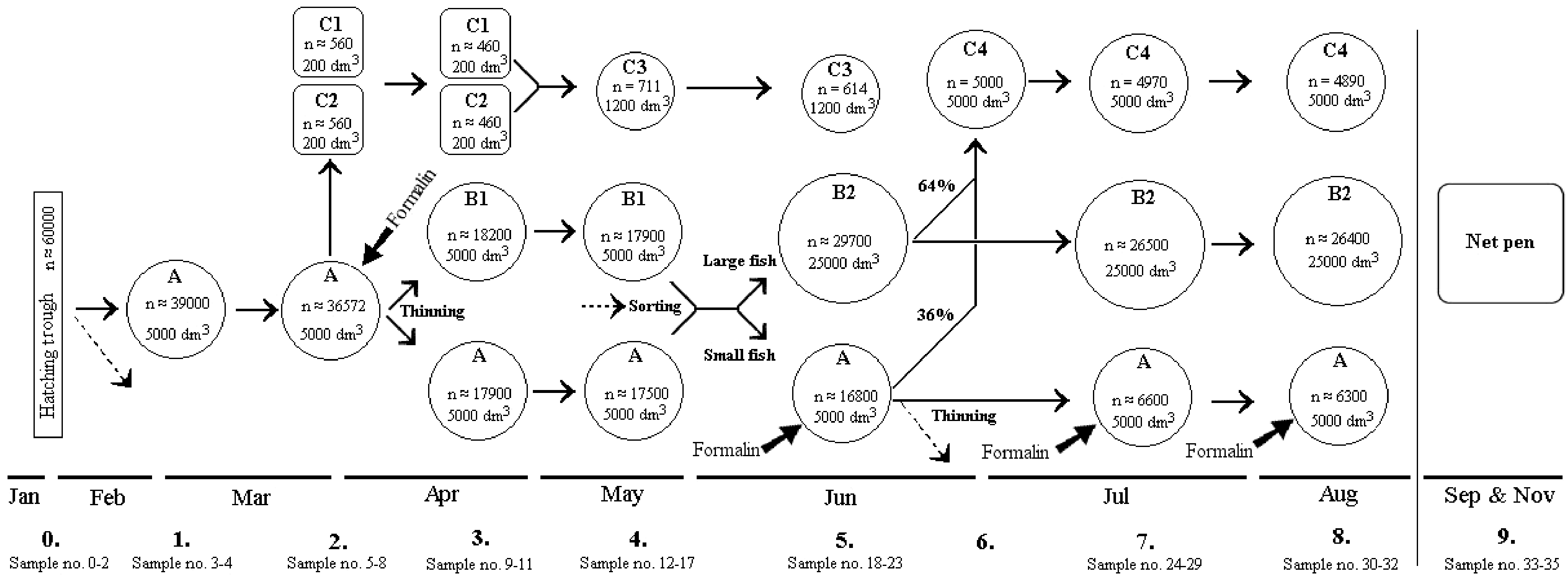


Figure 3 Study set up. Sizes of fish tanks (A, B and C) are given in volumes (dm^3), and total numbers of fish (n) in the tanks are estimated after last sampling taken in each event. Formalin treatment against ectoparasites was only used on fish in tank A. Arrows with dotted line marks transfers of salmon origin from the same hatching trough, which followed a parallel production line in the hatchery. Events during the study period are numbered 0-9 with sample numbers given for each event.

0. Incubation of eggs and hatching in a hatching-trough (January-February). **1.** Commencement of first feeding (February-April). **2.** Two small groups of fish (C1 and C2) separated from tank A (March 10th) for further rearing without chemical treatment and with a minimum of handling (grading and transfer). First formalin treatment of the fish reared in tank A (March 10th). **3.** Approximately half of the fish in tank A were transferred to a new tank (tank B1) to avoid overcrowding (April 24th). **4.** Fish from tank C1 and C2 gathered in one tank (tank C3) for more practical rearing (May 11th). **5.** Fish from tank A and B1 were mixed and sorted by size (June 14th) whereafter the larger fish were reared in tank B2 and the smaller in tank A. **6.** Second treatment of the fish reared in tank A (June 16th). Termination of tank C3 June 30th due to an accident. A new tank (C4) was immediately set up with a representative number of fish from tank A and B2. **7.** Approximately half of the population in tank A was transferred to a new tank (not marked in the figure) to reduce the rearing density (July 17th). The third formalin treatments of the fish in tank A (July 21st) **8.** The fourth and last treatment of the fish in tank A (August 01st). The last samples (no. 30-32) of salmon from the fibreglass tanks were collected August 18-19th. **9**. Samples from the net pen harbouring salmon originating from the same breeding stock and cohort as those from the tanks.

HOSTS AND SAMPLING PERIOD

All farmed fish (tank- and pen reared) examined originated from the hatchery. A total of 2106 salmon at various stages of development (eyed eggs, yolk sac larvae, fry, parr and pre-smolt) were examined from hatching in January to pre-smolt in November (year 2000). The salmon were collected approximately bi-weekly from tanks in the hatchery, and eventually net pens in Lake Skogseidvatn (Tab. 1). A few rainbow trout reared in this hatchery were also examined. Skin smears from *Ichthyobodo* infected rainbow trout were taken in August (2000) for morphological study of the flagellates (Tab. 4).

Five species and a total of 131 individuals of wild fish were caught in Sævareid watercourse in the period 26.03.00 – 12.06.01 (Tab. 2), and examined for protozoan ectosymbionts in the same way as the farmed fish. Salmon and rainbow trout are escapees from lake-pens (feral species), while brown trout, charr and stickleback are native species.

Staging system of the examined salmon

Eyed-egg stage: Late stages in development of the fertilised egg with a distinctive eye visible through the eggshell.

Yolk sac larvae (alevins): First stage after hatching. These salmon larvae dwell on the bottom, feeding from the attached yolk sac only (endogenous feeding). Fish weight ca. 0.2 g.

Fry: “First-feeders”. When most of the yolk sac is absorbed, the alevin lift from the bottom of the hatching trough and are dependent on exogenous feeding to survive. This first-feeding period lasts until the fish show a marked increase in weight. “Parr marks” (dark vertical bars) become visible at this stage. Fish weights ranging from 0.2 to ca.1.0 g.

Parr: The parr marks (8-10 vertical bars) are clearly visible. Fish weights ranging from 1.0 to maximum of ca. 50 g.

Pre-smolt: The parr marks disappear and are replaced by a silvery sheen. In this study, the salmon are defined as pre-smolt when parr marks are absent and/or the fish is larger than 50 g in weight.

Table 1 Sampling of hatchery/net pen reared salmon. Eyed eggs and yolk-sac larvae were reared in hatching trough (T), salmons in the period from commencement of first feeding (fry) in late February to parr and pre-smolt in August were reared in tanks (A, B1-B2 and C1-C4) while the last three samples of salmon were taken from a net pen (P). Sample numbers (0-35) are given in parentheses. All fish are from the same cohort of year 2000.

Date	Stages in life of salmon	Numbers of fish examined (Sample no.)								Total
		T	A	B1	B2	C1 & C2	C3	C4	P	
10 January	Eyed eggs	43 (0)	-	-	-	-	-	-	-	43
29 January	Yolk sac larvae	100 (1)	-	-	-	-	-	-	-	100
11 February	Yolk sac larvae	100 (2)	-	-	-	-	-	-	-	100
26 February	Fry	-	100 (3)	-	-	-	-	-	-	100
9 March	Fry	-	60 (4)	-	-	-	-	-	-	60
24-25 March	Fry/Parr	-	100 (5)	-	-	100 (6)	-	-	-	200
7-8 April	Parr	-	100 (7)	-	-	100 (8)	-	-	-	200
25-27 April	Parr	-	50 (9)	50 (10)	-	100 (11)	-	-	-	200
11-14 May	Parr	-	50 (12)	62 (13)	-	-	100 (14)	-	-	212
29-30 May	Parr	-	50 (15)	51 (16)	-	-	60 (17)	-	-	161
14-15 June	Parr	-	36 (18)	-	64 (19)	-	60 (20)	-	-	160
29 June - 1 July	Parr	-	36 (21)	-	64 (22)	-	35 (23)	-	-	135
17-20 July	Parr	-	30 (24)	-	31 (25)	-	-	30 (26)	-	91
29-31 July	Parr	-	36 (27)	-	30 (28)	-	-	39 (29)	-	105
18-19 August	Parr/pre-smolt	-	56 (30)	-	17 (31)	-	-	39 (32)	-	112
7 September	Parr/pre-smolt	-	-	-	-	-	-	-	46 (33)	46
28 September	Parr/pre-smolt	-	-	-	-	-	-	-	41 (34)	41
3 November	Pre-smolt	-	-	-	-	-	-	-	40 (35)	40
Total sum		243	704	163	206	300	255	108	127	2106

Table 2 Wild fish caught in Lake Henangervatn and Lake Skogseidvatn*. Numbers and size range (cm) of fish examined are given. The fish were caught by net, except salmonids in 2001 that were caught by angling and the three-spined sticklebacks that were caught by traps.

Date	Salmon *Salmo salar*	Brown trout *Salmo trutta*	Rainbow trout *Oncorhynchus mykiss*	Charr *Salvelinus alpinus*	Stickleback *Gasterosteus aculeatus*	Total
26 March (2000)	10 (24-31cm)	11 (24-29cm)	10 (22-26cm)	2 (25-28cm)	-	33
08 April (2000)	18 (23-32cm)	3 (26-27cm)	4 (21-27cm)	4 (27-30cm)	-	29
*03 November (2000)	-	-	-	-	10 (length not measured)	10
01 June (2001)	-	10 (21-35cm)	1 (28.6cm)	-	31 (3-5cm)	42
12 June (2001)	-	5 (25-31cm)	-	-	-	5
18 October (2001)	5 (19-28cm)	3 (18-30cm)	1 (23.0cm)	-	3 (3-4cm)	12
Total sum	33	32	16	6	44	131

SAMPLING PROCEDURES

Farmed fish

Eyed eggs were sampled from a hatching-trough in the hatchery and transported to the University of Bergen in a thermo-isolated plastic bottle (1litre) filled with water from the same tray. Fish sampled in September and November from the net pen were transported in plastic bags filled with water (approximately 1/3). Remaining air in these bags was replaced with oxygen before transportation. All other farmed salmon examined were collected with a landing net, few fish at a time, from the pre-selected tanks (tank A, B and C). The fish were placed in a water-filled bucket and carried to the laboratory at the fish farm.

The fish were euthanized (one by one) with benzocaine before being examined. Benzocaine (10% w/v in 96% ethanol) was diluted with water to a concentration of 3‰, which was sufficient to paralyse the fish within 30 seconds. This concentration did not detectably affect the symbionts.

The fish weight and total length was measured, and blood samples were drawn from the caudal blood vessels using a syringe or by cutting off the tail (small fish). The blood was collected in heparinized microhematocrit tubes and centrifuged (12 000 rpm, 5 min at room temperature) using a microhematocrit centrifuge (Sigma 201m). The hematocrit levels (Hct), was determined with the use of a hematocrit reader.

Skin sample

Skin scrapings were taken with a cover slip (18 x 18mm), and examined with a light microscope (Leitz Laborlux 12). These were taken from the left side of the fish only. Skin scrapings from yolk sac larvae and fry were taken from the whole body length along the lateral line except head and caudal fin, while skin scrapings of larger fish (>10 grams) were taken along the lateral line of the fish from the basis of the pectoral fin to the anterior part of the dorsal fin. Protozoans observed in these fresh smears were identified at least to genus level. Prevalence of infection is used according to Bush *et al*. (1997). Intensities of *Ichthyobodo*-infections were categorised on a scale from 1-3, where "1" is slight infection, "2" is moderate and "3" is heavy infection. Infections were regarded as "slight" when less than 10 *Ichthyobodo* cells were observed in the smear, 10-50 as "moderate", and >50 as heavy infection. Ciliate intensities were ranked in a similar way: Slight (1) <10, moderate (2) 10-30, and heavy (3) >30.

Gill samples

Primary filaments from the 2^{nd} gill arch were removed from the left side of each fish, mounted on a microscope slide, and examined with 250X and 400X magnification for presence or absence of protozoans in the same way as for the skin.

Protozoans were quantified by counting the total number (or an estimate in the same way as for the skin) on 5 randomly chosen primary filaments from the arch, and the mean number of protozoans per filament was calculated. Intensities of *Ichthyobodo*-infection were categorised in the same way as for the skin, while ciliate intensities were ranked as slight with <5 per primary filament, moderate 5-20 per filament, and heavy >20 per filament.

Wild fish

Salmonids were caught by angling and net fishing in Lake Henangervatn, while the sticklebacks were caught in traps in Lake Henangervatn and Lake Skogseidvatn (from the same watercourse)(Tab. 2). Samples from skin and gills of the wild fish were taken in the same way as for the farmed salmon.

The salmonids were killed in the field by a sharp blow to the head. Smears from skin and gills were then prepared, air-dried and later examined as stained smears.

The sticklebacks were transported to the laboratory at the University (max. 3 h) where the fish were euthanized with benzocaine and examined in the same way as the farmed salmon at the hatchery.

Water

Water samples for bacterial counts were taken at the water-inlet of the fish farm in Lake Henangervatn. Sterile tubules (2 x 50 ml) were opened and filled with water ca. 30 cm below the surface. Samples were also taken, in the same way, from the fish tanks and by the net pens.

Water samples were taken in the period March – September on the same sampling-dates as the farmed salmon (Tab. 1), preserved with 5% formalin and stored in a fridge (5 °C). Processing of the bacterial counts is described at p.24.

PROCESSING AND ANALYSES OF THE MATERIAL

Staining techniques

Smears of symbiont infected skin and gills were stained or impregnated for morphological and morphometric studies.

Diff-Quick®

Diff-Quick® is commonly used for staining tissue in studies of histology. It consists of three different dye solutions and is produced by Dade Behring AG (Switzerland). Air-dried smears were dipped five times in each solution, rinsed in tap water, air-dried and mounted with cover slip using a mounting medium (Histokit) for microscopes. Diff-Quick® was the most used method for staining of smears in this study, due to its simplicity and overall good staining results.

Harris' haematoxylin and eosin

Harris' haematoxylin were used as an alternative staining technique to Diff-Quick®, enabling better comparison with previous studies. The glass slides (air-dried smears) were covered with dye for 10 minutes and differentiated with the use of acid alcohol. Acid alcohol is made of 0.5ml concentrated hydrogen chloride (HCl) in 200ml 70% ethanol (C_2H_5OH). After differentiating, the slides were rinsed in deionized water and covered with Scott's tap water substitute (Bruno & Poppe 1996) for 10 minutes. This procedure makes the cell nuclei appear blue or black. The smears were then stained with eosin for better contrast to cytoplasma (Stevens & Wilson 1992).

Klein's dry silver impregnation method

This method was applied for morphological studies of *Trichodina.* Air-dried smears from skin or gills infected with *Trichodina* were impregnated with 2% $AgNO_3$ for 30-40 minutes, rinsed in deionized water, placed faced up in a petri-dish filled with deionized water, and exposed to bright sunlight (outdoor) for 60-90 minutes.

Scanning electron microscopy (SEM)

In cases of heavy infections, samples were fixed in a phosphate buffered fixative (Karnovsky's fixative) for scanning electron microscope (SEM). The preparation of fixed tissue prior to SEM was done as described in "Kompendium i fiskesykdommer. Fiskeparasitter" (Karlsbakk *et al.* 1999).

Morphology

Live symbionts from fresh smears were measured under a light microscope equipped with an ocular scale. More extensive studies of symbionts were done on stained or impregnated smears. The software ImagePro Plus was applied for measuring 2D-images of the symbionts captured with a digital microscope camera (Olympus DP11). The measurements were taken as illustrated in Figures 4 - 8.

The protozoan symbionts observed in the present study were classified following the classification used by Lom & Dyková (1992).

Ichthyobodo

Measurements were taken only when the cell was either completely free and rounded or clearly attached (trophozoites), and the principal features/characters "cytostome", axostyle and nucleus were all visible. "Cytostome" represents a "nose-like" protrusion of the cell at the border of the flagellar pocket, containing the end of the axostyle. This part of the cell corresponds to the attachment disc, which includes the cytostome according to Lom and Dyková (1992).

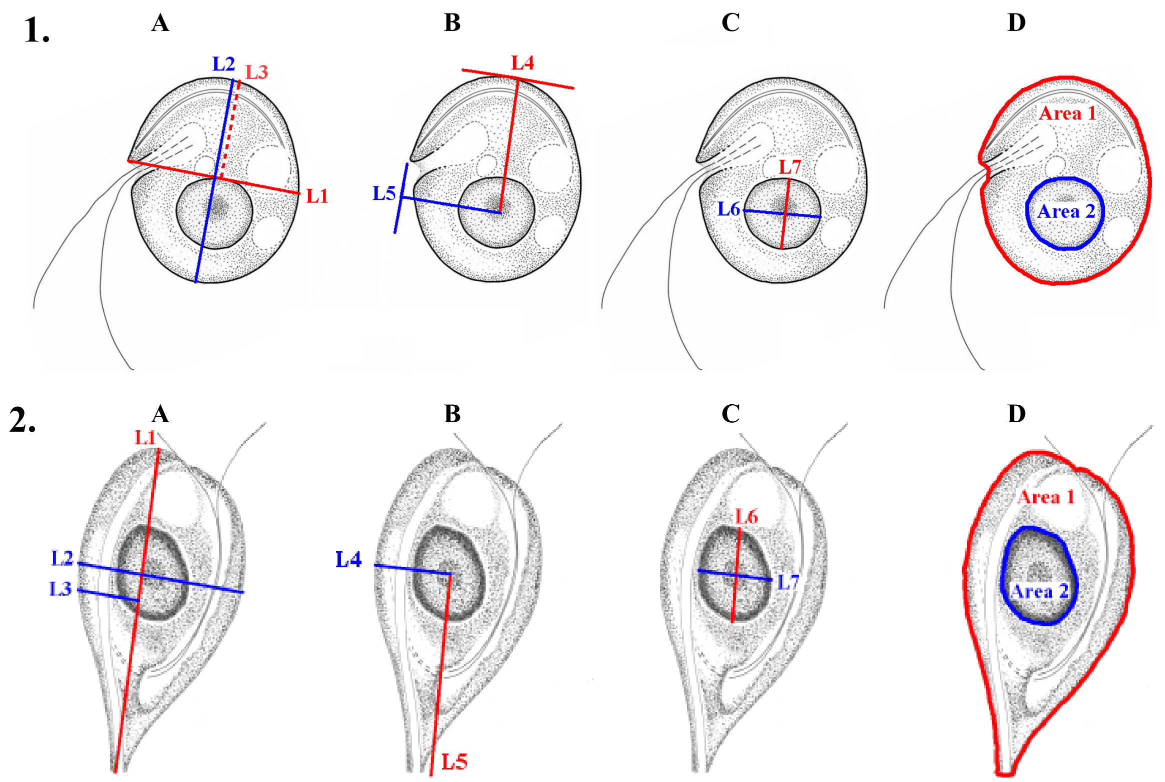


Figure 4 Measurements taken of the *Ichthyobodo* cells. **1**. Free form. **2.** Attached form (trophozoite). **A)** Length (L1), width (L2) and the distance from the centre of the longitudinal axis to the end of the cell at the pocket side (L3). L2 and L3 are right-angled to L1. **B)** Nucleus position: L5 and L4 are parallel to L1 and L2 respectively. **C)** Size of nucleus in diameters. L7 and L6 are parallel to L1 and L2 respectively. **D)** Area of cell (1) and nucleus (2).

Trichodina

Silver-impregnation is the preferred method for morphology studies of these ciliates, but *Trichodina* specimens from Diff-Quick® stained smears were also measured as a supplement to the few silver-impregnated smears available. Characteristics of silver-impregnated or Diff-Quick® stained *Trichodina* specimens from salmon were described as far as possible. The measurements were performed as illustrated in Figure 5.

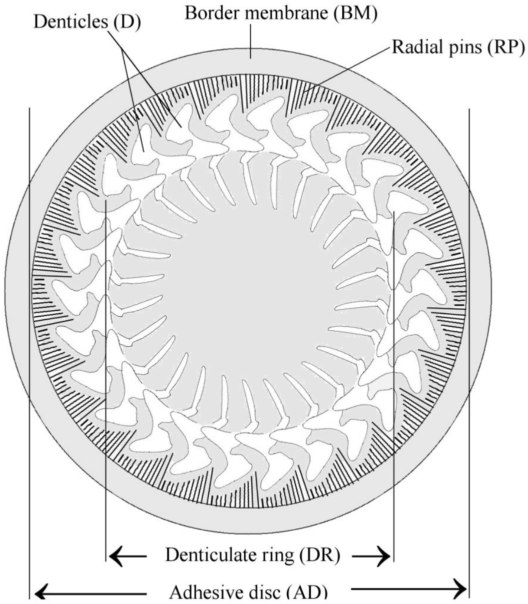


Figure 5 Characters of *Trichodina*. Diameters of the adhesive disc and the denticulate ring. Numbers of denticles and radial pins per denticle.

Apiosoma

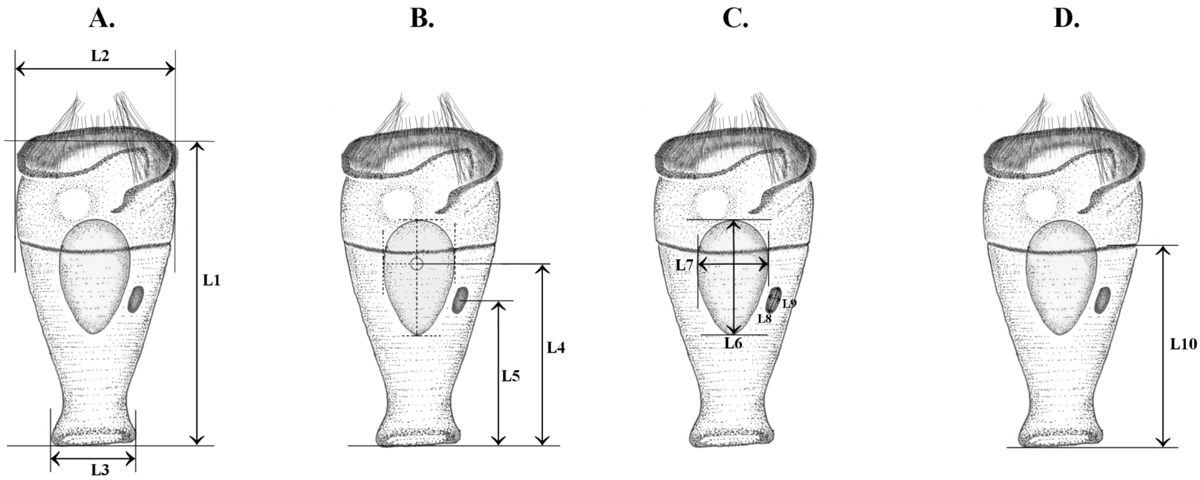


Figure 6 Measurements of *Apiosoma* cells **A)** Total length (L1) of the cell (from scopula to epistomial disc), maximum body width (L2) and size of the scopula (L3). **B)** Position of macronucleus (L4) and micronucleus (L5) as the distance from scopula to the centre of the nucleus. **C)** Size of macronucleus (L6 & L7) and micronucleus (L8 & L9). L7 and L9 are right-angled to L6 and L8 respectively. **D)** Position of pectinellar wreath measured as the distance between the wreath and the scopula.

Riboscyphidia

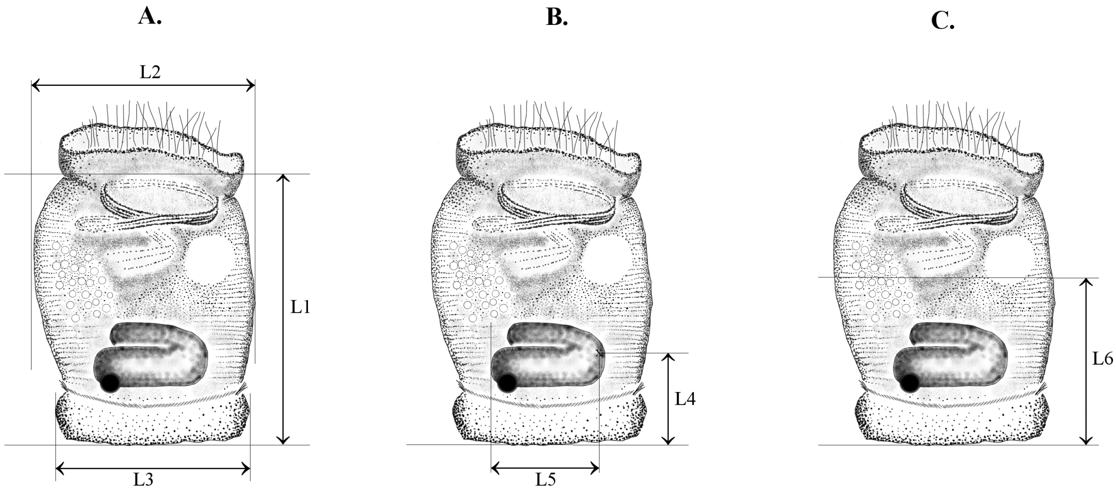


Figure 7 Measurements of *Riboscyphidia* cells **A)** Total length (L1) of the cell measured from scopula to the epistomial disc, maximum body width (L2) and the size of scopula (L3). **B)** Position (L4) of the macronucleus as the distance from scopula to the centre of the nucleus and size (L5) as length of one "arm" of the macronucleus. **C)** Extent of infundibulum (L6) as the distance from scopula to the lower part (the aboral extremity) of infundibulum.

Capriniana

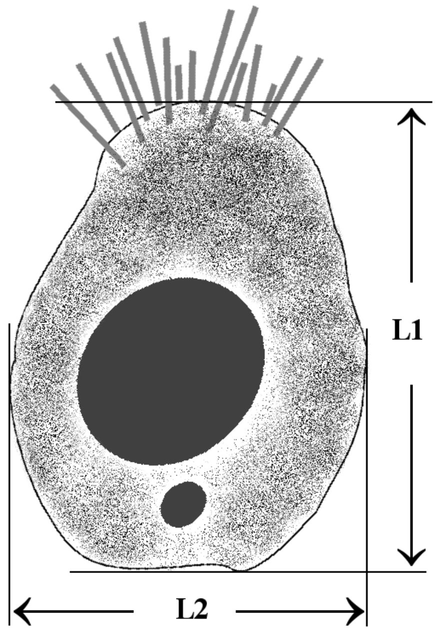


Figure 8 Measurements of *Capriniana* cells. **L1:** Length. Maximum distance from the anterior part (defined by the location of the tentacles) to the posterior. **L2:** Width. Maximum distance across the cell, right-angled to the longitudinal (L1) axis.

Water samples

A fluorescent dye, DAPI (4'6-diamidino-2-phenylindole), was used for a total count of bacteria (living and dead cells) in the water samples (Porter & Feig 1980, Fonnes 1999).

50 ml of the preserved samples, undiluted, was filtered (25 mm diameter, 0.2 µm pore size, black stained Nuclepore filters) using a vacuum pump (0.2-0.3 atmospheric pressure) for concentrating the bacteria. Filtered DAPI solution (1 mg/ 100 ml) was added in an amount that covered the Nuclepore filter. The solution was incubated for five minutes in darkness, and air-dried. The filter was then placed on a drop of low fluorescing immersion oil on a microscope slide and a drop of oil added before covering with a cover slip. An epifluorescense microscope (Zeiss universal) was used for counting bacteria. The Zeiss Universal microscope was equipped with a 50W HBO light source, BP 365/11 exciter filter, FT 390 chromate beam splitter, LP 395 barrier filter and 100/1.30 oil objective. All bacterial cells in a grid field were counted and 10 fields counted per slide.

Mean numbers of bacteria per ml water was calculated by using the formula:

$$(2.44 \cdot 10^6) \cdot \text{ mean no. bacterial cells per field } / \text{ volume}$$

The factor $(2.44 \cdot 10^6)$, unique for the microscope, is multiplied with mean number of bacterial cells in a grid field and divided with volume of the water sample filtered.

DATA PROCESSING (STATISTICS)

Statistical analyses were performed in Microsoft® Excel 2000 for Windows and Statistica® (6.1).

The condition of the fish (parr and pre-smolt) was measured using Fulton's condition factor: (Total weight (g) • 100) / (length (cm) ^{3}).

Correlations between two variables were examined using Spearman rank-order correlation coefficient (r_s). The Kendall partial rank-order correlation coefficient $T_{xy.z}$ (Siegel & Castellan 1988) was applied in an effort to eliminate the effect of a third variable in correlation analyses between two variables.

Analysis of variance (ANOVA) was applied in comparisons of morphological measurements of *Ichthyobodo* cells from different hosts. Significant differences among means in the multiple groups were tested (Newman-Keuls test) if the variances were homogeneous (Cochran's, Hartley's, and Bartlett's test for homogeneity of variance).

Co-occurrence of different symbiont species and associations between skin infection and skin damage were tested using the Chi-square (χ^2) method only when expected values in a 2x2 contingency table fulfilled the premises of the test, i.e. expected frequencies ≥ 5. Fisher's exact test (FET) was applied when the χ^2-test was not applicable in this matter (Bhattacharyya 1977, Weiss 1996). Expected co-existence among different symbionts was calculated for the most prevalent samplings as described by Urawa (1992b), with the assumption that infection of one symbiont species is random and not affected by presence of other species.

Statistical analyses were regarded as significant when the probability level (p) was less than 0.05 ($p<0.05$).

RESULTS

ENVIRONMENT

Climate

Daily measurements of air temperature and precipitation (Fig. 9) during the study-period (year 2000) were taken at the nearest weather station, which is located in Omastrand ca. 5 km east of the watercourse. February was the coldest month with a mean air-temperature of 2.4°C (± 2.9 mean standard deviation), while July was the warmest (15.4°C ± 2.2) month in the region. Most precipitation was measured in January (monthly mean 15.6 ± 14.7 mm) and February (15.7 ± 17.4 mm), while July was the driest month (1.0 ± 2.4 mm) this year.

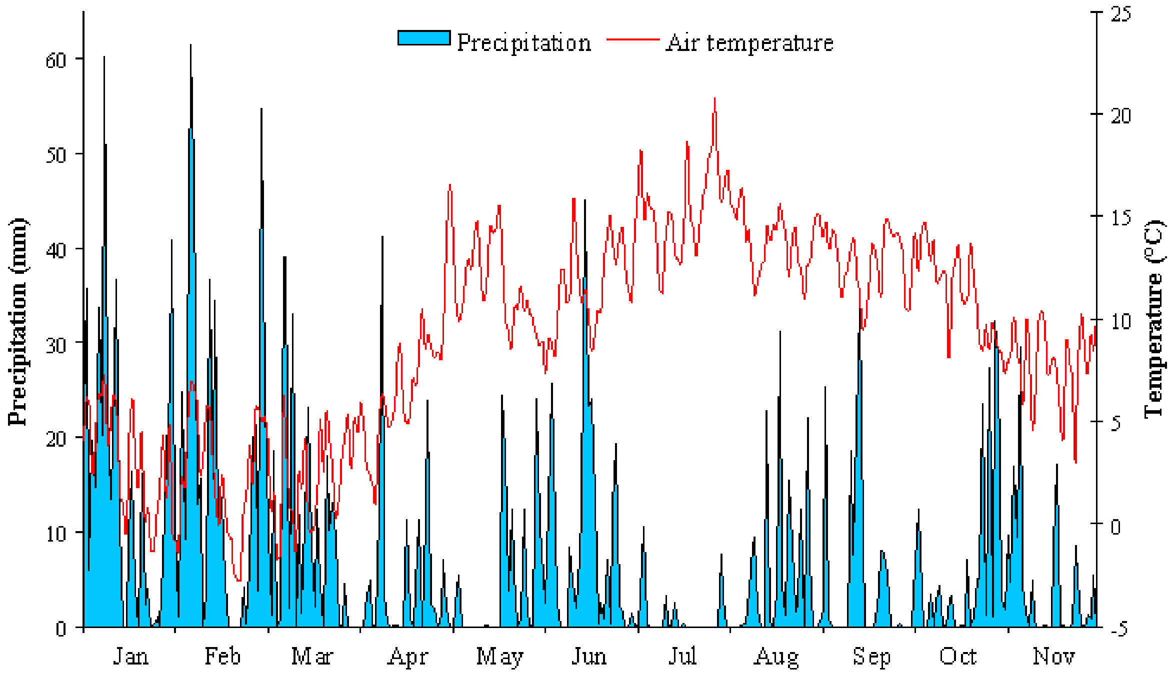


Figure 9 Monthly precipitation and air temperature in the time period studied (January – November 2000). Precipitation and temperatures were obtained daily by the Norwegian Meterological Institute from the nearest weather station (located in Omastrand) of the watercourse of Sævareid.

Water temperatures

The eyed eggs and salmon examined in this study were reared in a temperature-range from 4.1°C (measured in the hatching trough) to 18.4°C (Fig. 10). After hatching in February, the lowest water-temperature (6.5°C) was measured in November by the fish pens, while the maximum temperature (18.4°C) was recorded in late July (tank A).

A marked drop in temperature occurred in June (June 13th –14th), after a combination of heavy rain and strong winds, which probably had a stirring effect in the lake and caused cold water to reach the surface (up welling). The water-temperature decreased 5.6°C (from 14.5°C to 8.9°C) in 24 hours in tanks A and B1, but only 0.6°C in tank C3 (from 14.6°C to 14.0°C).

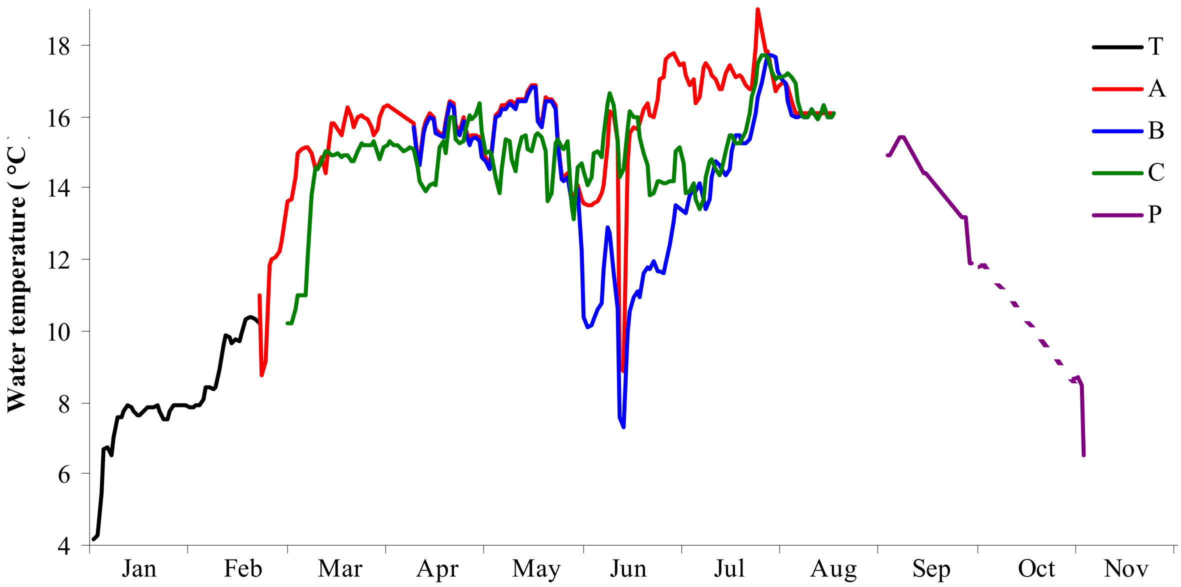


Figure 10 Rearing temperatures of the fish farm. Water temperatures in hatching trough (T), fish tanks (A, B and C) and by a net pen (P) during the study period (January-November 2000). No temperature data are obtained from October (dotted line).

Water quality

The pH (Fig. 11) of the inlet water (Lake Henangervatn) to the hatchery varied from 6.07 in January (mean pH 6.09 ± 0.02) to a maximum of 6.80 in late May (6.59 ± 0.19). The lowest pH (5.7) was measured in Lake Skogseidvatn among the net pens on November 3rd. The pH values were negatively correlated with precipitation (n=30, r_s=-0.49, p=0.007).

As a measure of contents of organic matter a total count of bacteria was used. Figure 12 shows the measured temporal variations of bacteria concentration in the lake, fish tanks and among the net pens during the study period. Highest concentration of bacteria in the inlet water and fish tanks occurred during the period when the higher pH values were measured. Bacteria concentration peaked in tank C3 (sample no. 17: 9.9 $\cdot 10^6$ bacteria per ml water) in late May, simultaneously as in the lake (4.9 $\cdot 10^6$ ml^{-1}), while the concentration peaked two weeks later (mid-June) in tank A (sample no. 18: 7.7 $\cdot 10^6$ ml^{-1}) and B2 (sample no. 19: 8.7 $\cdot 10^6$ ml^{-1}). A second peak of bacteria concentration in the lake occurred in early July (4.8 $\cdot 10^6$ ml^{-1}).

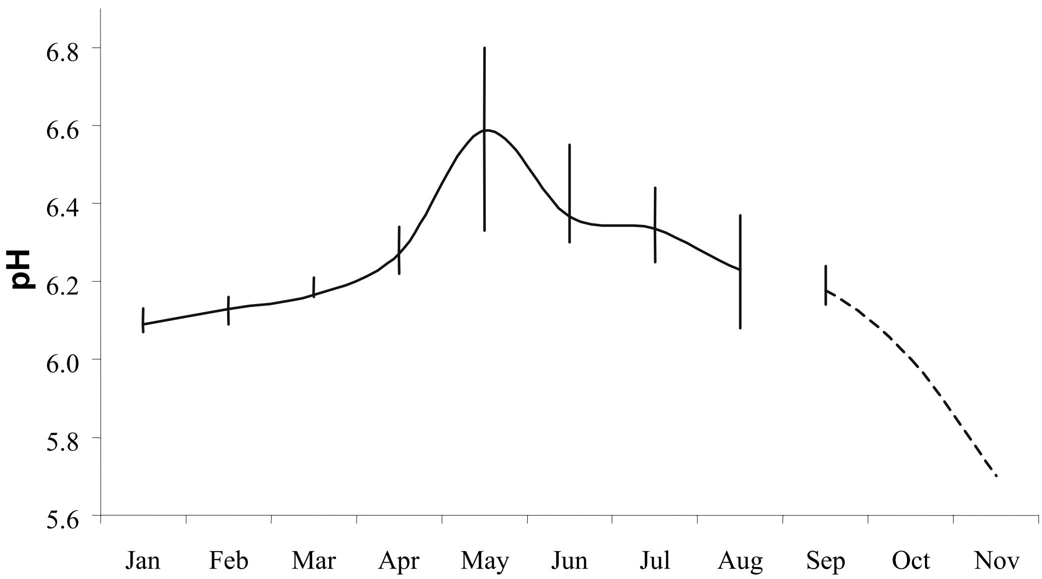


Figure 11 Monthly mean pH in the time period studied. Values of pH (bars = maximum and minimum for the month) were measured several times a week of inlet water to the hatchery (by Lake Henangervatn) in the period January - August and by the fish pens in Lake Skogseidvatn in the period September – November. No data were available for October (pH tendency marked with a dotted line).

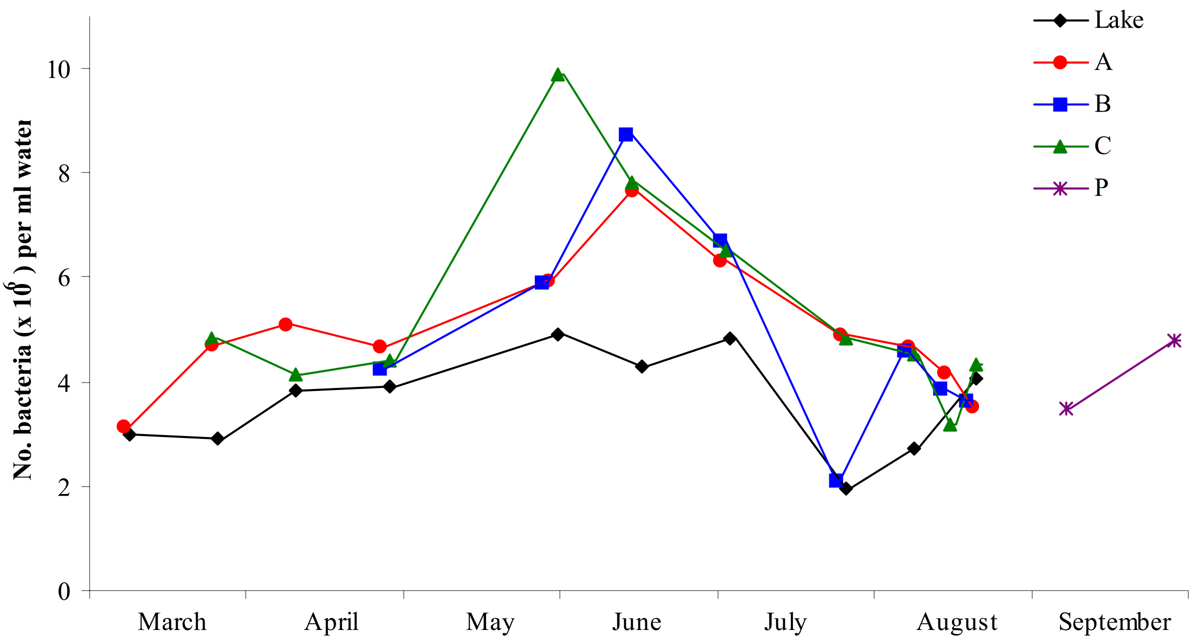


Figure 12 Total counts of bacteria in lake and hatchery water. Living and dead bacteria cells were counted with the use of a fluorescent dye (DAPI: 4'6-diamidino-2-phenylindole). Water samples taken from the inlet water (Lake Henangervatn, "Lake") to the hatchery, fish tanks (A, B and C) and among net pens (P) in Lake Skogseidvatn.

HOSTS AND ECTOSYMBIONTS

Farmed fish

Growth of the salmon

Growth (length) of salmon in the period from yolk sac larvae and fry in February and March to pre-smolt in November is shown in Figure 13. An outbreak of furunculosis in the hatchery in August terminated the study of the tank-reared salmon. The study was continued with salmon of the same cohort, reared in net pens.

Rearing density

After grading in mid-June, most of the salmon was reared in tank B2 (volume = 25 000 dm^3). These fish (tank B2) were larger in size and more crowded (measured as biomass per volume) in the period July to August, compared to the tanks A and C4 (both 5 000 dm^3) in the same period. Rearing densities during the study period are shown in Figure 14.

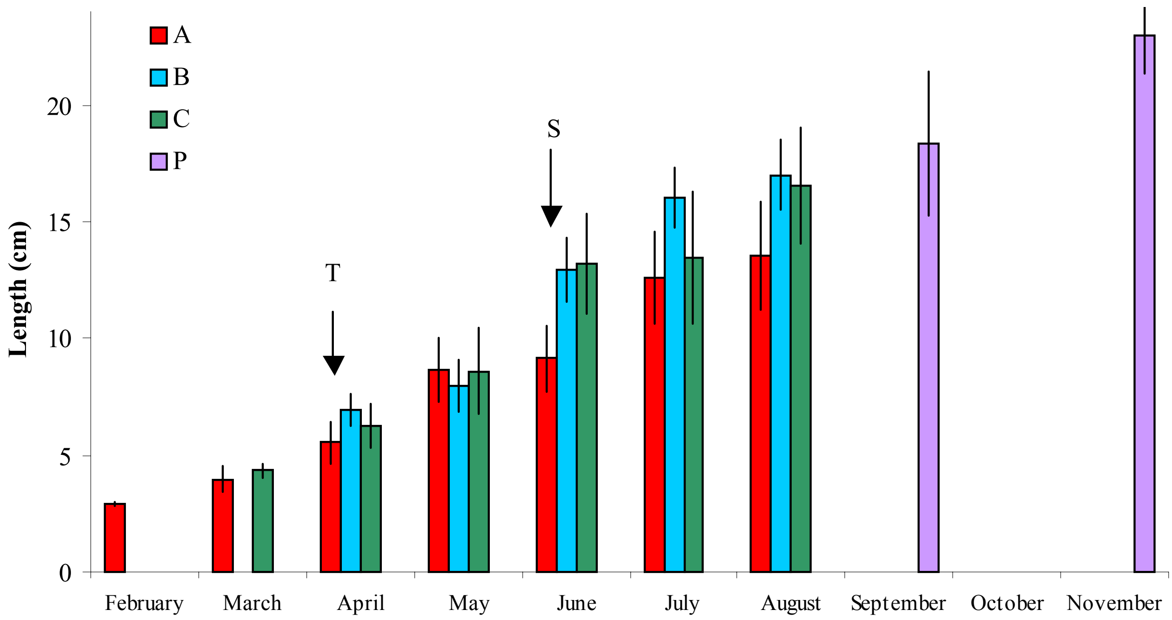


Figure 13 Growth of hatchery-reared salmon from the stage of fry (first feeders) in late February to pre-smolt in November (2000). Monthly mean length of the fish, with bars indicating standard deviation. Columns represent fish tanks (A, B (1-2) and C (1-4)) and net pen (P). Tank B1 was first established in April as a result of thinning of tank A (marked as "T" in figure). These tanks (A and B1) were later sorted by size in June ("S" in figure), whereafter the larger fish were transferred to a new tank (B2). The control tanks (C) were reared without grading and thinning. Tank C1 and C2 were gathered in tank C3 in May. Tank C4 was established in late June (after termination of tank C3) with fish from tank A and B2. No samples were taken in October.

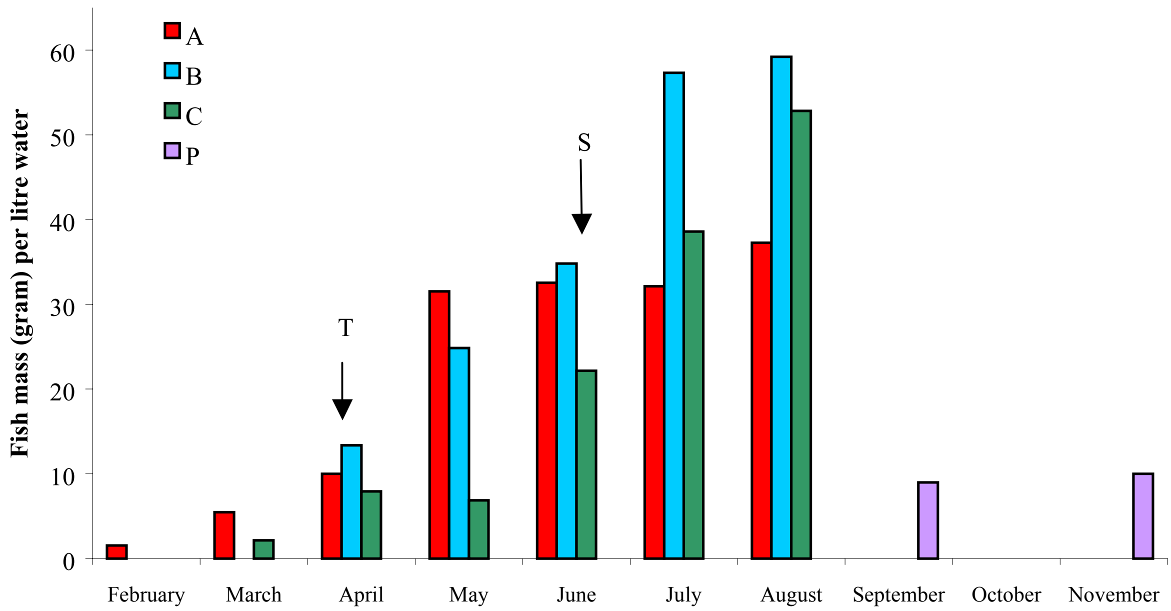


Figure 14 Rearing densities of hatchery-reared salmon from the stage of fry (first feeders) in late February to pre-smolt in November (2000). Monthly mean length of the fish, with bars indicating standard deviation. Columns represent fish tanks (A, B (1-2) and C (1-4)) and net pen (P). Tank B1 was first established in April as a result of thinning of tank A (marked as "T" in figure). These tanks (A and B1) were later sorted by size in June ("S" in figure), whereafter the larger fish were transferred to a new tank (B2). The control tanks (C) were reared without grading and thinning. Tank C1 and C2 were gathered in tank C3 in May. Tank C4 was established in late June (after termination of tank C3) with fish from tank A and B2. No samples were taken in October.

Ectosymbionts on farmed salmon

Five genera of protozoan symbionts were observed on the skin or gills of the hatchery-reared salmon in the 11 months (January – November, 2000) of study. Infections with the flagellates (*Ichthyobodo*) was observed in March (fry), August (parr) and September (pre-smolt), while ciliate infections (*Trichodina, Apiosoma, Riboscyphidia* and *Capriniana*) occurred in the period from late May (parr) to November (pre-smolt). The most common symbiont genus observed on the skin of salmon was *Riboscyphidia*, while *Capriniana* was the most common on the gill (Fig. 15).

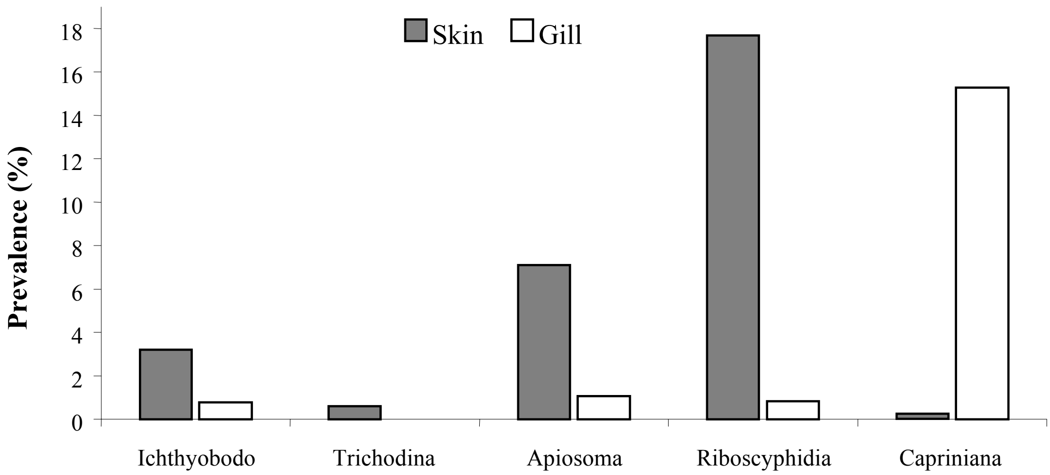


Figure 15 Genera of protozoan ectosymbionts observed on the skin and the gills of hatchery-reared salmon. Columns show total prevalence of infected salmon (n=2106) during the period from yolksac-larvae in January to pre-smolt in November (2000).

Wild fish

A total of 131 individual fish of five different species were caught and examined (Tab. 2). Six genera of protozoan ectosymbionts (*Ichthyobodo*, *Trichodina*, *Capriniana*, *Apiosoma*, *Riboscyphidia* and *Epistylis*) were observed, all on both skin and gills except *Riboscyphidia* sp. that occurred only on the skin (Tab. 3). No symbionts were observed on the few charr examined.

Table 3 Protozoan ectosymbiont (genera) observed on skin and gills of wild and feral* fish from Sævareid watercourse. Number of fish infected/number of fish examined.

SYMBIONTS	HOSTS									
	Salmon*		**Brown trout**		**Rainbow trout***		**Charr**		**Stickleback**	
	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
Ichthyobodo	2/33	0/23	4/32	0/21	0/16	0/6	0/6	0/4	21/44	7/44
Trichodina	12/33	0/23	3/32	0/21	0/16	0/6	0/6	0/4	43/44	36/44
Apiosoma	1/33	0/23	17/32	0/21	1/16	0/6	0/6	0/4	21/44	42/44
Riboscyphidia	14/33	0/23	21/32	0/21	1/16	0/6	0/6	0/4	0/44	0/44
Epistylis	0/33	0/23	0/32	0/21	0/16	0/6	0/6	0/4	25/44	26/44
Capriniana	1/33	2/23	1/32	9/21	0/16	1/6	0/6	0/4	0/44	0/44

MORPHOLOGY AND PATTERNS OF INFECTION

Ichthyobodo

In live smears, flagellates belonging to genus *Ichthyobodo* were observed in two forms, either as trophozoites attached to hosts' cells or as free-swimming flagellates. Both forms occurred on both skin and gills.

Free-swimming form of *Ichthyobodo* (Fig. 16)

Free forms of *Ichthyobodo* are easy to observe live when they move around with a sliding and twisting motion. They are flat, rounded to oval when seen from the flattened sides, but appeared "comma shaped" in lateral view. Live flagellates in skin smears measured from 7.8 to 13.0 µm in length (n=7, 9.8 ± 2.2 µm (mean ± SD)) and 10.4 – 15.6 µm in width (n=18, 12.6 ± 1.7 µm). Measurements of the flagellate in stained smears are given in Table 4. Dimensions of the cell were measured as illustrated in Figure 4.

Most of the cells had two flagellae, one of them longer than the other, but occasionally also four flagelled cells were seen (Fig. 16 F-H).

The nucleus was rounded in shape and measured ca. 4 µm in diameter. Its area, measured in 2D images, covered ca. 1/8 of the area of the cell (Tab. 4). The nucleus was located at, or just below, an axis defined by the ends of the axostyle. The axostyle appeared in stained smears as a bent rod between the cell membrane and the flagellar pocket.

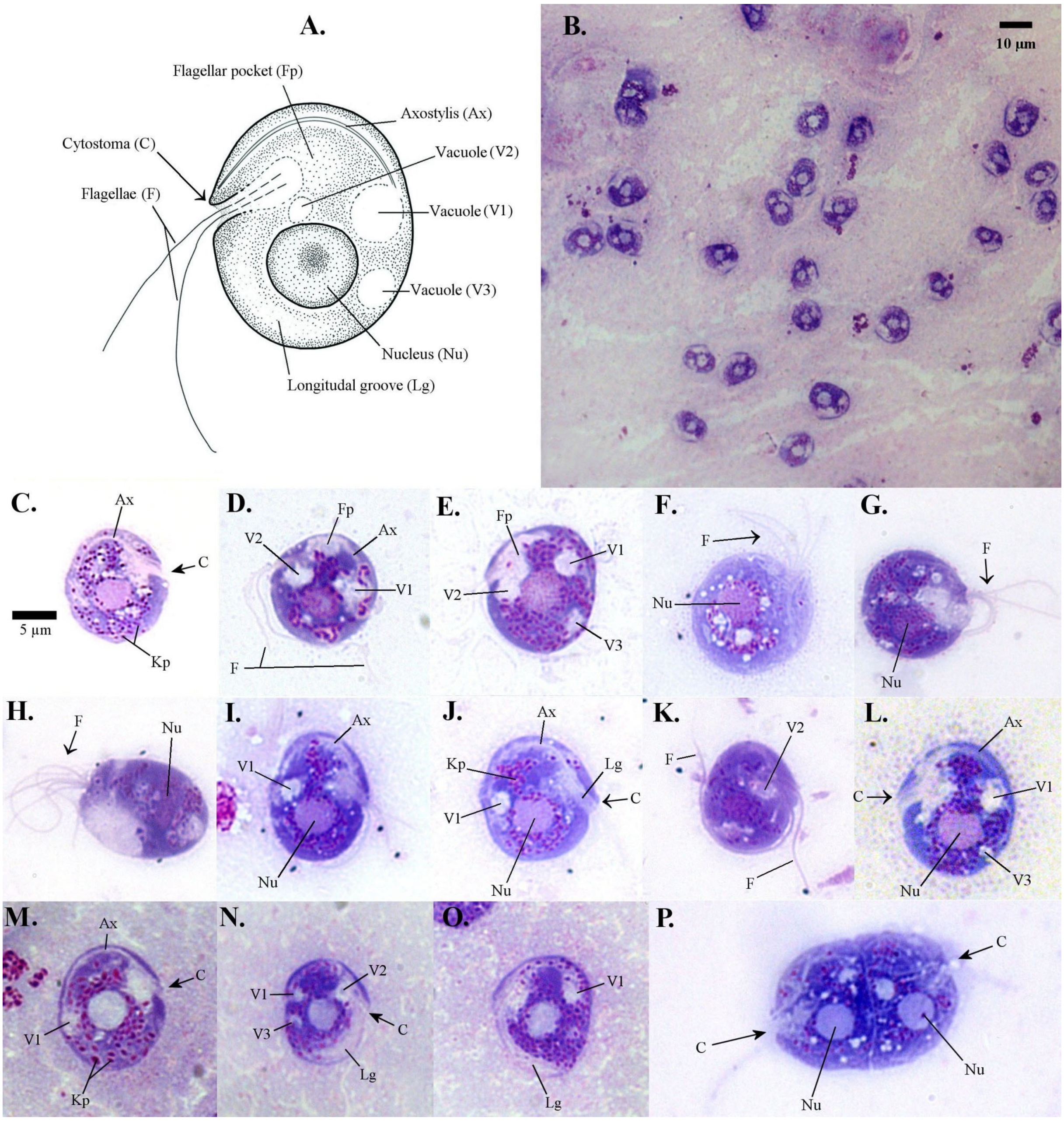


Figure 16 Morphology of *Ichthyobodo* in its free form. The bar (5 µm) given for photo C is the standard scale for all single cell photos (C-P). **A)** Characteristic structures of *Ichthyobodo*. Kinetoplasts (Kp) not drawn **B)** Typical aggregate of flagellates in smear of skin **C-O)** Photos of single *Ichthyobodo* cells with features marked out. **P)** Dividing form of the flagellate.

Table 4 Measurements of *Ichthyobodo*-cells (free swimming forms and trophozoites*) from skin or gills of different host individuals. The salmonids (salmon and rainbow trout) are hatchery-reared, while the three-spined stickleback is wild caught. Sampling dates and total length (cm) are given for each host. All measurements of *Ichthyobodo* cells are of 2D images from Diff-Quick® stained smears. Dimensions are given as range with mean ± SD in parenthesis. **L1 and L2:** Diameters (length and width respectively) of the cell. **L3**: Distance from the centre of the longitudinal axis to the end of the cell at the flagellar pocket. **L4 and L5**: Position of the nucleus as the distance from the centre to margin of the cell at the flagellar pocket and the anterior part respectively. Positions calculated in a cell-size ratio (L4/L2 and L5/L1). **L6 and L7**: Diameter of the nucleus with L6 and L7 parallels to L1 and L2 respectively. **Area 1**: Area of the cell. **Area 2**: Area of the nucleus.

	Ichthyobodo dimensions	Salmon 02 Aug 2000 7.6 cm	Salmon 20 Aug.2000 10.7 cm	Salmon 20 Aug 2000 10.1 cm	Salmon 07 Sep 2000 12.1 cm	Rainbow trout 10 Aug 2000 7.2 cm	Stickleback 01 Jun 2001 4.3 cm	Salmon * 09 Mar 2000 3.5 cm
		Skin	Skin	Gill	Skin	Skin	Skin	Skin
Diameters	**L1** (μm)	10.0-16.5 (12.3±1.5)	9.3-15.6 (11.6±1.4)	8.3-13.2 (10.4±1.2)	8.7-14.0 (11.7±1.3)	10.1-15.2 (11.8±1.2)	9.5-13.9 (11.8±1.0)	11.6-19.0 (14.9±1.9)
	L2 (μm)	11.5-18.0 (13.6±1.3)	10.9-15.9 (13.5±1.3)	9.7-13.9 (11.7±1.0)	11.2-15.2 (13.1±1.2)	11.0-16.0 (13.5±1.2)	10.0-14.6 (12.7±1.2)	6.3-10.7 (8.6±1.2)
	L3 (μm)	4.9-8.2 (6.5±0.8)	5.3-8.5 (6.5±0.8)	4.1-6.7 (5.2±0.8)	3.7-7.6 (5.8±1.0)	4.0-8.2 (6.6±1.2)	3.9-8.2 (5.8±1.0)	2.9-7.5 (4.5±1.0)
Position of nucleus	**L4/L2**	0.53-0.72 (0.62±0.04)	0.41-0.71 (0.57±0.06)	0.55-0.71 (0.62±0.04)	0.53-0.70 (0.63±0.05)	0.46-0.69 (0.57±0.06)	0.45-0.71 (0.62±0.05)	0.48-1.25 (0.88±0.18)
	L5/L1	0.42-0.58 (0.51±0.04)	0.42-0.61 (0.51±0.05)	0.46-0.69 (0.56±0.06)	0.39-0.66 (0.53±0.05)	0.40-0.60 (0.52±0.04)	0.36-0.60 (0.47±0.06)	0.21-0.45 (0.32±0.06)
Size of nucleus	**L6** (μm)	4.0-6.0 (4.7±0.4)	3.7-5.6 (4.3±0.4)	3.0-5.1 (3.7±0.5)	3.2-5.8 (4.6±0.5)	3.2-5.1 (4.3±0.5)	3.2-5.8 (4.4±0.7)	2.7-6.9 (4.5±0.8)
	L7 (μm)	3.2-5.2 (4.1±0.5)	3.0-5.3 (4.0±0.6)	2.8-4.9 (3.5±0.4)	3.4-5.1 (4.1±0.4)	3.1-5.1 (4.1±0.5)	3.4-5.7 (4.2±0.6)	2.9-5.8 (4.2±0.7)
Area 1 (μm^2)		90.1-226.2 (134.6±26.7)	77.9-167.3 (120.1±23.4)	69.6-139.1 (95.4±17.2)	81.4-168.1 (125.1±22.8)	85.5-174.8 (126.3±22.2)	73.5-150.7 (122.3±20.1)	55.7-124.9 (93.4±21.5)
Area 2 (μm^2)		11.2-27.7 (17.3±3.2)	10.1-24.3 (15.2±3.2)	7.6-20.3 (11.9±2.2)	10.3-22.9 (17.0±2.6)	11.1-24.0 (16.4±2.8)	10.8-24.9 (17.5±4.2)	9.0-27.6 (15.9±4.4)
Nucleus/cell ratio (Area 2/Area 1)		0.10-0.15 (0.13±0.01)	0.10-0.15 (0.13±0.01)	0.10-0.15 (0.12±0.01)	0.12-0.16 (0.14±0.01)	0.11-0.16 (0.13±0.01)	0.11-0.18 (0.14±0.02)	0.10-0.23 (0.17±0.04)
Length/width ratio (L1/L2)		0.76-1.02 (0.90±0.06)	0.80-1.09 (0.86±0.05)	0.75-1.08 (0.89±0.07)	0.76-1.02 (0.89±0.07)	0.74-1.04 (0.88±0.08)	0.81-1.08 (0.93±0.06)	1.31-2.33 (1.74±0.21)

Differences in the dimensions of *Ichthyobodo*-cells from different microhabitat (skin and gills) were found (Tab. 4). *Ichthyobodo* from gills of salmon were significantly smaller in length (L1: ANOVA, p<0.001) and width (L2: ANOVA, p<0.001) compared to *Ichthyobodo* from skin of salmon, rainbow trout and stickleback. Also, *Ichthyobodo* from the skin of sticklebacks were significantly more rounded (L1/L2: ANOVA, p<0.05) compared with *Ichthyobodo* specimens from the other hosts except skin-*Ichthyobodo* from salmon examined 02 August 2000. These specimens (stickleback *Ichthyobodo* and gill-*Ichthyobodo*) also differed regarding nucleus position. That is, nucleus in stickleback *Ichthyobodo* was located significantly closer to the anterior part of the cell (L5/L1: ANOVA, p<0.02), while nucleus in gill-*Ichthyobodo* was located significantly more posterior in the cell (L5/L1: ANOVA, p<0.02).

Table 5 Occurrence of vacuoles in free forms of *Ichthyobodo* in Diff-Quick® stained smears from skin or gills of different hosts. Vacuole no. 1 is situated at the posterior end of the axostyle, while no. 2 and no. 3 are located in the area by the flagellar pocket and longitudinal groove respectively.
The occurrences are given as ratio $N_{\text{cases where vacuoles were observed}} / N_{\textit{Ichthyobodo} \text{ cells examined}}$.

	Salmon (skin)	Salmon (gill)	Rainbow trout (skin)	Stickleback (skin)	Total
Vacuole no. 1	67/68	19/19	20/20	6/6	112/113
Vacuole no. 2	35/68	14/19	8/20	6/6	63/113
Vacuole no. 3	11/68	2/19	0/20	0/6	13/113

Table 6 Counts of kinetoplasts in free forms of *Ichthyobodo* in Diff-Quick® stained smears from skin or gills of different hosts. n = numbers of *Ichthyobodo*-cells examined. Numbers of kinetoplasts are given as range (minimum – maximum) and mode with frequency of mode in parenthesis.

	Salmon (skin)	Salmon (gill)	Rainbow trout (skin)	Stickleback (skin)
n	65	32	38	21
Range	39-116	30-79	39-85	26-93
Mode	54 (6)	Multiple	51 (4)	Multiple

One vacuole (V1 in Fig. 16) was commonly located at the end of the axostyle on the opposite side (posterior to) of the cytostome opening. In addition, one or two other vacuoles (V2 and V3 in Fig. 16) located in the area of the flagellar pocket and close to the longitudinal groove, respectively, were occasionally observed. Occurrences of vacuoles in *Ichthyobodo*-cells from gills and skin of salmon and skin of rainbow trout and sticklebacks are shown in Table 5. Many small kinetoplasts occurred as densely stained spots in Diff-Quick® stained smears. No regular pattern in distributions of kinetoplasts in the free-swimming form of *Ichthyobodo* was detected. The kinetoplasts appeared to be randomly dispersed in the cell. Counts of kinetoplasts in 2D-images of *Ichthyobodo*-cells, from skin or gills of different hosts, ranged from 26 to 116 (Tab. 6).

Attached form (trophozoite) of *Ichthyobodo* (Figs. 17 and 18)

In fresh smears from skin and gills, the number of free-swimming forms was observed to increase within minutes, with trophozoites actively transforming into the free form. Compared to the free form, the trophozoites appeared motionless or with a sluggish waving. The flagellate was flattened pyriform, drawn out towards an attachment point. The point of attachment contains the anterior end of the axostyle (Fig. 17). In scanning electron microscopy (SEM), attached flagellates can be seen to apparently penetrate the host cell (Fig. 18 D).

The axostyle was located on the same side of the cell as the flagellar pocket, and in flagellates in stained smears these structures and the longitudinal groove appeared as a characteristic Y-shaped pattern (Fig. 17).

Flagellae might be difficult to see in both fresh and stained smears with the use of light microscope (Fig. 17 E), but the use of SEM (Fig. 18 C) revealed the appearance of two flagellae (one longer than the other).

A single large vacuole was occasionally seen in the trophozoites, located near the posterior end of the flagellar pocket and the axostyle (Fig. 17 A & E).

In trophozoites from stained smears, kinetoplasts are readily seen as dark stained dots all over the cell, but usually fewer towards the cytostome (Fig. 17 B-E).

Measurements of the flagellate in stained smears are given in Table 4. Dimensions of the cell were measured as illustrated in Figure 4.

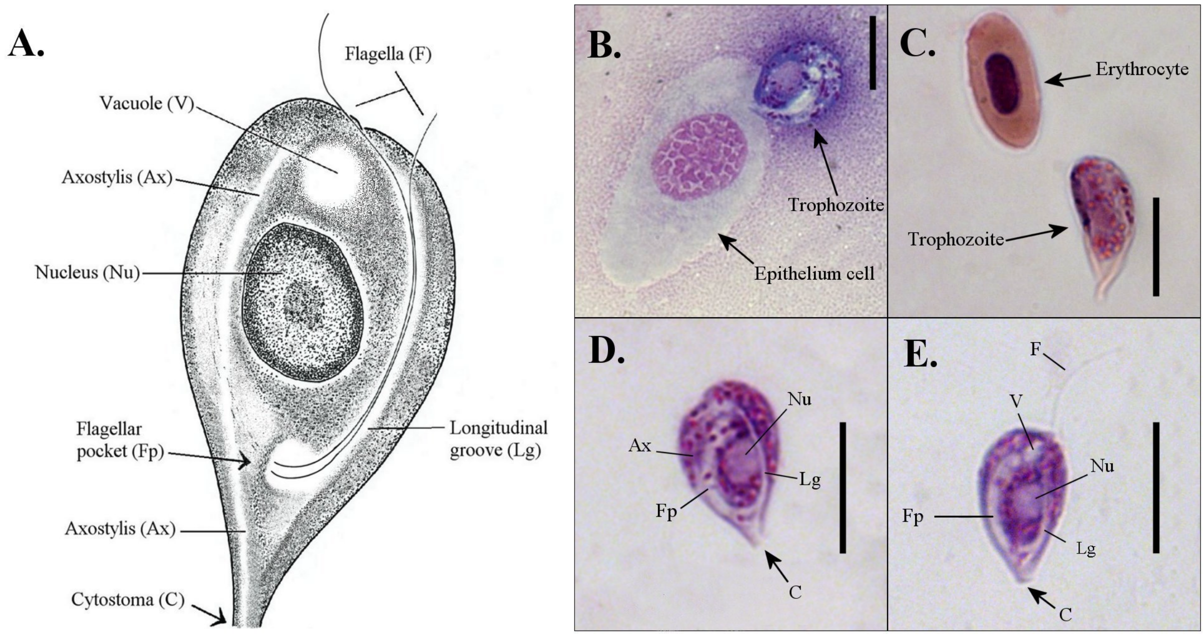


Figure 17 Principal characters of *Ichthyobodo* in its parasitic form (trophozoite). **A)** Sketch of trophozoite observed on skin from juvenile salmon. Kinetoplasts not drawn. **B-E)** Photos of trophozoites from skin-smears. Bars are equal to 10 µm.

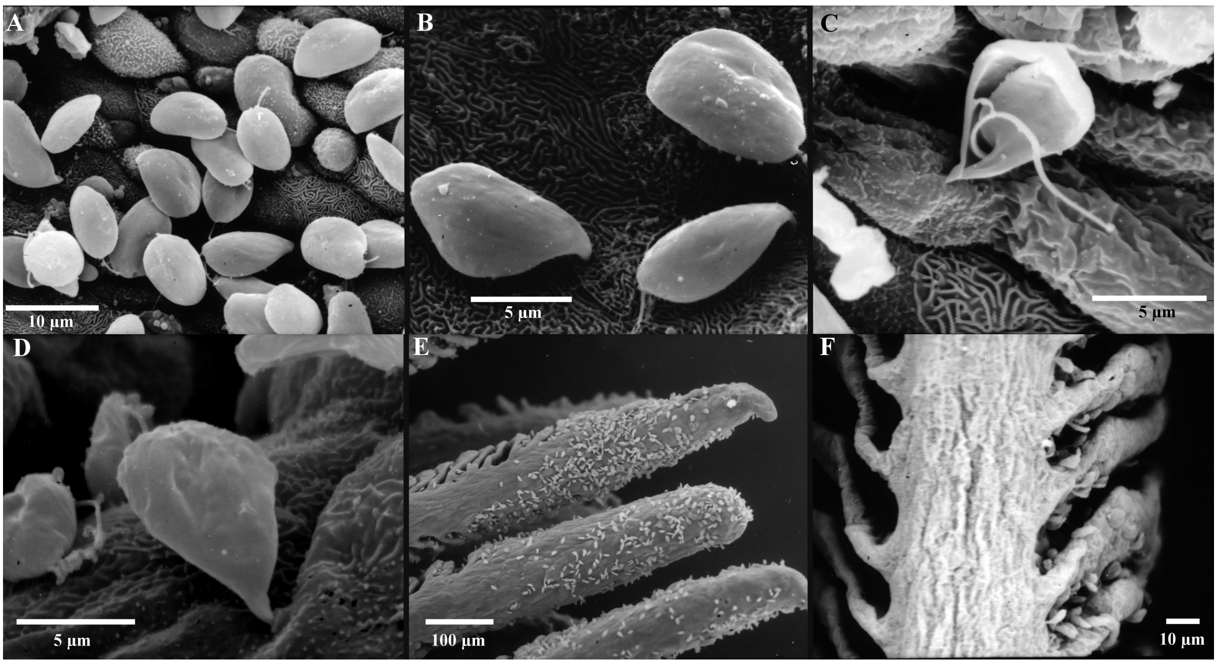


Figure 18 *Ichthyobodo* infections of juvenile salmon, SEM. **A.** Heavy skin-infection. **B.** Skin infection. Microridge structures of the skin are clearly visible. **C.** Skin infection. Flagellae (one long and one short) of the trophozoite arising from the flagellar pocket into a longitudinal groove. Microridge-structures absent in the area of the attachment site. **D.** Skin infection. No microridge-structures in the penetration area. **E.** Heavy infection on gills. Flagellates attached to primary lamellae. **F.** Flagellates attached to secondary lamellae of gills.

Dynamics of *Ichthyobodo* infection in the fish farm

This flagellate occurred on skin and gills of fry in March and later on parr and pre-smolt (pen-reared salmon, skin infection only) during the period July 30th to September 28th (Fig. 19).

Infections were first detected on fry in March (tank A, sample no. 4), two weeks after commencement of first feeding. The combined prevalence of skin and gill infections was 38% (sample no. 4: mean fish length 3.4 ± 0.3 cm, water temperature 14.3 °C). After formalin treatment the prevalence dropped to zero. Tanks C1 and C2 was set up (March 9th) with *Ichthyobodo*-infected fish taken from tank A prior to formalin treatment (March 10th). The *Ichthyobodo* infections in these tanks also disappeared in early April (sample no. 8), without treatment. The flagellate was detected again on parr in late July (tank A), after which the prevalence increased markedly despite two formalin treatments ("F" in Fig. 19) of the tank (A). Infections never occurred in tank B1 or B2. Tank B1 was set up with approximately 50% of the fish from tank A in late April. Tank A and B1 was later mixed and sorted by size in mid-June, whereafter the larger salmon was reared in tank B2 (Fig. 3 and 13).

Maximum prevalence of infection was observed on pen-reared (P) pre-smolt in late September (sample no. 34: 19.8 ± 2.5 cm, 11.9°C) when 54% of the fish examined was infected with this flagellate on the skin.

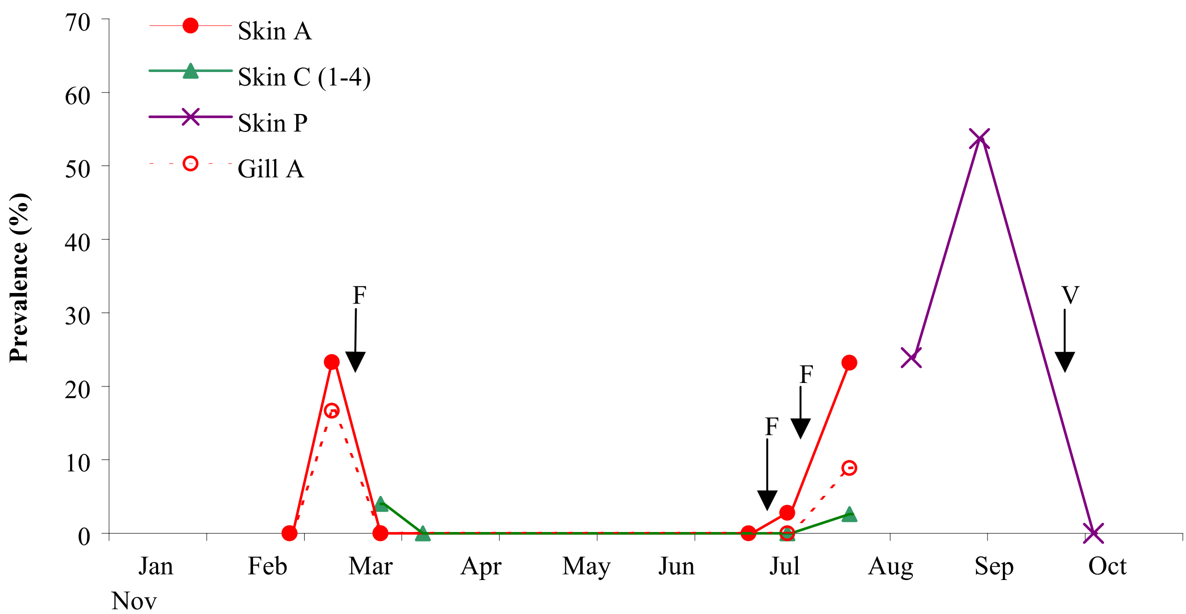


Figure 19 Temporal variations in *Ichthyobodo*-prevalence among hatchery/lake-pen reared salmon. Samples (numbered 0-35) were taken from different tanks (A and C1-C4) and a net pen (P). The salmon reared in control tanks (C1 and C2: March 10th – May 11th, C3: May 11th – June 30th, C4: June 30th – August 19th) were not exposed to handling (i.e. grading and thinning). Tank A was treated with formalin at three occasions ("F"). The pen-reared fish was routinely vaccinated ("V") in late October.

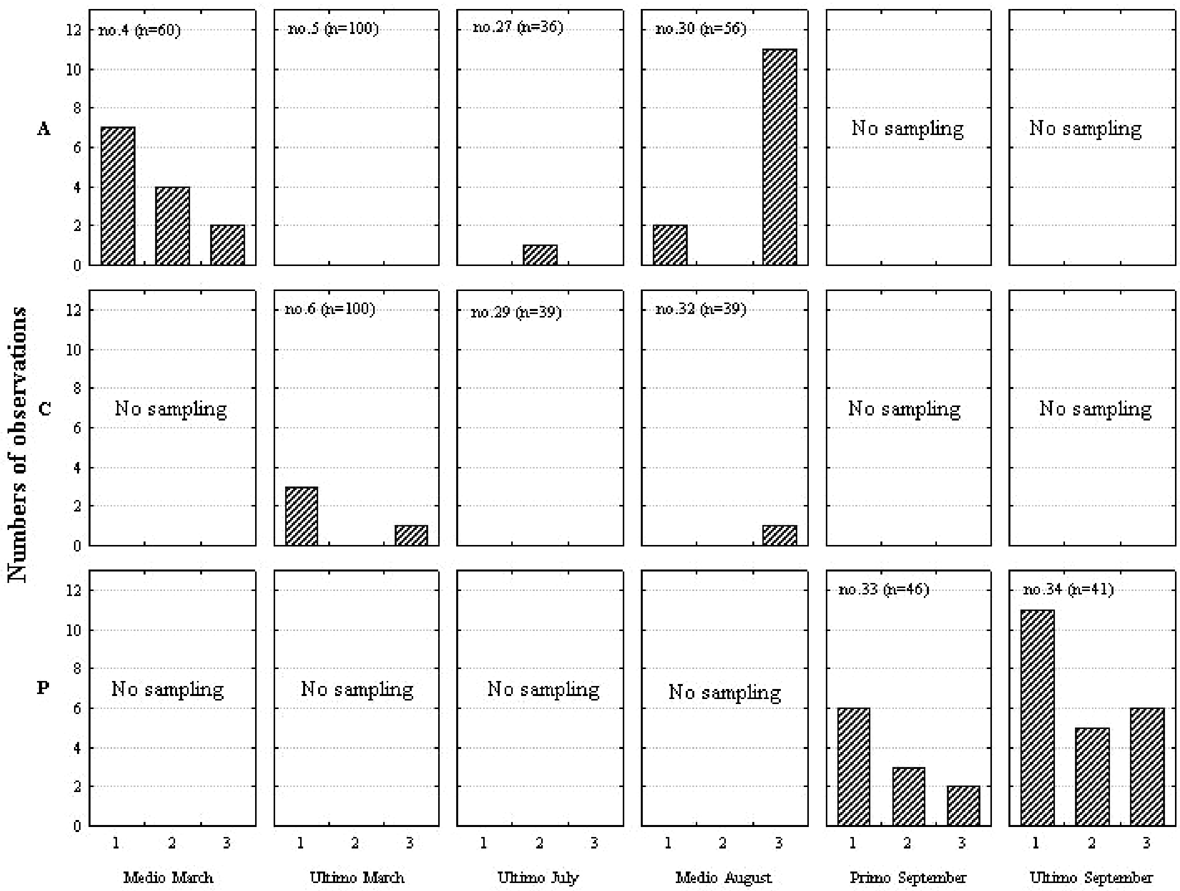


Figure 20 Ranked intensities of *Ichthyobodo* infections on the skin of salmon reared in different tanks (A and C) and a net pen (P). Tank C was first established in late March. The tanks (A and C) terminated in late August, whereafter pen-reared salmon was studied. All fish examined are from the same cohort. A total of 36 samples were taken in the period from hatching (January) to pre-smolt (November). Only periods of *Ichthyobodo* infection are shown in the figure. Sample numbers (no.) and numbers of fish examined (n) are given above each histogram. Intensities of infection in a lateral scraping from base of the pectoral fin to level of the start of the dorsal fin are ranked on a scale from 1 – 3: 1, <10 *Ichthyobodo* cells observed in the smear; 2, 10-50; 3, >50.

Ichthyobodo infections were not detected in pen-reared fish early in November; one week after the fish received routine vaccination ("V" in Fig. 19) using tricaine as anaesthesia.

Intensities of the *Ichthyobodo* infections are shown in Figure 20. The heaviest infections occurred at the lower rearing densities (tank A in March and August; net pen in September) (Fig. 14).

Ichthyobodo infections were observed on the examined salmon in a water-temperature range of 11.9 - 16.7 °C and at pH values ranging from 6.08 to 6.36.

The relationship between *Ichthyobodo* infection and size of the host was examined (Fig. 21). In March (sample no. 4), the larger fry were more intensely infected on the skin than the smaller ones (n= 59, r_s= 0.28, p=0.03), while an opposite tendency (not significant) occurred when only gill infection was regarded (n= 59, r_s= -0.23, p=0.08).

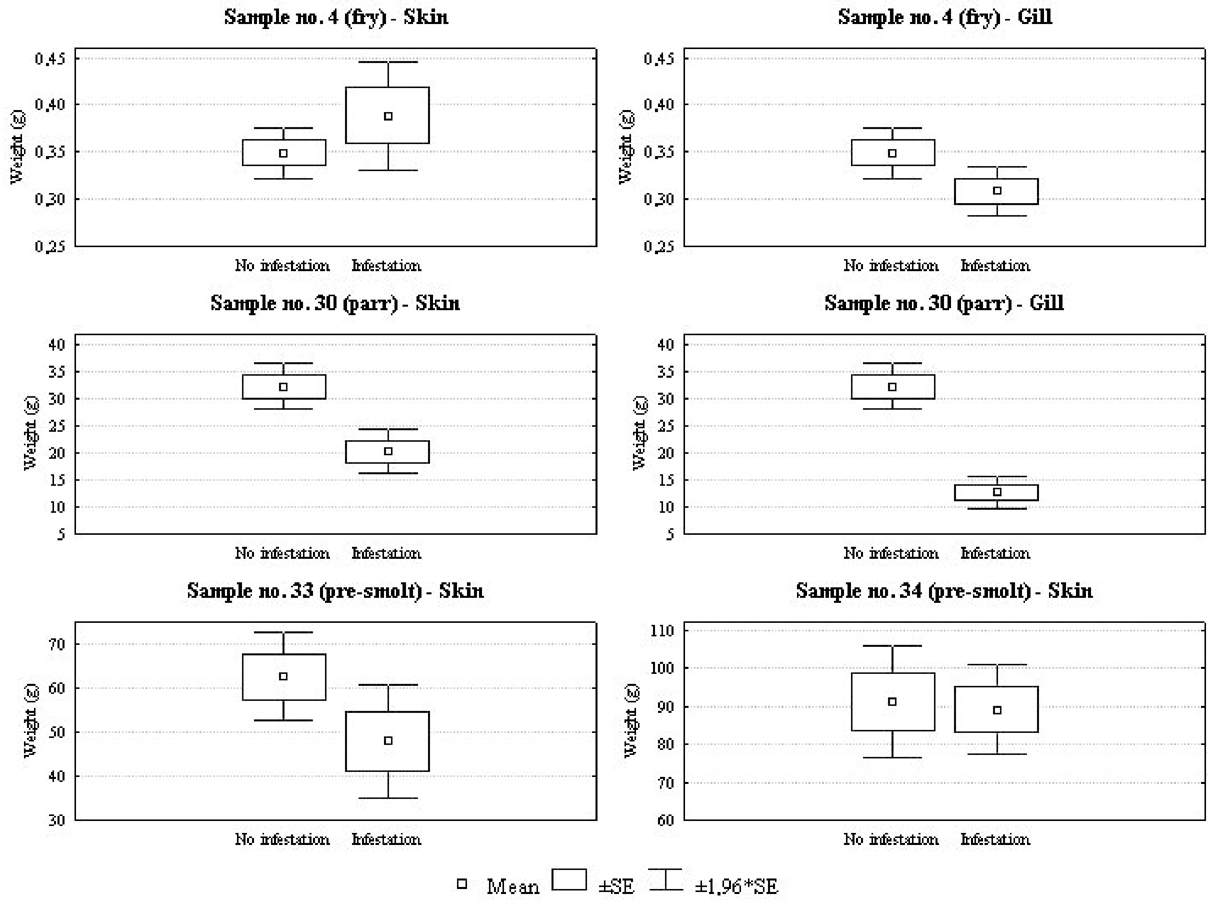


Figure 21 The relationship between *Ichthyobodo* infection and size of the host (juvenile salmon) in samples with heavy infections. The salmon were reared in fibreglass tanks (samples no. 4 and 30) and net pen (samples no. 33 and 34). Fry (first feeders) were sampled in March, parr in August and pre-smolt in September (2000). All fish are from the same cohort.

In August (tank A, sample no. 30) there was a significant negative correlation between fish length of the parr and ranked intensities of infection on the skin (n=56, r_s=-0.33, p=0.011) and gills (n=56, r_s=-0.36, p=0.007). A similar significant correlation occurred among the fish in sample no. 33 (only skin infections) from the net pen in early September (n=46, r_s=-0.30, p=0.042), while there was no correlation between infection and size of the fish (n=41, r_s=0.06, p=0.7) sampled three weeks later from the same net pen (late September, sample no. 34). Sample no. 30 (parr from tank A) was the only sample with high prevalence of salmon that were heavily infected on both skin and gill, for which hematocrit (Hct) also was measured (Hct not measured in fry). In this group there was a significant negative correlation between ranked intensities of *Ichthyobodo* and Hct (n=36, r_s=-0.48, p=0.003) and between the *Ichthyobodo* intensity and condition factor (CF) of the host (n=56, r_s=-0.46, p<0.001).

However, there was also a positive correlation between host length and Hct (n=36, r_s=0.50, p=0.002). To examine whether the correlation was due to the relationships between infection and the parameters Hct and CF, or between infection and the size of the fish, the Kendall partial rank-order correlation coefficient $T_{xy.z}$ was applied.

Partial correlation confirmed that hematocrit value and condition factor (CF) correlated negatively with ranked intensities of *Ichthyobodo*, independent of the length of the fish (n= 36, $T_{(Hct)(Ichthyobodo).\ Length} = -0.31$, p<0.005; n= 56, $T_{(CF)(Ichthyobodo).\ Length} = -0.35$, p<0.001). In addition, these correlations were found to be stronger when only fish that were infected with *Ichthyobodo* on the gills were regarded (n= 36, $T_{(Hct)(Ichthyobodo).\ Length} = -0.43$, p<0.001; n= 56, $T_{(CF)(Ichthyobodo).\ Length} = -0.37$, p<0.001).

There was also a significant negative correlation between intensities of *Ichthyobodo* and Hct (n=46, r_s=-0.38, p=0.034) in sample no. 33 (early September), but no correlation between infection and CF, or between Hct and fish size. In sample no. 34 (late September), there were no correlation between ranked intensities and these parameters (Hct and CF) at all. Fish sampled from the net pen (samples no. 33 and no. 34) were not infected on the gills, as opposed to sample no. 30 (tank A), *Ichthyobodo* occurring only on the skin.

A pale coating on the body surface of heavily infected fry and parr was observed. The coating partly covered the back (around the dorsal fin) and the lateral side of the body. Fresh smears from the skin of these salmon were less transparent, and more greyish compared with smears from uninfected fish.

“Flashing” (fish rubbing against the bottom of the tank or pen wall) occurred in the tanks and the net pen containing *Ichthyobodo*-infected parr or pre-smolt, even when the infections were regarded as slight. This behaviour of the fish was also occasionally observed in tanks that appeared to be uninfected with this flagellate. An area of scale losses or small skin ulcers, located on the lateral side of the fish body below the dorsal fin, was common in the period (August-September) when flashing occurred. A significant positive association between skin damage and *Ichthyobodo* infection was observed in sample no. 30 and 34 (FET: p<0.001 and p<0.003 respectively), and there was a tendency also in sample no. 33 (FET: p=0.09 (not significant)) (Tab. 7).

Mortality was not associated with *Ichthyobodo* infections in this present study. Two periods of relative high mortality rates occurred in the study period (overall mortality of 6.0 % among yolksac larvae in February and 6.6 % among fry in March), but these occurrences did not coincidence with the *Ichthyobodo* infections. The mortality among fry in March mainly occurred in the period after formalin treatment on March 10th.

Table 7 *Ichthyobodo* infection and skin damage of the host (*Salmo salar*). The observed and expected (in parenthesis) co-occurrences of symbionts (*Ichthyobodo*) and scale losses or skin ulcer among hatchery reared salmon. No or slight infections are designated as "0" and moderate or heavy infections as "1".

Sample no. 30 (Tank A, August 18th)	***Ichthyobodo* 0**	***Ichthyobodo* 1**	**Total**
No skin damage	44 (38)	3 (9)	47
Skin damage	1 (7)	8 (2)	9
Total	45	11	56
Sample no. 33 (Net pen, September 7th)	***Ichthyobodo* 0**	***Ichthyobodo* 1**	**Total**
No skin damage	30 (28)	1 (3)	31
Skin damage	12 (14)	3 (1)	15
Total	42	4	46
Sample no. 34 (Net pen, September 28th)	***Ichthyobodo* 0**	***Ichthyobodo* 1**	**Total**
No skin damage	19 (15)	1 (5)	20
Skin damage	11 (15)	10 (6)	21
Total	30	11	41

Table 8 *Ichthyobodo* infections on wild caught fish (skin and gills). The fish were all caught in the same watercourse by net, except salmonids in 2001 that were caught by angling and the sticklebacks that were caught with traps. Salmon and rainbow trout are feral fish* (escapees from lake-pens) while brown trout, charr, and three-spined sticklebacks are native species. Number of fish infected/number of fish examined.

Date	**Salmon***		**Brown trout**		**Rainbow trout***		**Charr**		**Stickleback**	
	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
26.03.00	0/10	-	0/11	-	0/10	-	0/2	-	-	-
08.04.00	0/18	0/18	0/3	0/3	0/4	0/4	0/4	0/4	-	-
03.11.00	-	-	-	-	-	-	-	-	0/10	0/10
01.06.01	-	-	3/10	0/10	0/1	0/1	-	-	21/31	7/31
12.06.01	-	-	1/5	0/5	-	-	-	-	-	-
18.10.01	2/5	0/5	0/3	0/3	0/1	0/1	-	-	0/3	0/3
Total	**2/33**	**0/23**	**4/32**	**0/21**	**0/16**	**0/6**	**0/6**	**0/4**	**21/44**	**7/44**

Wild fish

Ichthyobodo infections were observed on sticklebacks and brown trout in June, with a prevalence of 74% (n=31) and 27% (n=15) respectively. It was also observed on 2 of 5 salmons examined in October (Tab. 8). *Ichthyobodo* infections were denser on the sticklebacks than on the salmonids. Infections occurred on both skin and gills of the stickleback, while only skin infections were observed among the wild salmonids.

Table 9 Dimensions of *Trichodina*-cells from skin and gills of different hosts. Salmon marked with an asterisk (*) is hatchery reared, while salmon, brown trout, and three-spined sticklebacks are wild fish caught in the lake by the hatchery. Two distinct types of *Trichodina* (distinguished by the denticle numbers) observed on the gills of sticklebacks are grouped as Gill[1] and Gill[2]. The measurements of *Trichodina*-cells are from live ciliates or 2D images from smears stained with Diff-Quick® (DQ) or impregnated with silvernitrate (S). Dimensions of the cells are given in range (minimum-maximum) with mean ± SD or mode (when appropriate) in parenthesis. n= numbers of specimens measured.

Host	**Salmon***		**Salmon**	**Brown trout**	**Stickleback**		
Microhabitat	Skin (S)	Skin (DQ)	Skin (DQ)	Skin (DQ)	Skin (S)	Gill[1] (S)	Gill[2] (S)
Diameter of:							
Adhesive disc (µm)	38.8-55.7 (46.7±6.5) n=5	47.4-59.3 (55.4±5.4) n=4	43.9-58.3 (50.0±3.9) n=17	48.5-60.0 (54.3±4.1) n=18	38.6-52.9 (45.3±4.0) n=29	38.5-47.1 (42.2±4.0) n=4	47.7-64.9 (56.4±7.5) n=4
Denticulate ring (µm)	30.8-34.8 (32.6±2.0) n=3	23.7-35.0 (31.3±5.3) n=4	24.8-35.3 (30.2±2.3) n=17	29.4-39.7 (34.1±3.1) n=19	23.8-31.3 (28.0±2.2) n=29	24.8-28.9 (26.3±2.0) n=4	30.6-42.1 (36.1±4.7) n=4
Numbers of:							
Denticles	26 n=1	25-27 n=2	24-28 (27) n=14	25-27 (27) n=16	19-23 (22) n=25	20-22 (20) n=4	30-35 n=4
Radial pins per denticle	10 n=3	n=0	n=0	10-11 (10) n=9	9-10 (10) n= 4	9-10 n=2	8 n=1

Trichodina (Figs. 22-24)

Farmed salmon

The trichodinids moved around with a sliding, circulating motion over the substrate (i.e. skin or gill) with the use of cilia that were clearly visible under a light microscope (Fig 24 F).

A characteristic denticle ring was visible in the ciliates from both fresh and stained smear, but details of this skeleton were more visible in smears that were impregnated with silvernitrate (Fig. 22 and 24). The denticle skeleton consists of characteristically shaped denticles, which overlap and form a ring structure (denticulate ring) in the cell, and fine skeletal rods (radial pins) that make the outer border of the adhesive disc. Center of the adhesive disc appeared dark in *Trichodina* specimens from silver-impregnated smears from salmon, i.e. no center circle or assembling of vesicles present (Fig. 22 B).

The macronucleus was extended and horseshoe-shaped (Fig. 22 D).

Measurements of *Trichodina* in stained or impregnated smears from skin or gill of different hosts are given in Table 9. Dimensions of the cell were measured as illustrated in Figure 5.

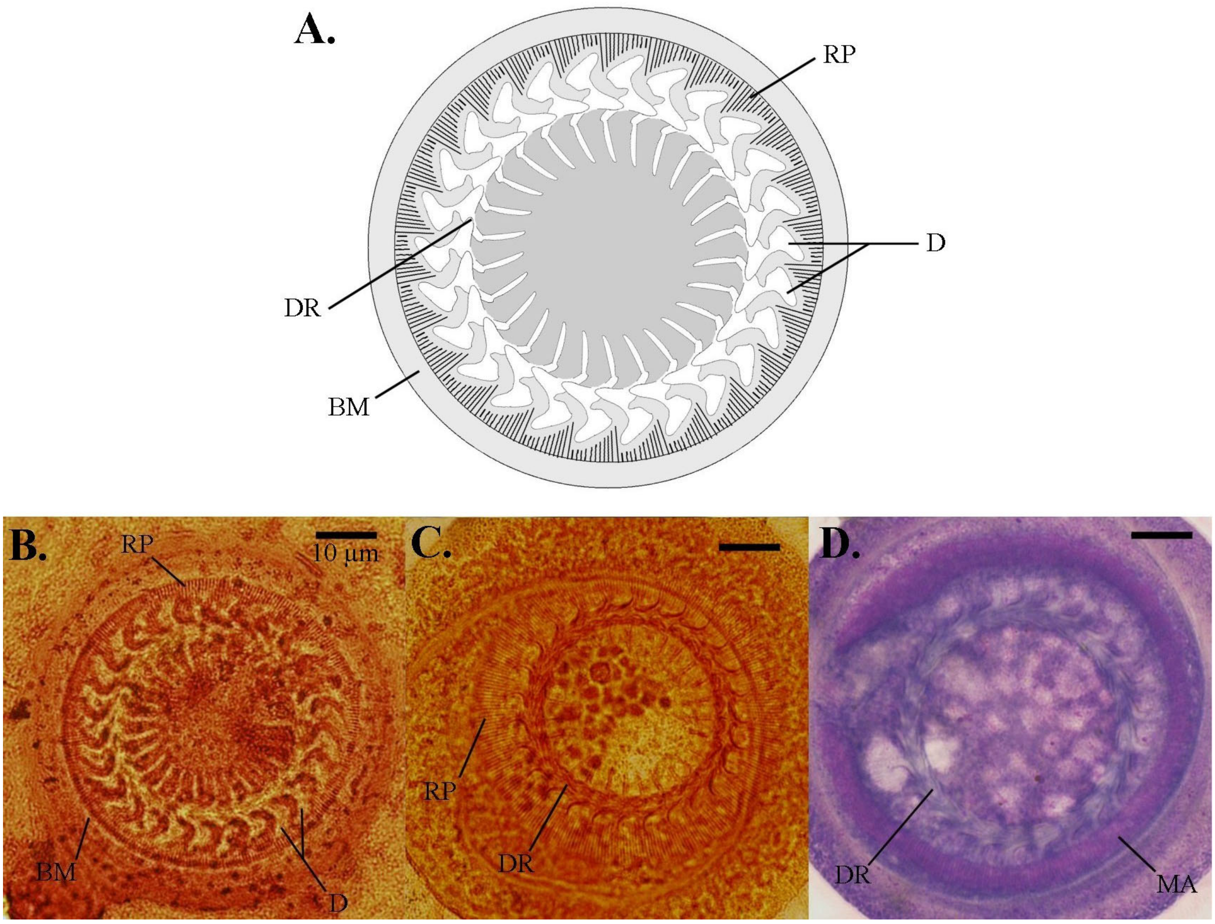


Figure 22 *Trichodina* from skin of hatchery-reared salmon. Bars are equal to 10µm. BM: Border membrane; D: Denticles; DR: Denticulate ring; MA: Macronucleus; RP: Radial pins. **A.** Features of *Trichodina* from salmon. Cilia not drawn. **B-C.** *Trichodina* from skin smear impregnated with silvernitrate. **D.** Shape and position of macronucleus. *Trichodina* from smear stained with Diff-Quick®.

Wild caught salmon and brown trout

The dimensions of *Trichodina* specimens from the skin of farmed salmon were comparable with measurements of the specimens from wild caught salmon and brown trout (Tab. 9, Fig. 22 and 23).

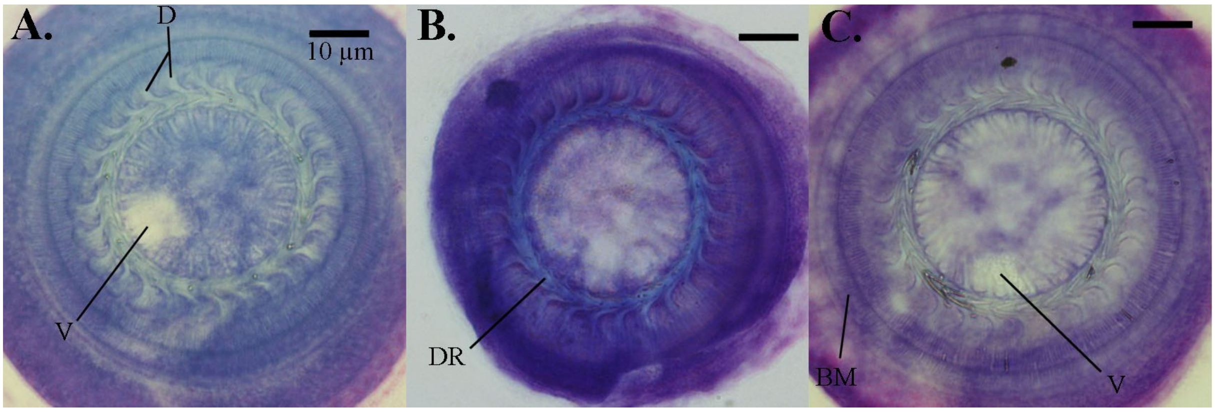


Figure 23 *Trichodina* from skin of brown trout. Bars are equal to 10µm. BM: Border membrane; D: Denticles; DR: Denticulate ring; V: Vacuole. **A-C.** *Trichodina* from smear stained with Diff-Quick®.

Three-spined sticklebacks

Two distinct types of *Trichodina* (Type I and Type II) were observed on the skin and gills of sticklebacks. *Trichodina* sp. I occurred on both skin and gills (Gill[1] in Tab. 9), while *Trichodina* sp. II occurred on the gills (Gill[2]) and rarely skin. Species I was smaller than species II, but the denticle numbers more easily distinguished these types (Tab. 9). In addition, the adhesive disc of species I had a clearly visible centre circle, while there was an assembling of granules (possible vesicles) in the center of species II (Fig. 24).

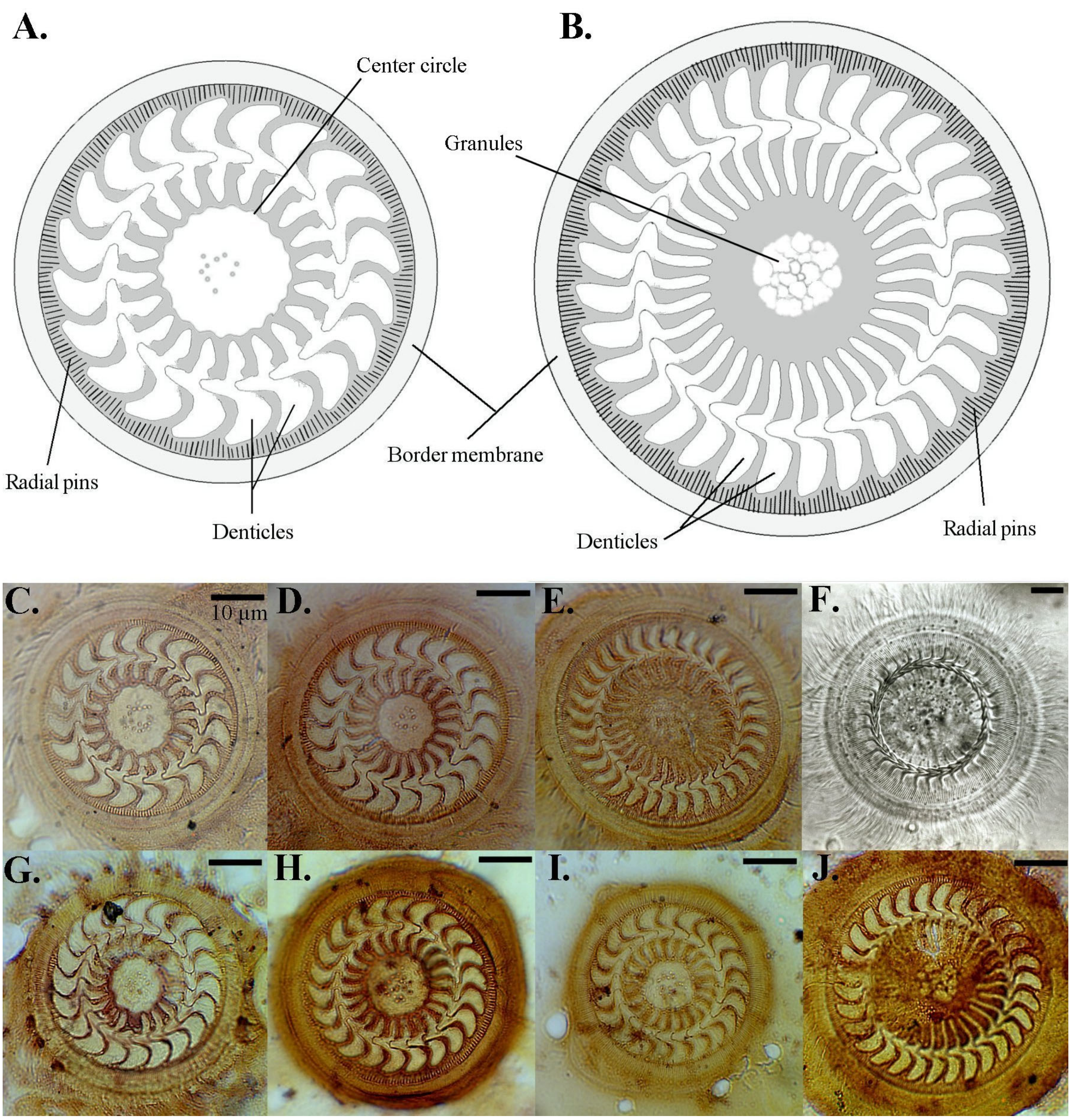


Figure 24 Trichodinids of three-spined stickleback. Smears are impregnated with silvernitrate (Klein's method), except photo F that is a "live" photo. Bars are equal to 10 µm. **A.** Features of *Trichodina* sp. I (corresponds to photos C, D, G, H and I). **B.** Features of *Trichodina* sp. II (corresponds to photos E, F and J). **C-F.** Trichodinids from skin of sticklebacks. **G-J.** Trichodinids from gills of sticklebacks.

Table 10 *Trichodina* infections on wild caught fish (skin and gills). The fish were caught in the same watercourse by net, except salmonids in 2001 that were caught by angling and the sticklebacks that were caught with traps. The salmon and rainbow trout are feral fish* (escapees from lake-pens) while brown trout, charr and three-spined sticklebacks are native species. Number of fish infected/number of fish examined.

Date	**Salmon***		**Brown trout**		**Rainbow trout***		**Charr**		**Stickleback**	
	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
26.03.00	2/10	-	0/11	-	0/10	-	0/2	-	-	-
08.04.00	9/18	0/18	0/3	0/3	0/4	0/4	0/4	0/4	-	-
03.11.00	-	-	-	-	-	-	-	-	9/10	6/10
01.06.01	-	-	1/10	0/10	0/1	0/1	-	-	31/31	27/31
12.06.01	-	-	1/5	0/5	-	-	-	-	-	-
18.10.01	1/5	0/5	1/3	0/3	0/1	0/1	-	-	3/3	3/3
Total	**12/33**	**0/23**	**3/32**	**0/21**	**0/16**	**0/6**	**0/6**	**0/4**	**43/44**	**36/44**

Trichodina infection in the fish farm

On salmon, *Trichodina* infections were only observed on the skin. The ciliate was first detected in late May (tank C3, sample no. 17) and again in September-November (net pen, sample no. 33 and no. 35). Only slight infections occurred, but a tendency of increasing prevalence occurred in tank C3 in a four-week period (May 30th – June 29th) reaching of 18% (sample no. 23: mean fish length 15.4 ± 0.9 cm, water temperature 14.2 °C, n=35). The infections in tank C occurred at the same time as the level of bacteria (organic matter) in this tank peaked (Fig. 12). An unfortunate accident (June 30th) killed the fish in this tank (C3), preventing further study.

Among the net pen fish, only 2 salmons of 46 examined were infected (slightly) with *Trichodina* in September (sample no. 33: 17.0±2.9 cm, 14.9 °C) and 1 of 40 in November (sample no. 35: 22.9±1.6 cm, 6.5 °C).

Trichodina was observed on the skin of salmon at water temperatures between 6.5 – 14.9 °C and at pH from 5.7 to 6.5. Due to low prevalence and intensities, the relationships between *Trichodina* infections and abiotic or biotic parameters could not be examined.

Wild fish

Trichodina infection was common on skin and gills of the sticklebacks. Nearly 100% of the sticklebacks examined were infected on the skin, while 82% were infected on the gills (Tab. 10). *Trichodina* infections were also detected on the skin of salmon (39%) and brown trout (9%), but at lower density compared with the sticklebacks. No trichodinids were observed on rainbow trout or the few charr examined.

Apiosoma (Figs. 25-28)

Farmed salmon

These ciliates mainly occurred singly, but also in pairs (Fig. 26 B) or in small groups. They were attached to the skin (rarely gills) by an attachment disc (scopula). The cell body of the *Apiosoma* specimens observed on salmon was conical in shape and tapered towards the scopula.

Measured live, the length from scopula to the epistomial disc ranged from 51.4 – 70.0 µm (n= 7, 57.9 ± 7.5 µm (mean ± SD)), maximum width 19.8 – 31.6 µm (n= 7, 24.8 ± 4.3 µm) and scopula width from 7.9 – 11.9 (n=3). When observed live, the cilia, located at the oral end (adoral ciliature) of the cell, showed vigorous undulation. The peristomial lip was also active in motion showing fits of opening and closing.

The macronucleus is triangular with its pointed end directed posterior towards the scopula when observed in living specimens (Fig. 26 B). In stained smears (Fig. 26 A) it was compact and appeared more rounded (oval or drop-shaped). The micronucleus was oval in shape and located lateral to the macronucleus, near its aboral part.

A distinct wreath (pectinellar wreath) surrounded the upper half of the cell, typically appearing as a secant or tangent to the upper part of the macronucleus (illustrated in Fig. 25).

Annular striations in the pellicle were evident in some *Apiosoma* specimens in Diff-Quick® stained smears, especially below the pectinellar wreath (Fig. 26 A).

An infundibulum with rows of associated kineties could often be discerned as a pale area, winding down towards the centre of the cell, ending near a prominent vacuole.

The epistomial disc was slightly convex and more or less shielded by the adoral ciliature and the surrounding peristomial lip, the latter forming the outermost structure at the adoral part of the cell.

Measurements of *Apiosoma* in stained smears from skin or gill of different hosts are given in Table 11. Dimensions of the cell were measured as illustrated in Figure 6.

Brown trout

Apiosoma specimens from skin of brown trout were larger than those observed on the skin of salmon (Tab. 11), but similar in body shape and other characteristics like position and shape of macro- and micronucleus (Fig. 27 & 29).

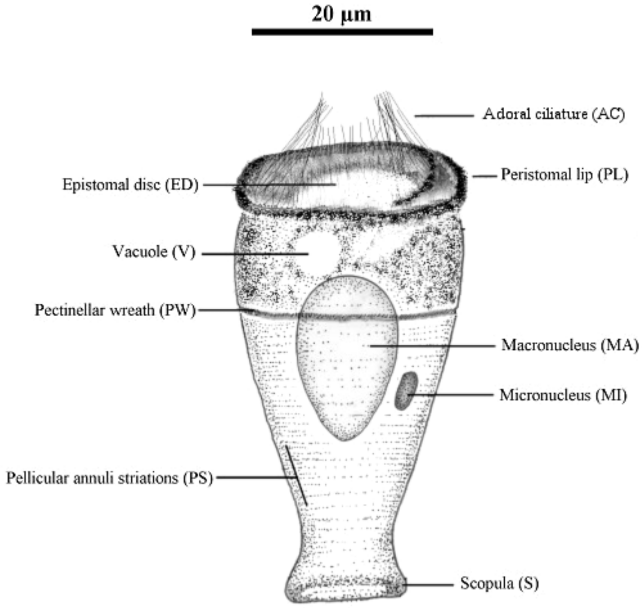


Figure 25 Characteristic features of an *Apiosoma* specimen from the skin of salmon.

Three-spined sticklebacks

Apiosoma specimens observed in fresh smears from skin of sticklebacks mostly occurred singly, but also in pairs or in clusters, and the cell body appeared less elongated (shorter stem) in shape compared with those observed in salmon and trout.

Apiosoma specimens observed on the gills of sticklebacks occurred more frequently in clusters (Fig. 28 A) compared with the skin-*Apiosoma*, and some of them were attached to the substrate (gill surface) with a clearly visible stalk (Fig. 28 A and D).

Apiosoma specimens observed on gills of sticklebacks were morphologically similar to those from skin, regarding shape and position of MA and MI (Fig. 28 & 29). In stained smears, a large compact macronucleus is taking most of the volume in the lower half of the cell. The micronucleus is rounded and located at, or below, the lowest part of the macronucleus (Fig. 28 C). In addition to the stalk, position of the nuclei, especially macronucleus (Fig. 29), appear to be characteristics that distinguish these stickleback *Apiosoma* from the salmon *Apiosoma*.

Epistylis specimens were also commonly observed on both skin and gills of sticklebacks, occurring solitary or in pairs, attached to the substrate with a stalk. The macronucleus is sausage-shaped, and situated in the upper half of the cell. Features of this ciliate are shown in Figure 28 (B, E & F).

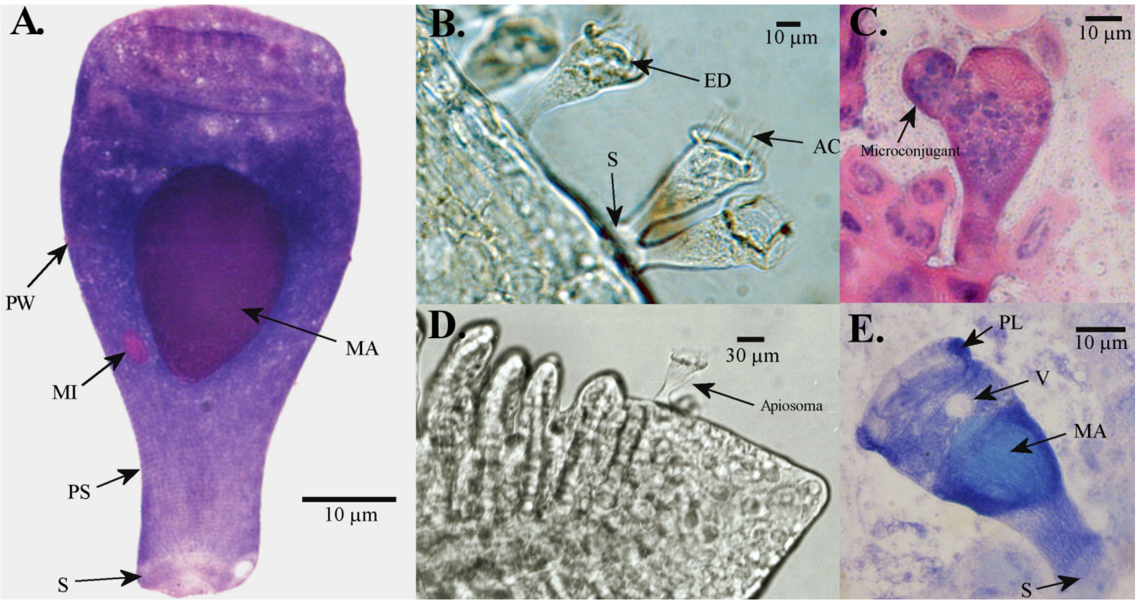


Figure 26 *Apiosoma* from juvenile salmon. AC: Adoral ciliature; MA: Macronucleus; MI: Micronucleus; PL: Peristomial lips; PS: Pellicular annuli striations; PW: Pectinellar wreath; S: Scopula; V: Vacuole. **A)** *Apiosoma* from skin-smear stained with Diff-Quick®. **B)** Skin infection (live). **C)** Conjugation. Skin smear (haematoxylin and eosin). **D)** Gill infection (live). **E)** *Apiosoma* from skin-smear (Diff-Quick®).

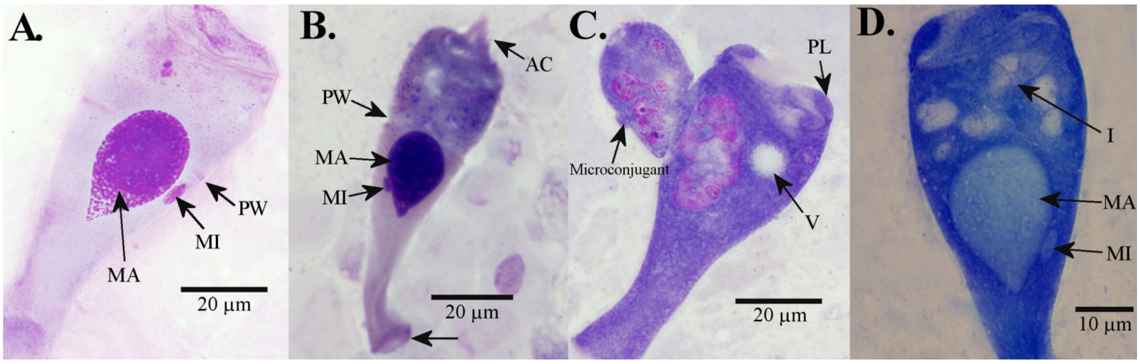


Figure 27 *Apiosoma* from skin of brown trout. Diff-Quick® stained. AC: Adoral ciliature; MA: Macronucleus; MI: Micronucleus; PL: Peristomial lips; PW: Pectinellar wreath; S: Scopula; V: Vacuole.

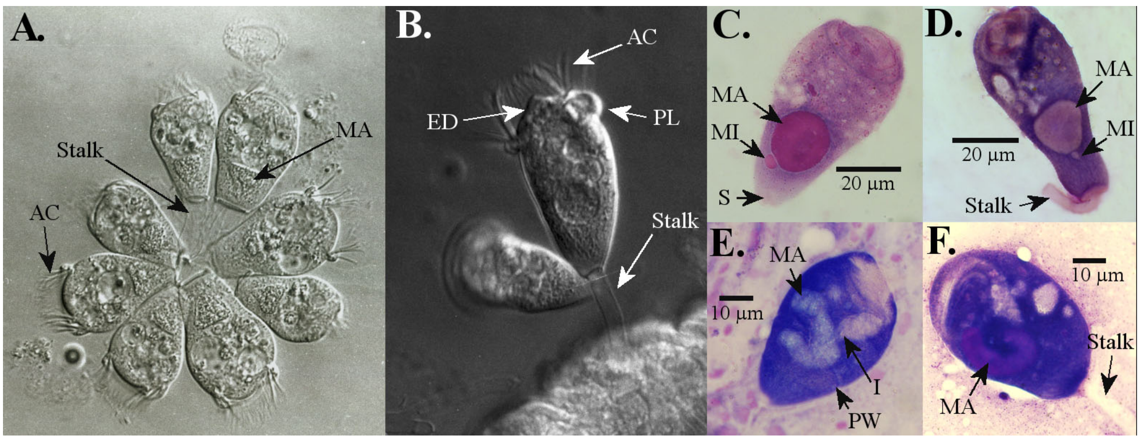


Figure 28 Sessiline peritrichs from skin and gills of three-spined sticklebacks. AC: Adoral ciliature; ED: Epistomial disc; MA: Macronucleus; MI: Micronucleus; PL: Peristomial lips; PW: Pectinellar wreath; S: Scopula. **A)** *Apiosoma* infections on gills (live). **B)** *Epistylis* infection on gill (live). **C)** *Apiosoma* from skin. **D)** *Apiosoma* from gills. **E)** *Epistylis* from gills. **F)** *Epistylis* from skin.

Table 11 Dimensions of *Apiosoma* from different hosts. Salmon* is hatchery-reared, while brown trout, and three-spined sticklebacks are native species from the lake by the hatchery. Sampling month and total length (cm) is given for each host. All measurements of *Apiosoma*-cells are from 2D images from haematoxylin* or Diff-Quick® stained smears. Numbers of measured ciliates (n) and origin hosts (N) are given. Dimensions (µm) are given as range (minimum-maximum) with mean ± SD in parenthesis. **L1:** Total length of the cell. **L2:** Maximum width. **L3**: Size of scopula. **L4** and **L5**: Position of macronucleus and micronucleus. **L6** and **L7**: Size of macronucleus. **L8** and **L9**: Size of micronucleus. **L10**: Distance between pectinellar wreath and scopula.

***Apiosoma* dimensions**	**Salmon* July 2000 13.4-13.7 cm N=2**	**Brown trout June 2001 27.5-30.9 cm N=2**	**Stickleback June 2001 4.5 cm N=2**	**Stickleback June 2001 4.6 cm N=1**
	Skin	Skin	Skin	Gill
L1	39.6 - 63.0 (51.9 ± 6.0) n=31	53.9 - 97.6 (67.0 ± 10.5) n=22	35.6 - 60.9 (45.2 ± 8.3) n=11	52.2 - 79.0 (62.6 ± 8.9) n=13
L2	18.0 - 36.1 (25.8 ± 4.4) n=30	21.2 - 41.8 (33.0 ± 5.3) n=22	25.4 - 44.7 (34.3 ± 5.9) n=11	32.0 - 40.8 (35.9 ± 2.3) n=13
L3	4.4 - 22.6 (10.0 ± 3.4) n=31	5.9 - 19.5 (11.5 ± 2.9) n=21	6.6 - 23.5 (12.9 ± 5.3) n=11	7.5 - 20.9 (11.7 ± 3.9) n=13
L4	21.1 - 34.5 (27.8 ± 3.2) n=30	22.8 - 61.7 (35.1±8.3) n=22	9.9 - 21.2 (15.6 ± 3.5) n=11	16.5 - 36.1 (23.7 ± 6.0) n=13
L5	26.5 - 27.3 n=2	14.6 - 67.9 (28.4 ± 12.4) n=15	1.6 - 11.2 (6.4±2.9) n=9	7.2 - 25.1 (14.9 ± 5.9) n=13
L6	13.3 - 21.3 (17.3 ± 1.9) n=30	17.9 - 33.8 (24.4 ± 4.0) n=22	11.0 - 23.9 (15.7 ± 4.3) n=11	13.8 - 21.8 (18.0 ± 2.6) n=12
L7	10.0 - 18.9 (13.6 ± 2.2) n=30	11.5 - 24.4 (19.3 ± 3.2) n=22	15.3 - 26.0 (19.8 ± 3.6) n=11	16.2 - 21.3 (18.9 ± 1.9) n=12
L8	3.3 n=1	2.7 - 5.3 (4.4) n=6	2.2 - 6.1 (3.4) n=5	2.6 - 3.4 (2.9) n=4
L9	2.4 n=1	2.5 - 6.4 (3.7) n=4	1.8 - 3.5 (2.6) n=3	2.3 - 3.4 (2.7) n=4
L10	24.5 - 42.9 (33.4 ± 4.2) n=27	29.9 - 69.3 (41.2 ± 8.9) n=21	15.5 - 32.7 (24.8 ± 5.5) n=10	23.9 - 42.4 (31.6 ± 5.7) n=13

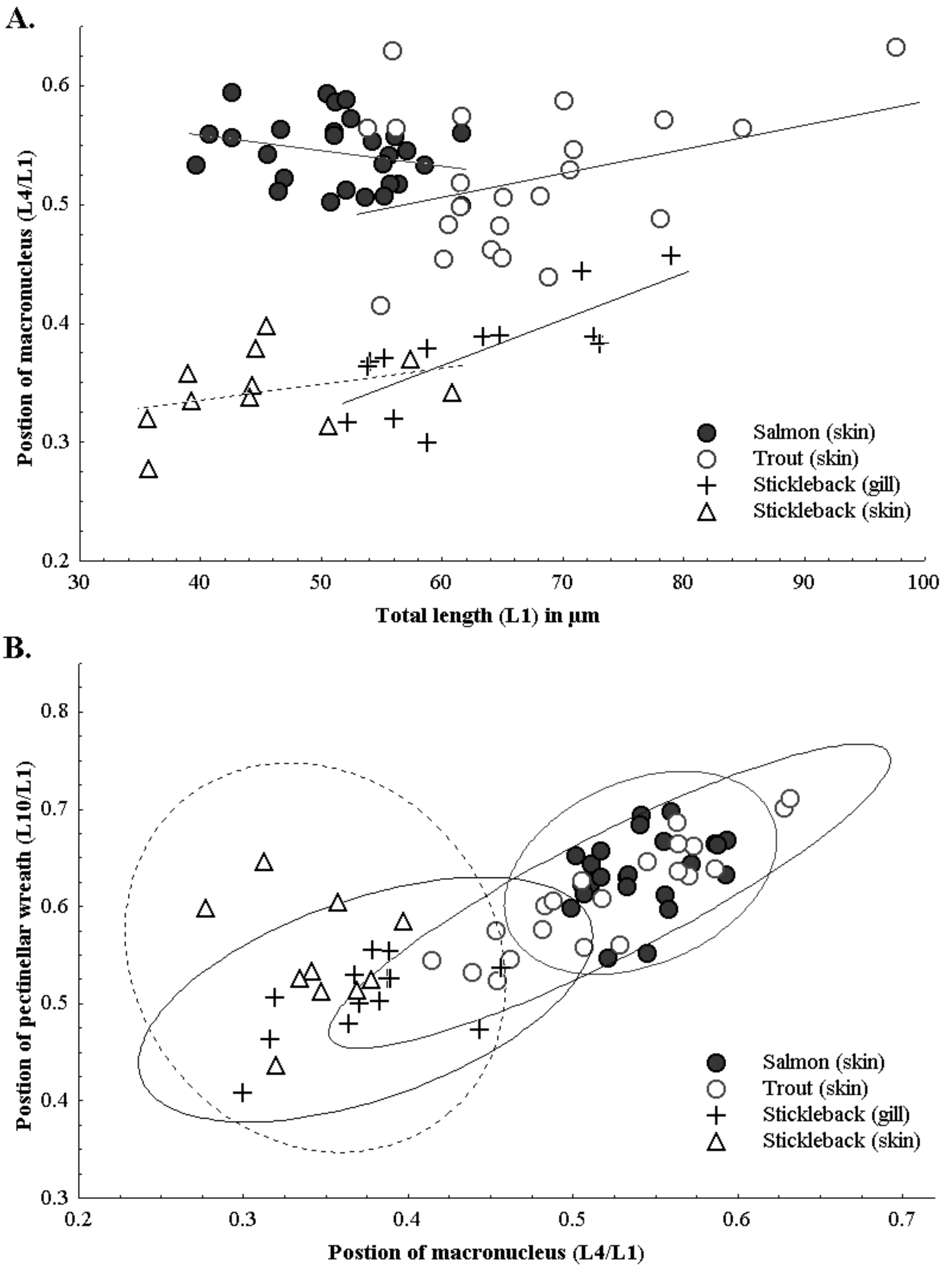


Figure 29 Morphometrics of *Apiosoma*-cells from different hosts. Salmon is hatchery reared, while brown trout and sticklebacks are wild fish, caught in the lake that serves as water source for the fish farm.

A) Scatterplots with linear regression lines showing the relative position of macronucleus in relation to the cell length.

B) Scatterplots with 95% prediction interval ellipse of relative positions of macronucleus versus pectinellar wreath.

Dynamics of *Apiosoma* infection in the fish farm

Apiosoma infections occurred during summer (the warmer period of the year (Fig. 9)) and were more prevalent on skin than gills (Fig. 30). In gill-infections, the ciliate was most commonly located at the tip of a primary filament (Fig. 26 D).

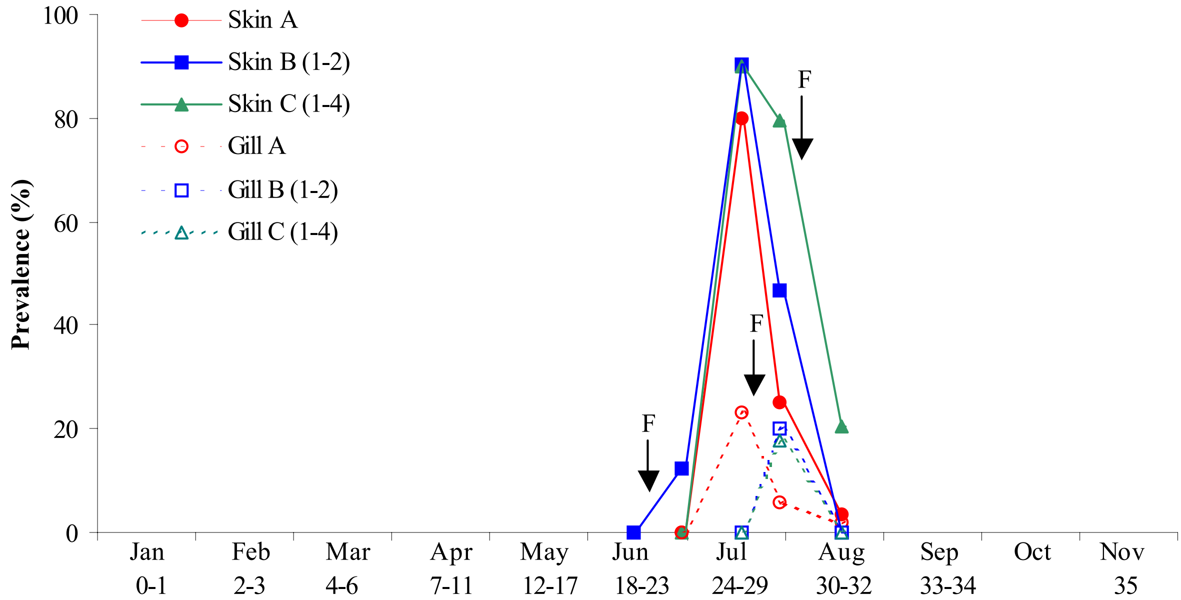


Figure 30 Temporal variations in *Apiosoma*-prevalence among hatchery/lake-pen reared salmon. Samples (numbered 0-35) were taken from different tanks (A, B1-B2 and C1-C4) and a net pen (P). The salmon reared in control tanks (C1 and C2: March 10th – May 11th, C3: May 11th – June 30th, C4: June 30th – August 19th) were not exposed to handling (i.e. grading, thinning). Tank A was treated with formalin at three occasions ("F").

This ciliate was first observed in late June on parr from tank B2 (Sample no. 22: n= 64, mean fish length 13.8 ± 1.1 cm, water temperature 15.0 °C), and the prevalence peaked in mid-July when most of the fish in all tanks were infected (Tank A, sample no. 24; tank B2, sample no. 25; tank C4, sample no. 26). The prevalence declined markedly in tank A from July (sample no. 24), when 80% of the fish examined were infected, to only 4% in mid-August (sample no. 30) after receiving two formalin treatments (July 21st and August 01st). However, the prevalence of *Apiosoma*-infection also decreased markedly during the same period for the other tanks (B2 and C4) without treatment. Among the fish reared in tank B2, 90% were infected in mid-July (sample no. 25), while none of the fish examined four weeks later (mid-August) were infected (sample no. 31). Prevalence of infection declined from 90% in tank C4 in mid-July (sample no. 26) to 21% in mid-August (sample no. 32).

Heavy *Apiosoma* infections (i.e. more than 30 symbionts observed per skin-smear) occurred on a few fish in July only (Fig. 31). Prevalence of *Apiosoma* infections increased to a maximum during a period when bacteria concentrations in the water of the fish tanks decreased (Fig. 12 and 30).

There were no correlations between infection and crowding, fish size, condition factor or Hct. Overall, *Apiosoma* infections occurred in a temperature range of 11.9 – 17.5 °C and in a pH range of 6.08 - 6.37. No mortality or clinical signs was associated with the presence of this ciliate.

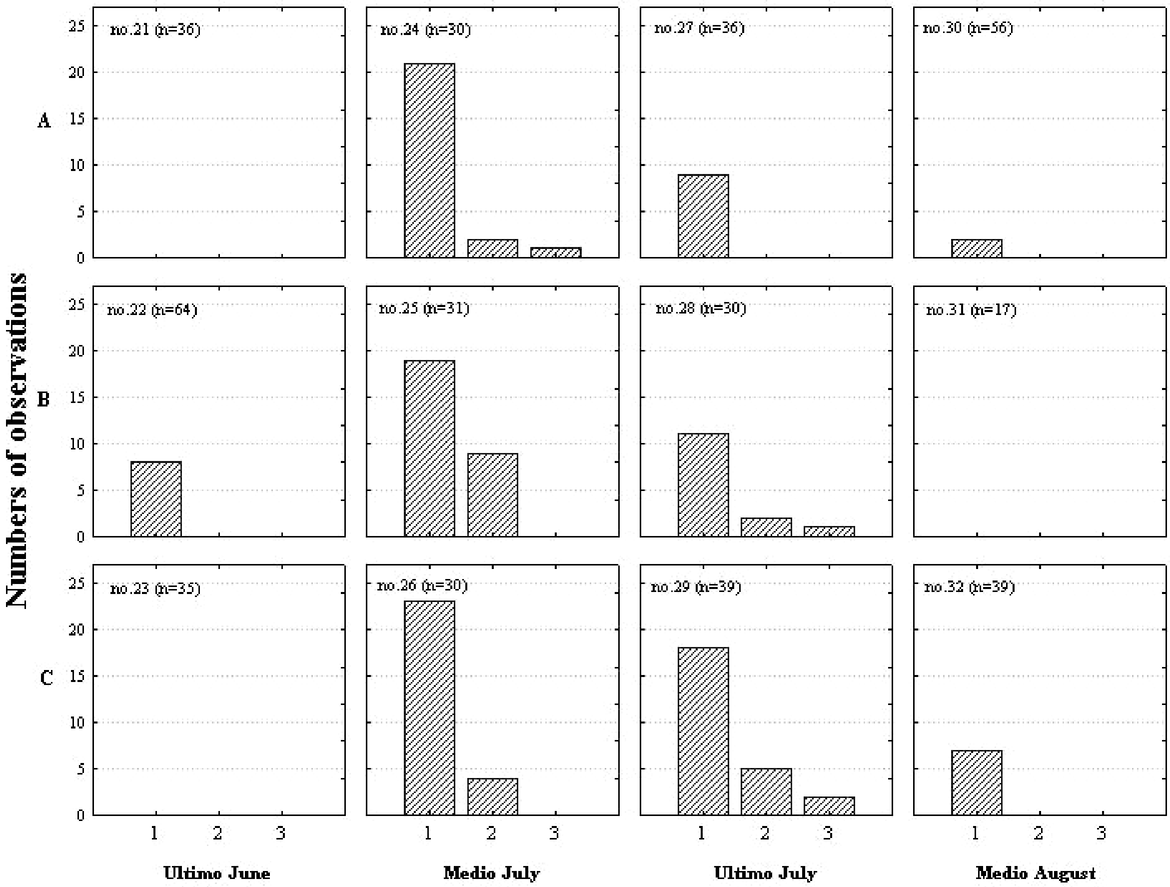


Figure 31 Ranked intensities of *Apiosoma* infections on the skin of salmon reared in different tanks (A, B and C) and a net pen (P). All fish examined are from the same cohort. A total of 36 samples were taken in the period from hatching (January) to pre-smolt (November). Only periods of *Apiosoma* infection are shown in the figure. Sample numbers (no.) and numbers of fish examined (n) are given above each histogram. Intensities of infection in a lateral scraping from base of the pectoral fin to level of the start of the dorsal fin are ranked on a scale from 1 – 3: 1, <10 *Apiosoma* cells observed in the smear, 2, 10-30; 3, >30.

Table 12 *Apiosoma* infection on wild caught fish (skin and gill)**.** The fish were caught in the same watercourse by net, except salmonids in 2001 that were caught by angling and the sticklebacks that were caught with traps. Salmon and rainbow trout are feral fish* (escapees from lake-pens) while brown trout, charr and three-spined sticklebacks are native species. Number of fish infected/number of fish examined.

Date	**Salmon***		**Brown trout**		**Rainbow trout***		**Charr**		**Stickleback**	
	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
26.03.00	1/10	-	3/11	-	1/10	-	0/2	-	-	-
08.04.00	0/18	0/18	1/3	0/3	0/4	0/4	0/4	0/4	-	-
03.11.00	-	-	-	-	-	-	-	-	4/10	10/10
01.06.01	-	-	8/10	0/10	0/1	0/1	-	-	17/31	29/31
12.06.01	-	-	5/5	0/5	-	-	-	-	-	-
18.10.01	0/5	0/5	0/3	0/3	0/1	0/1	-	-	0/3	3/3
Total	**1/33**	**0/23**	**17/32**	**0/21**	**1/16**	**0/6**	**0/6**	**0/4**	**21/44**	**42/44**

Wild fish

Apiosoma infections were commonly observed on the skin of brown trout in summer (June, 87%), but appeared to be less prevalent in the spring (March-April, 29%). Infections were also observed on the skin of salmon and rainbow trout in March (Tab. 12). *Apiosoma* infections occurred on both skin and gills of sticklebacks, but were most prevalent on the gills (95%).

Riboscyphidia (Figs. 32-34)

Farmed salmon

These ciliates most commonly occurred as single cells, but also in pairs or small groups. They were attached to the skin (rarely gill) by a scopula. The scopula is broad, compared to the scopula of *Apiosoma* from salmonids and sticklebacks. This gives the *Riboscyphidia*- cell a barrel-like shape. Measured live (n=18), the cell length from scopula to the epistomial disc ranged from 27.5 to 55.0 µm (41.5 ± 6.2 (mean ± SD)), maximum width ranged from 27.5 to 40.0 µm (32.0 ± 4.0) and scopula width from 20.0 to 37.5 µm (25.8 ± 5.14). In live ciliates, the adoral cilia showed vigorous undulation.

The macronucleus is horseshoe-shaped and located in the aboral part of the cell. The macronucleus in stained smears was located 6.0 to 24.1µm above the scopula (Tab. 13). The micronucleus was rounded, and most commonly located at the end of a macronucleus “arm” as illustrated in Figure 32.

The infundibulum appeared as a spiral-shaped structure with kineties, often partly visible in *Riboscyphidia* cells from Diff-Quick® stained smears.

Several small vacuoles (possible food vacuoles, “FV” in Fig. 32 and 33 D, E & F) were occasionally observed located near the end of the infundibulum. In some occasions, these vacuoles contained small green coloured particles (Fig. 33 D). One large vacuole (CV) was located alongside, or just below the infundibulum.

The epistomial disc appeared relatively flat and was more or less shielded by its surrounding ciliature and the peristomial lip.

A trocheal wreath (often inconspicuous), was detected in the area between scopula and macronucleus, surrounded the lower part of the cell. Annular striations in the pellicle above this wreath might be discerned in Diff-Quick® stained smears.

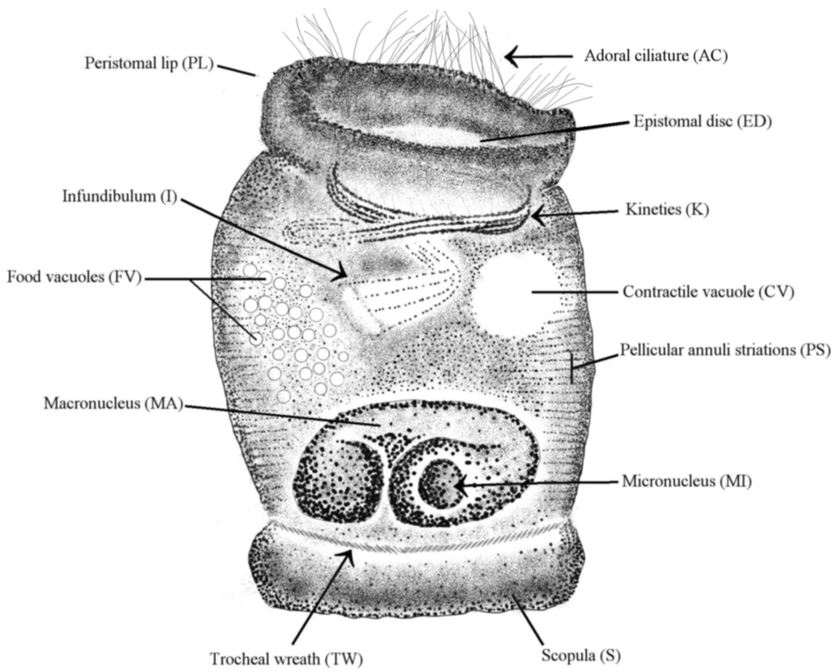


Figure 32 Characteristic features of a *Riboscyphidia* specimen from the skin of salmon in freshwater.

Table 13 Measurements of *Riboscyphidia*-cells from salmonids. Salmon* is hatchery-reared, while brown trout is native species from the lake by the hatchery. Sampling month (year) and sizes (range of total length in cm) of the hosts are given. All measurements of *Riboscyphidia*-cells are of 2D images from haematoxylin* or Diff-Quick® stained smears. Numbers of fish examined are given as N while numbers of ciliates measured are given as n. Dimensions (µm) are given as range (minimum-maximum) with mean ± SD in parenthesis. **L1:** Total length of the cell measured from scopula to epistomial disc. **L2:** Maximum body width. **L3:** Width of scopula. **L4:** Position of macronucleus as distance from scopula to centre of the nucleus. **L5:** Length of one "arm" of the macronucleus. **L6:** Position of infundibulum as distance from scopula to the lower part of infundibulum. **L1:L2** is aspect ratio for total length (L1) of the cell and maximum width (L2). **L2:L3** is aspect ratio for maximum width (L2) and width of the scopula (L3).

Host	***Riboscyphidia* dimensions**							
	L1	**L2**	**L3**	**L4**	**L5**	**L6**	**L1:L2**	**L2:L3**
Salmon* (N=2) 15.4-15.8 cm July (2000)	28.1-51.5 (41.3±6.4) n=30	25.7-53.7 (39.9±6.5) n=30	13.9-38.8 (26.8±7.1) n=29	6.3-24.1 (14.0±4.9) n=30	12.5-18.5 (15.8±2.0) n=8	18.4-38.6 (27.9±5.0) n=22	0.8-1.4 (1.0±0.1) n=30	1.1-2.2 (1.6±0.3) n=29
Brown trout (N=2) 27.5-30.9 cm June (2001)	30.6-60.2 (44.4±6.3) n=21	35.8-50.2 (41.4±4.1) n=21	19.9-40.7 (30.1±5.8) n=21	7.7-23.7 (14.0±4.5) n=18	14.5-24.6 (17.4±3.4) n=7	16.3-24.6 (20.9±2.9) n=8	0.8-1.3 (1.1±0.1) n=21	1.1-2.0 (1.4±0.2) n=21

A disc-shaped migratory stage, telotroch, was observed in *Riboscyphidia* infections during the autumn. These telotrochs moved around in a spinning motion with the use of a girdle of locomotory cilia that surrounds the cell. In some telotrochs from stained smears, this girdle was seen to be composed of many short and oblique kineties (pectinelles). The macronucleus was horseshoe-shaped as for the sessile *Riboscyphidia* (Fig. 33 J-L & 34 J-L.). Measured in Diff-Quick® stained smears, the diameter of these telotrochs ranged from 32.4 to 39.9 µm (n=3).

Brown trout

Riboscyphidia from the skin of brown trout was morphologically similar to those that were observed on hatchery-reared salmon (Tab. 13 and Fig. 34).

Specimens of *Riboscyphidia* undergoing division (Fig. 34 G-I) and conjugation (Fig. 34 E-F) were observed in skin smears from brown trout during summer.

Telotrochs observed in Diff-Quick® stained skin-smears of brown trout conformed to the morphology of those from salmon, and ranged from 24.8 to 49.6 µm (n=9, mean 34.7±7.2) in diameters.

Measurements of attached *Riboscyphidia* specimens in stained smears of salmon and brown trout are given in Table 13. Dimensions of the cell were measured as illustrated in Figure 7.

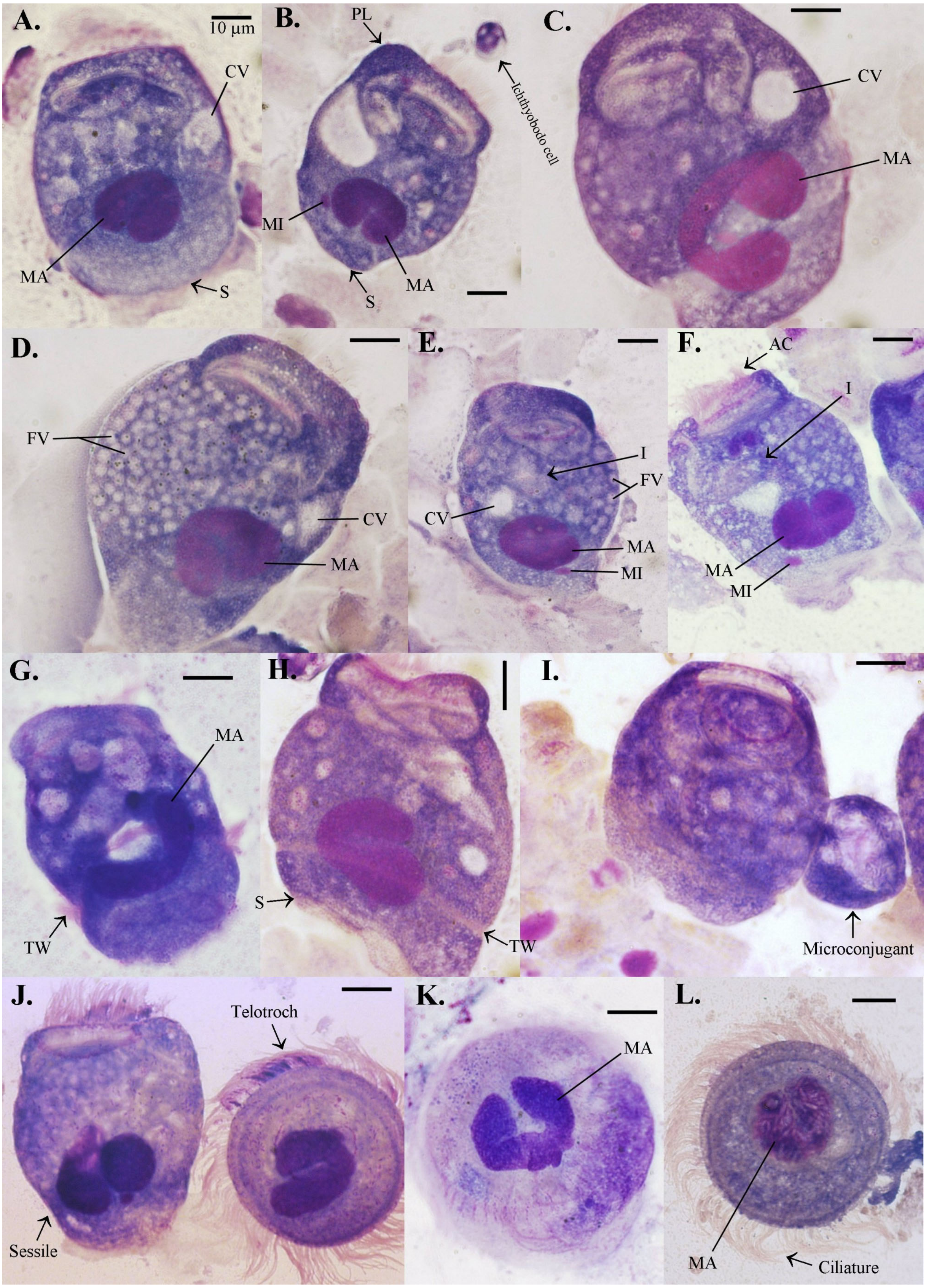


Figure 33 *Riboscyphidia* specimens from skin of juvenile salmon. Bars are equal to 10 µm. AC: Adoral ciliature; CV: Contractile vacuole; FV: Food vacuole; I: Infundibulum; MA: Macronucleus; MI: Micronucleus; PL: Peristomial lip; S: Scopula; TW: Trocheal wreath. **A-C**: Characteristic horseshoe-shaped MA. **D-F**: Numerous food vacuoles at the end of infundibulum. **G**: Trocheal wreath with cilia clearly visible **H**: Position of trocheal wreath. **I**: Conjugation. **J-L**: Telotrochs.

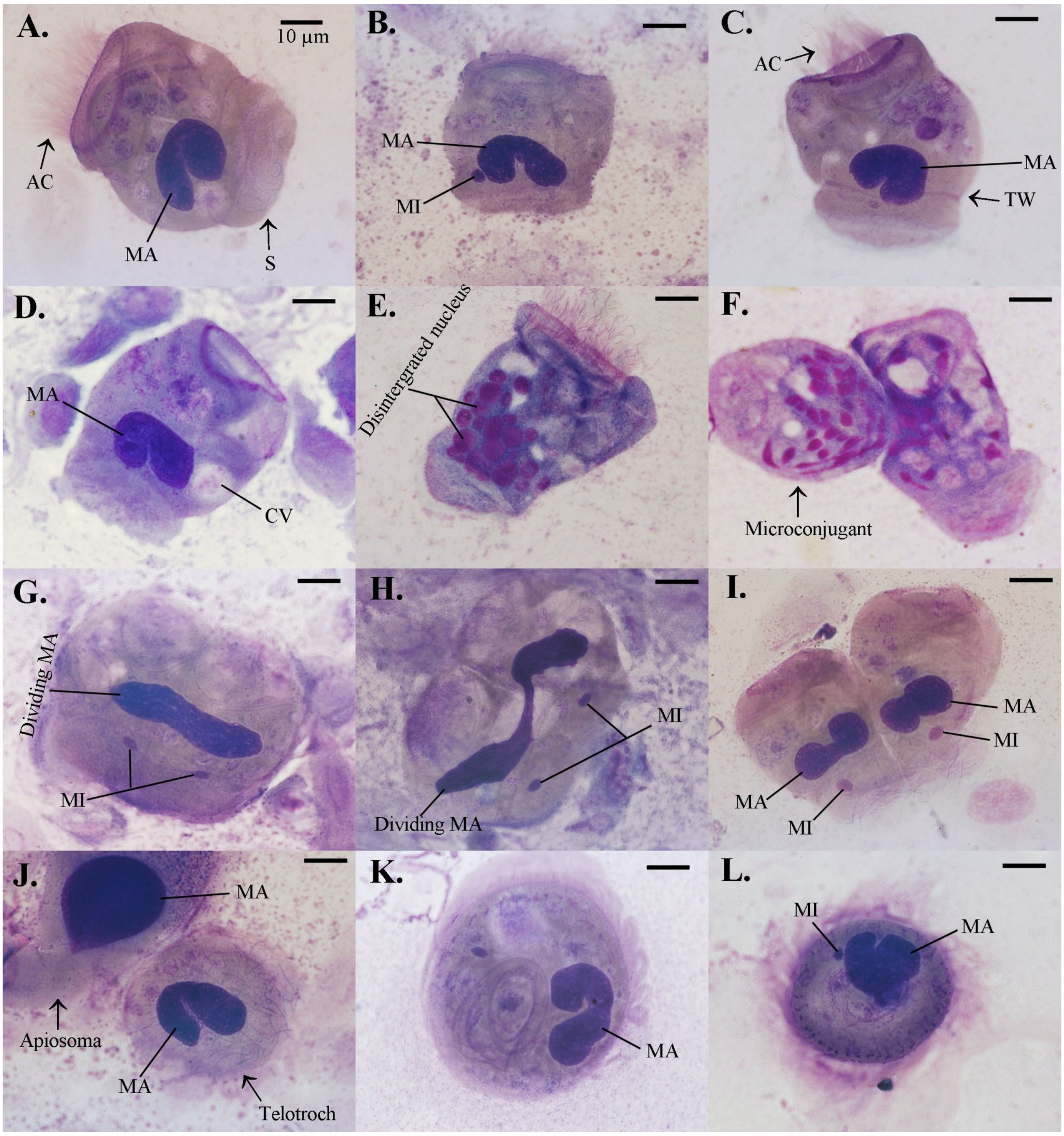


Figure 34 *Riboscyphidia* specimens from skin of brown trout. Bars are equal to 10 µm. AC: Adoral ciliature; CV: Contractile vacuole; MA: Macronucleus; MI: Micronucleus; S: Scopula; TW: Trocheal wreath. **A-D**: Adult, sessile *Riboscyphidia*. **E-F**: Conjugation. **G-H**: Cell division. **I**: Two daughter cells. **J-L**: Telotrochs.

Dynamics of *Riboscyphidia* infection in the fish farm

Riboscyphidia infections were far more prevalent on skin than gills of salmon. Single or a few ciliates were occasionally observed on the gills of salmon in August - November.

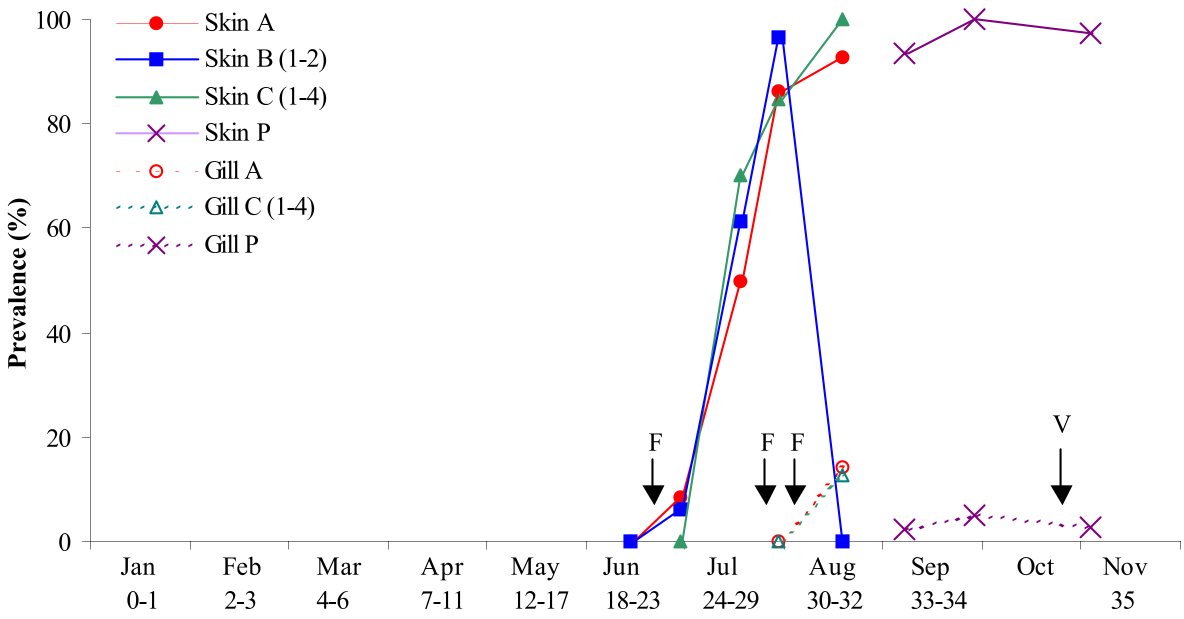


Figure 35 Temporal variations in *Riboscyphidia*-prevalence among hatchery/lake-pen reared salmon. Samples (numbered 0-35) were taken from different tanks (A, B1-B2 and C1-C4) and a net pen (P). Tank A and B1 were mixed and sorted on June 15th, whereafter the larger fish was reared in tank B2 while the smaller fish was reared in tank A. The salmon reared in control tanks (C1 and C2: March 10th – May 11th, C3: May 11th – June 30th, C4: June 30th – August 19th) were not exposed to handling (i.e. grading, thinning). Tank A was treated with formalin at three occasions ("F"). The pen-reared fish was routinely vaccinated ("V") in late October.

This ciliate was first detected on the skin of parr from tank A (sample no. 21: n=36, mean fish length 9.3 ± 1.7 cm, water temperature 17.6 °C) and B2 (sample no. 22: n=64, 13.6 ± 1.1 cm, 15.0 °C) in late June when 6-8 % were infected. Prevalence increased markedly in all tanks during July (Fig. 35).

Prevalence declined to zero among the larger fish (tank B2, sample no. 31) in the period from late July to mid-August, while it stayed high (equal or close to 100 %) in tank A (sample no. 30) despite two formalin treatments ("F" in Fig. 35), and in tank C4 (sample no. 32). Intensities of the *Riboscyphidia* infections are shown in Figure 36. Heavy infections occurred, more or less, in all tanks (A, B2 and C4) and in the net pen (P) despite different rearing densities (Fig. 14). As for the *Apiosoma* infections, prevalence of *Riboscyphidia* infections increased to a maximum in the period when bacteria concentrations in the water of the fish tanks decreased (Fig. 12).

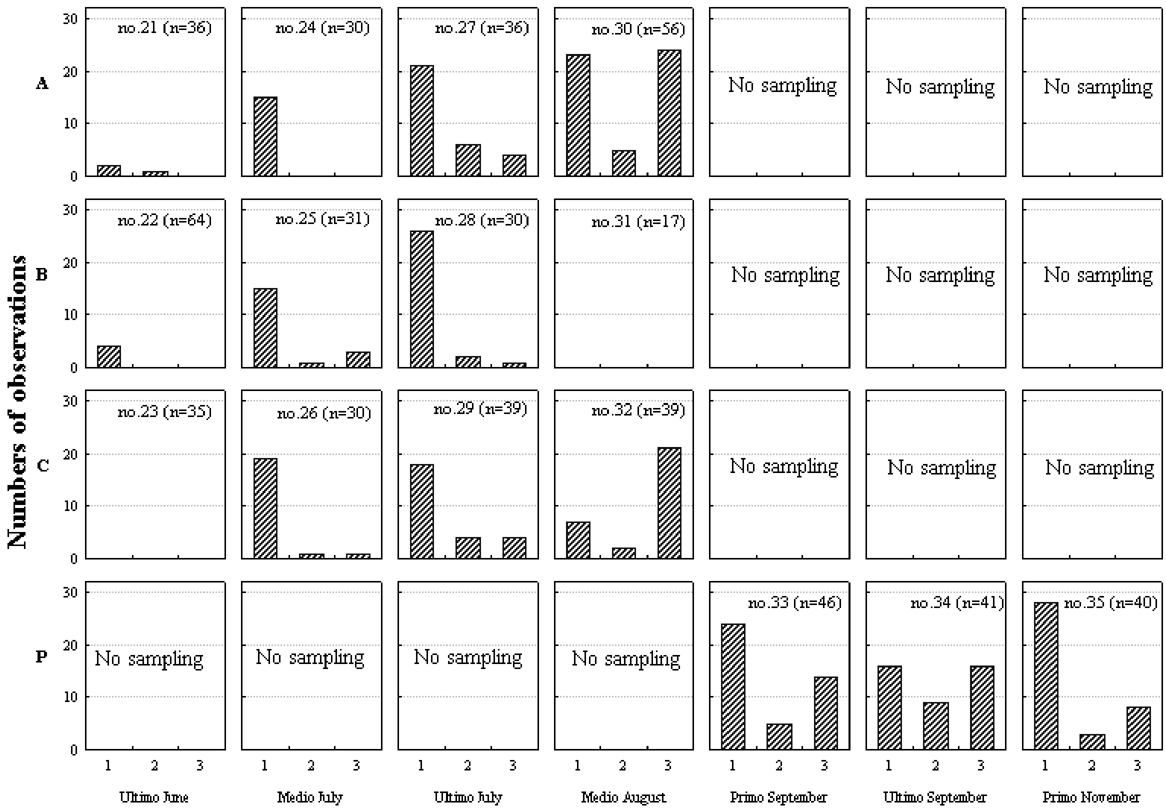


Figure 36 Ranked intensities of *Riboscyphidia* infections on the skin of salmon reared in different tanks (A, B and C) and a net pen (P). The tanks (A, B, C) terminated in August, whereafter pen-reared salmon was studied. All fish examined are from the same cohort. A total of 36 samples were taken in the period from hatching (January) to pre-smolt (November). Only periods of *Riboscyphidia* infection are shown in the figure. Sample numbers (no.) and numbers of fish examined (n) are given above each histogram. Intensities of infection in a lateral scraping from base of the pectoral fin to level of the start of the dorsal fin are ranked on a scale from 1 – 3: 1, <10 *Riboscyphidia* cells observed in the smear; 2, 10-30; 3, >30.

With one exception, there were no correlations between ranked intensities and fish size, condition factor, or Hct. The exception being a positive correlation between infection and size in tank C (sample no. 29, r_s=0.55, p=0.002, n= 39).

Telotrochs were observed in late September (sample no. 34, prevalence 71%) and early November (sample no. 35, 53%), and their presence was associated with heavy *Riboscyphidia* infections (χ^2= 6.45, p=0.01).

Overall, *Riboscyphidia* infections of the hatchery-reared salmon occurred in a water-temperature range of 6.5 – 17.6 °C and at pH values ranging from 5.70 to 6.50.

"Flashing", described as a clinical sign of *Ichthyobodo* infection, also occurred among parr and pre-smolt in the same tanks and net pen simultaneously with the occurrence of heavy *Riboscyphidia* infections. There were no relations between skin damage and presence of the ciliate (Tab. 14), that is, skin ulcers occurred with or without the presence of *Riboscyphidia*.

No significant mortalities could be ascribed to this ciliate.

Table 14 *Riboscyphidia* infection versus skin damage of farmed salmon. The observed and expected (in parenthesis) co-occurrences of symbionts (*Riboscyphidia*) and scale losses or skin ulcer among hatchery reared salmon. No or slight infections are designated as "0" and moderate or heavy infections as "1".

Sample no. 30 (Tank A, August 18th)	*Riboscyphidia* 0	*Riboscyphidia* 1	Total
No skin damage	22 (21)	25 (26)	47
Skin damage	3 (4)	6 (5)	9
Total	25	31	56
Sample no. 33 (Net pen, September 7th)	***Riboscyphidia* 0**	***Riboscyphidia* 1**	**Total**
No skin damage	15 (17)	16 (14)	31
Skin damage	10 (8)	5 (7)	15
Total	25	21	46
Sample no. 34 (Net pen, September 28th)	***Riboscyphidia* 0**	***Riboscyphidia* 1**	**Total**
No skin damage	9 (7)	11 (13)	20
Skin damage	5 (7)	16 (14)	21
Total	14	27	41

Table 15 *Riboscyphidia* infection on wild caught fish**.** The fish were caught in the same watercourse by net, except salmonids in 2001 that were caught by angling and the sticklebacks that were caught with traps. Salmon and rainbow trout are feral fish* (escapees from lake-pens) while brown trout, charr, and three-spined sticklebacks are native species. Number of fish infected/number of fish examined.

Date	Salmon*		Brown trout		Rainbow trout*		Charr		Stickleback	
	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
26.03.00	6/10	-	4/11	-	1/10	-	0/2	-	-	-
08.04.00	4/18	0/18	1/3	0/3	0/4	0/4	0/4	0/4	-	-
03.11.00	-	-	-	-	-	-	-	-	0/10	0/10
01.06.01	-	-	9/10	0/10	0/1	0/1	-	-	0/31	0/31
12.06.01	-	-	5/5	0/5	-	-	-	-	-	-
18.10.01	4/5	0/5	2/3	0/3	0/1	0/1	-	-	0/3	0/3
Total	**14/33**	**0/23**	**21/32**	**0/21**	**1/16**	**0/6**	**0/6**	**0/4**	**0/44**	**0/44**

Wild fish

Riboscyphidia infections were commonly observed on the skin of salmon and brown trout, with a total prevalence of 42% and 66% respectively. This ciliate was also observed on the skin of rainbow trout in one occasion (Tab. 15). Infections were most prevalent on the skin of brown trout in summer (June, 93%).

Capriniana (Figs. 37-38)

This suctorian ciliate was most commonly observed on gills, attached to the secondary lamellae (Fig. 37). Under the light microscope these ciliates often appeared as dark, brownish spots (Fig. 38 A), apparently due to numerous pigmented granules in the cytoplasm.

The suctorians were motionless and potato-shaped with no cilia in the adult stage. Ciliated daughter cells (Fig. 38 E) were occasionally observed in motion inside an adult.

The anterior part is defined by the presence of numerous (16-29, n=10) contractile tentacles (Fig. 37 and 38). Occasionally, tentacles also were observed at the posterior end, being less numerous than anterior (Fig. 38 I).

Measured live in fresh smears, as illustrated in Figure 8, maximum body length (anterior-posterior) ranged from 31.6 to 98.8 µm (n= 24, 71.1 ± 17.9 (mean ± SD)) and maximum body width from 21.7 to 75.1 µm (n=23, 47.1 ± 14.0).

The macronucleus was compact and rounded or oval in shape, as was the micronucleus, when observed in Diff-Quick stained smears (Fig. 38 D). The micronucleus was commonly located posterior or postero-lateral to the macronucleus.

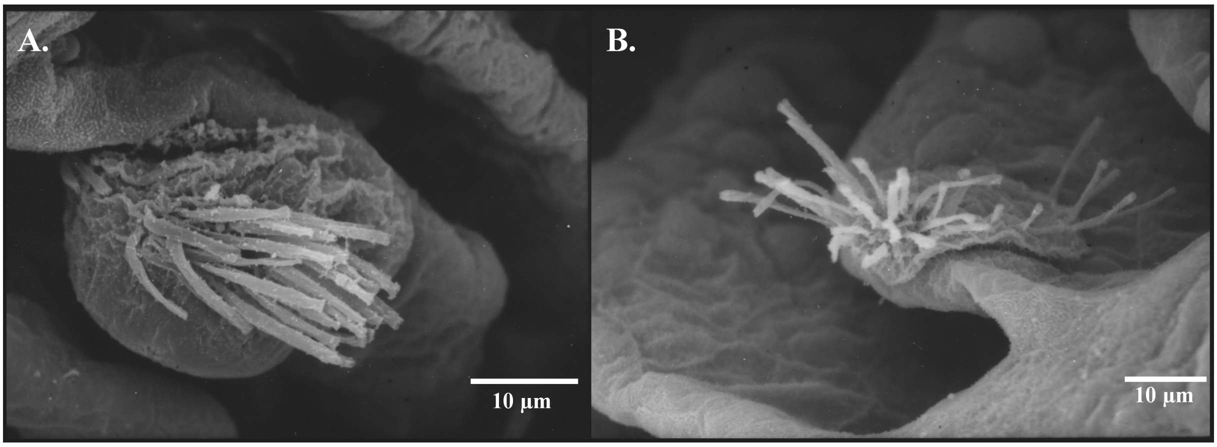


Figure 37 *Capriniana* specimens attached to secondary lamellae of juvenile salmon gills. SEM.

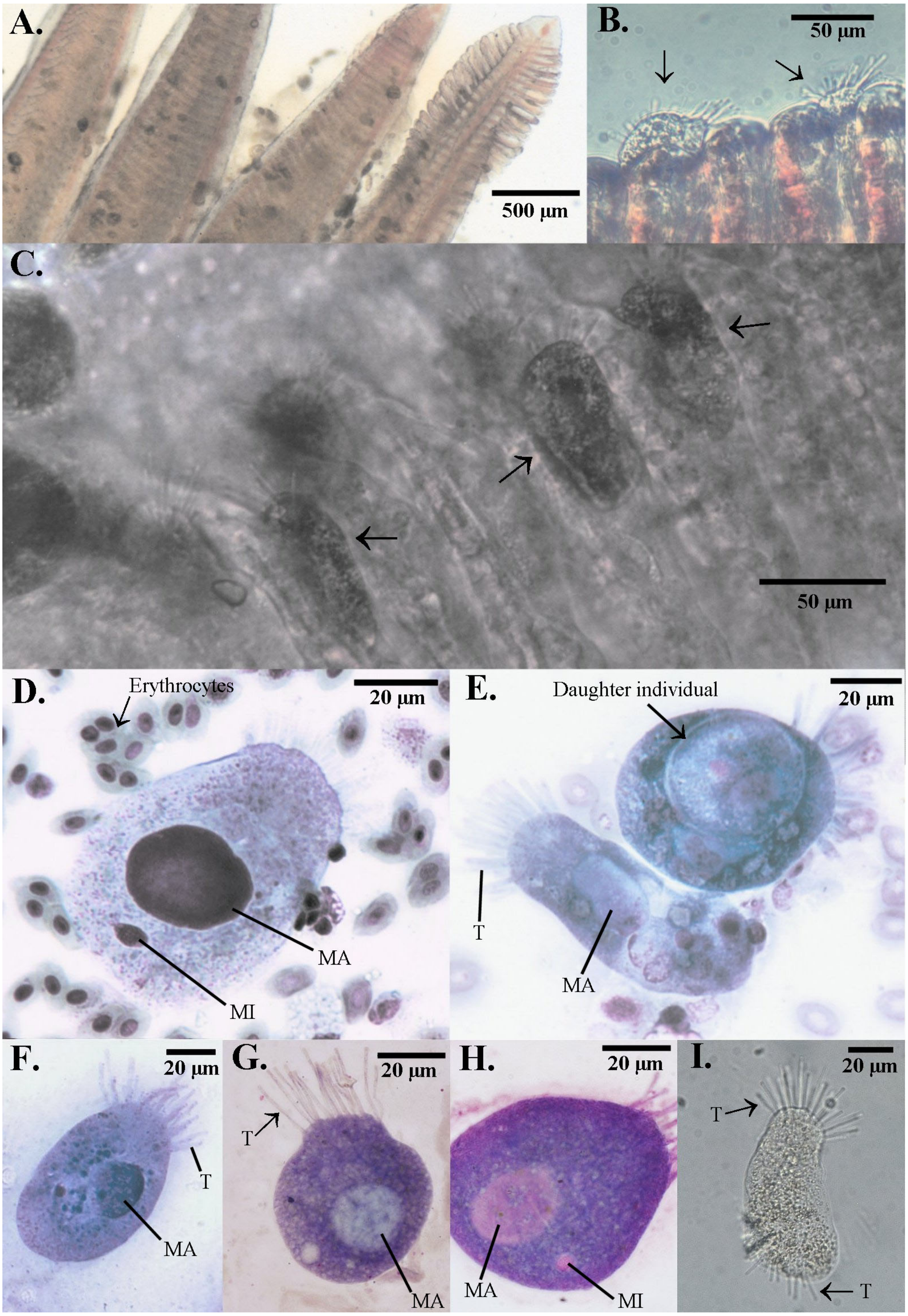


Figure 38 *Capriniana* infections on gills of salmon. MA: Macronucleus; MI: Micronucleus; T: Tentacles.
A: *Capriniana* "live" on gills of salmon. Appearances of the ciliates are seen as dark spots along the primary lamella of the gills. **B-C:** The ciliates located between secondary lamellae of the gills. **D-H**: Ciliates from stained smears. **I**.: *Capriniana* (live) with tentacles both posterior and anterior.

Dynamics of *Capriniana* infection in the fish farm

This suctorian ciliate occurred mainly on the gills and was observed on parr during summer and on pre-smolt in autumn (Fig. 39).

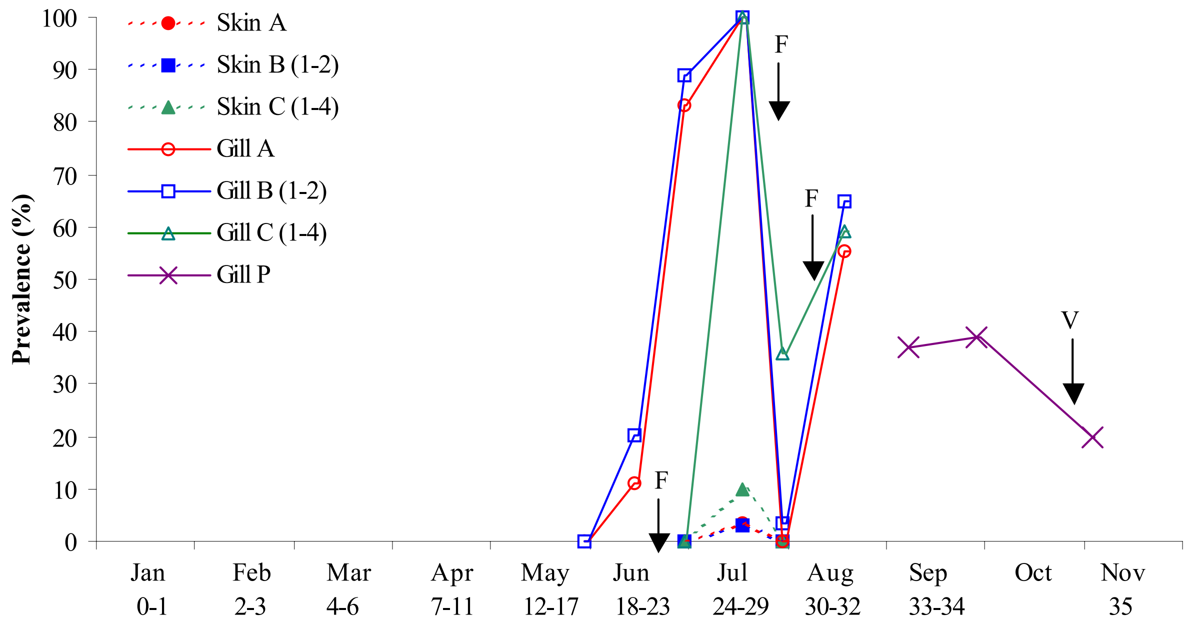


Figure 39 Temporal variations in *Capriniana*-prevalence among hatchery/lake-pen reared salmon. Samples (numbered 0-35) were taken from different tanks (A, B1-B2 and C1-C4) and a net pen (P). Tank A and B1 were mixed and sorted on June 15th, whereafter the larger fish was reared in tank B2 while the smaller fish was reared in tank A. The salmon reared in control tanks (C1 and C2: March 10th – May 11th, C3: May 11th – June 30th, C4: June 30th – August 19th) were not exposed to handling (i.e. grading, thinning). Tank A was treated with formalin at three occasions (“F”). The pen-reared fish was routinely vaccinated (“V”) in late October.

Capriniana was first observed on June 15th on gills of parr from tank A (Sample no. 18: 11.1%, mean fish length 9.0 ± 0.9 cm, water temperature 14.2 °C) and tank B2 (sample no. 19: 20.3% 12.1±1.1 cm, 9.6 °C). Prevalence of infection increased markedly in both tank A and B2 during the following period of only two weeks (from June 15th to July 1st) reaching 83.3% and 89.1% respectively. Fish reared in tank C3 was not infected at this time (June 29th). Prevalence peaked in mid-July, when all fish examined were infected (samples no. 24-26). A drop in prevalence occurred in late July when *Capriniana* infections declined to zero (or close to zero) in tanks A and B2, while approximately one-third of the fish in tank C4 remained infected.

Patterns of *Capriniana*-infection are almost identical for tanks A and B, despite several formalin treatments (”F” in Fig. 39) of the fish reared in tank A.

Heavy infections occurred in mid-July in tanks B2 and C4 (sample no. 25 & 26) when more than 100 individuals on 5 random primary gill filaments could be observed (Fig. 40).

As for infections with the sessiline peritrichs (*Apiosoma* and *Riboscyphidia*), prevalence of *Capriniana* infections also increased to a maximum during the period when bacteria concentrations in the water of the fish tanks decreased (Fig. 12).

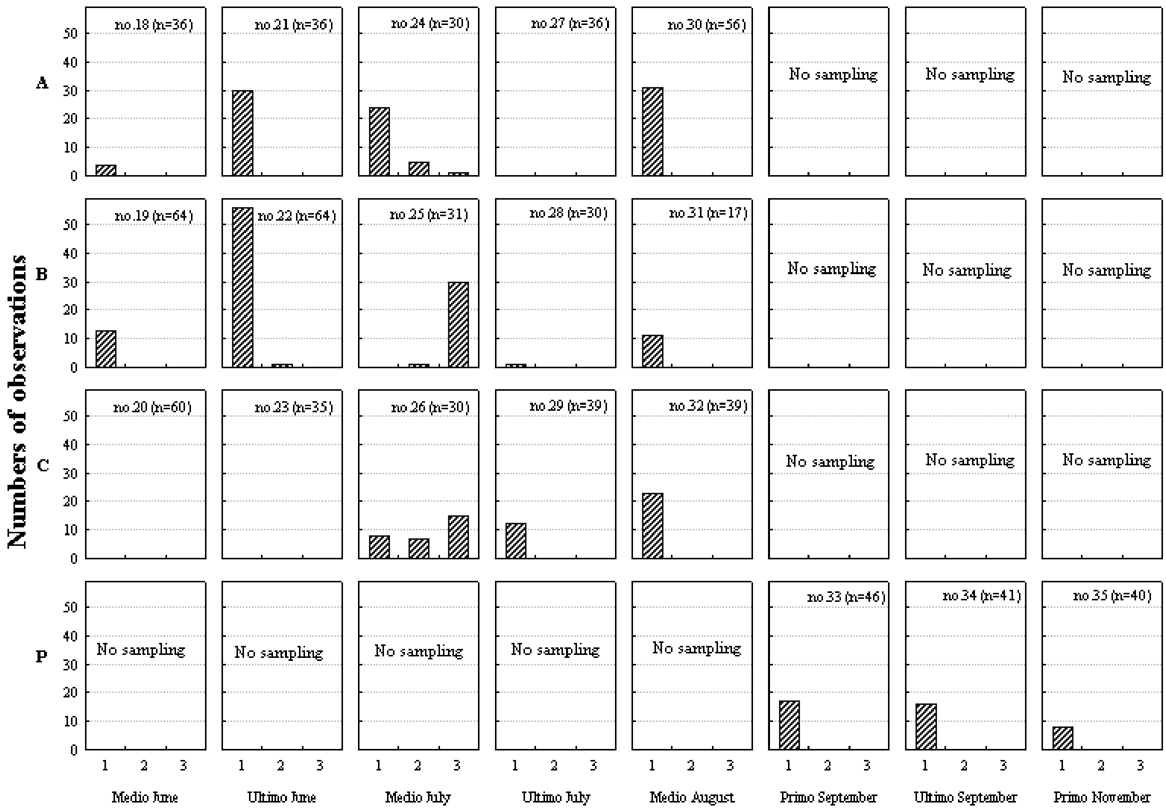


Figure 40 Ranked intensities of *Capriniana* infections on the gills of salmon reared in different tanks (A, B and C) and a net pen (P). The tanks terminated in August, whereafter pen-reared salmon was studied. All fish examined are from the same cohort. A total of 36 samples were taken in the period from hatching (January) to pre-smolt (November). Only periods of *Capriniana* infection are shown in the figure. Sample numbers (no.) and numbers of fish examined (n) are given above each histogram. Intensities of infection on the gills are ranked on a scale from 1 – 3: 1, <5 *Capriniana* cells observed per primary gill filament; 2, 5-20; 3, >20.

There were positive correlations between the heavy infections in mid-July (Fig. 40) and size of the fish reared in tank B2 (sample no. 25, r_s=0.31, p=0.09 (not significant), n=31) and tank C4 (sample no. 26, r_s=0.66, p<0.001, n=30). In this period (July-August), the fish reared in tanks B2 and C4 were larger (Fig. 13) compared to those reared in tank A. Tank B2 and C4 were also more crowded compared to tank A. (Fig. 14).

Capriniana infections of the hatchery-reared salmon occurred in a water-temperature range of 6.5 – 17.6 °C and at pH values ranging from 5.70 to 6.37.

There were no correlations between levels of *Capriniana* infection and hematocrit values. No mortality or clinical signs was associated with the presence of this ciliate.

Table 16 *Capriniana* infections on wild caught fish (skin and gill). The fish were caught in the same watercourse by net, except salmonids in 2001 that were caught by angling and the sticklebacks that were caught with traps. Salmon and rainbow trout are feral fish* (escapees from lake-pens) while brown trout, charr, and three-spined sticklebacks are native species. Number of fish infected/number of fish examined.

Date	Salmon*		Brown trout		Rainbow trout*		Charr		Stickleback	
	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
26.03.00	0/10	-	1/11	-	0/10	-	0/2	-	-	-
08.04.00	0/18	0/18	0/3	0/3	0/4	0/4	0/4	0/4	-	-
03.11.00	-	-	-	-	-	-	-	-	0/10	0/10
01.06.01	-	-	0/10	5/10	0/1	0/1	-	-	0/31	0/31
12.06.01	-	-	0/5	2/5	-	-	-	-	-	-
18.10.01	0/5	2/5	0/3	2/3	0/1	1/1	-	-	0/3	0/3
Total	**0/33**	**2/23**	**1/32**	**9/21**	**0/16**	**1/6**	**0/6**	**0/4**	**0/44**	**0/44**

Wild fish

Capriniana infections were observed on gills of salmon (prevalence 9%) and brown trout (43%). In single cases, this suctorian ciliate was also observed on the gill of rainbow trout and the skin of brown trout (Tab. 16).

CO-OCCURRENCE OF THE SYMBIONTS

Co-existence of the ciliate symbionts on hatchery-reared salmon occurred during summer. There was a positive association between *Capriniana* on gills and *Apiosoma* on the skin of salmon from tank A and B (Tab. 17). In the same samples the ranked intensities of these symbionts were also positively correlated. The opposite tendency was found between *Capriniana*- and *Riboscyphidia* infections. The observed co-existence was less than expected on a random basis, and the ranked intensities correlated negatively (Tab. 17).

Specimens of *Riboscyphidia* and *Apiosoma* observed on the salmon were sharing the same microhabitat, and an apparent antagonistic relationship between these sessiline peritrichs was found on infected fish from tank A and C4. These ciliates were negatively associated, and their ranked intensities correlated negatively. In this period (July – August) there was an increase in intensity of *Riboscyphidia* infection on the fish reared in these tanks (Fig. 36), at the same time the intensity of *Apiosoma* infection decreased (Fig. 31). No sessiline ciliates were observed on the fish in tank B2 in August (sample no. 31).

Moderate or heavy *Ichthyobodo* infections among parr and pre-smolt occurred in August (tank A) and September (net pen), the same period when most of the salmon was infected with *Riboscyphidia.* There were no significant correlations between their ranked intensities.

Table 17 Co-existence of ectosymbionts on hatchery reared salmon. Infections on salmon from different tanks (A, B and C) during a four-week period (July-August) are compared. Sample no. given for each tank. Prevalence of infections (no. infected/no. fish examined) is given for each symbiont genus (*Capriniana, Apiosoma* and *Riboscyphidia*). The right upper half of this cross tabulation shows observed co-existence, with calculated expected values in parenthesis. Pearson's Chi-square (χ^2) test was applied to detect differences between observed and expected values. Two-tailed Fisher exact test (FET) was applied when χ^2 was not appropriate. The second half of this table shows correlations in intensity of infections for which Spearman rank order correlation (r_s) was applied (double zeros excluded). Associations or correlations are not regarded as significant (n.s.) when p>0.05. *Apiosoma*- and *Riboscyphidia* specimens were far more common on skin than gills of the host, while the *Capriniana* specimens are regarded as gill symbionts.

Tank A no. 24, 27 and 30	*Capriniana* 61/122	*Apiosoma* 40/122	*Riboscyphidia* 98/122
Capriniana		Co existence: 27 (20) χ^2=7.3, p=0.007	Co existence: 43 (49) χ^2=7.5, p=0.006
Apiosoma	r_s=0.34, p=0.003 n=74		Co existence: 24 (32) χ^2=15.6, p<0.001
Riboscyphidia	r_s=-0.50, p<0.001 n=116	r_s = -0.52, p<0.001 n=114	
Tank B no. 25, 28 and 31	*Capriniana* 43/78	*Apiosoma* 43/78	*Riboscyphidia* 48/78
Capriniana		Co existence: 28 (24) χ^2=3.9, p=0.049	Co existence: 20 (26) χ^2=9.1, p=0.003
Apiosoma	r_s=0.28, p=0.031 n=58		Co existence: 28(24) χ^2=2.7, p=0.1 (n.s.)
Riboscyphidia	r_s=-0.23, p=0.053 (n.s.) n=71	r_s=-0.04, p=0.78 (n.s.) n=61	
Tank C no. 26, 29 and 32	*Capriniana* 65/99	*Apiosoma* 60/99	*Riboscyphidia* 86/99
Capriniana		Co existence: 40(39) χ^2=0.1, p=0.79 (n.s.)	Co existence: 56(56) FET: p=1.0 (n.s.)
Apiosoma	r_s=0.05, p=0.67 (n.s.) n=85		Co existence: 48 (52) χ^2=6.3, p=0.012
Riboscyphidia	r_s=-0.21, p=0.043 n=95	r_s=-0.30, p=0.002 n=98	

DISCUSSION

Flagellates

Phylum **Mastigophora** Diesing, 1866

Order **Kinetoplastida** Honigberg, 1963

Genus ***Ichthyobodo*** Pinto, 1928

Recent molecular phylogenetic analyses have revealed that there are different species within the genus *Ichthyobodo* (Todal *et al*. in press). Among these, two distinct species of *Ichthyobodo*, separated by their SSU-rDNA sequences, were found on Atlantic salmon: One predominantly skin parasitic (species I) and the other predominantly gill parasitic (species II). *Ichthyobodo* sp. I were also identified from the gills of salmon, and was found to have identical sequences with species from the skin of stickleback in freshwater as well. *Ichthyobodo* sp. II occurred on the gills of salmon reared in both fresh- and seawater, and is considered euryhaline.

The *Ichthyobodo* samples from salmon and sticklebacks that Todal *et al*. (in press) obtained SSU rDNA sequences from (their species I), were provided from the present samples. *Ichthyobodo* sp. I is considered by Todal *et al*. (in press) to likely represent the true *Ichthyobodo necator*, according to the descriptions of Henneguy (1883).

These findings show that there are two distinct *Ichthyobodo* species infecting gills of freshwater reared salmon. There may be morphological characters that distinguish these *Ichthyobodo* species (species I and II sensu Todal *et al*. in press), but this aspect remains to be studied. Despite extensive productions of salmonids for several decades, there are surprisingly few morphological descriptions of *Ichthyobodo* from freshwater reared salmonids in Europe since Henneguy (1883) first described this flagellate (Fig. 41). Authors often leave out descriptions of the applied method for measuring *Ichthyobodo* cells, hence comparisons of the cell dimensions given in the literature should be applied with care. It must be assumed that length and width of *Ichthyobodo* cells are measured (if exact definitions are omitted) as maximum and minimum diameters. Until now, only Andai (1933) has tried to define a way to measure *Ichthyobodo* cells in smears. However, his method does not clearly define a starting point. The only readily observable feature at the cell circumference is a "nose" like protrusion near the flagellar pocket, that include the end of the axostyle. In the present study, a scheme is proposed for measuring of *Ichthyobodo* using this structure as a starting point. The measurements revealed some variation in the dimensions of the *Ichthyobodo*-cells from different micro- (skin and gill) and macro-habitats (hosts).

Gill-*Ichthyobodo* from salmon was significantly smaller compared to skin-*Ichthyobodo* from salmon, rainbow trout, and sticklebacks. However, there is a high degree of overlap in cell diameters of *Ichthyobodo* cells from all these different populations. Overall, *Ichthyobodo* cells observed in the present study were relatively large compared with the dimensions of *Ichthyobodo*-cell from freshwater fish as reported in the literature (Tab. 18 and 19). The most comparable measurements appear to be those of Henneguy (1883), who gave the dimensions of the free form as 0.01 x 0.02 mm.

Ichthyobodo cells from the skin of sticklebacks were significantly more rounded (length:width ratio) in shape compared to other *Ichthyobodo* populations (except one population from skin of salmon). Also, position of nucleus differed significant in gill-*Ichthyobodo* from salmon and stickleback-*Ichthyobodo*. However, differences in the nucleus position might be a consequence of the size and shape of these cells.

Beside cell dimensions, there are few morphological features of *Ichthyobodo* described in the literature. Flagellae, vacuoles and kinetoplasts appear to be the most studied characters at light microscope level. The lengths of the flagellae are difficult to measure exactly, since they often appear blurred in stained smears and their proximal parts are hidden by the flagellar pocket. Hence the validity of flagellar measurements as characters may be limited. In the present study, *Ichthyobodo* possessing two unequal flagellae were far more commonly observed than four-flagellated, the latter being a pre-dividing form (Lom & Dyková 1992). Although reproduction of this parasite has been described as longitudinal division of both the free *Ichthyobodo* and the trophozoites (Woo & Poynton 1995), stages of binary division were only observed among the free forms in the present study. The dividing cells observed were similar to that figured by Henneguy (1883, Fig. 41-10).

Vacuoles are rarely observed in *Ichthyobodo* specimens from hosts in seawater (Diamant 1987, Urawa & Kusakari 1990), but one or several vacuoles have been observed in *Ichthyobodo* specimens from different hosts in freshwater (Benisch 1936, Tavolga & Nigrelli 1947, Joyon & Lom 1969, Miyazaki *et al.* 1986). In the present study, there were no major differences in the *Ichthyobodo* cells from the different sites and hosts regarding numbers and locations of vacuoles. In the free-swimming form, a prominent vacuole (V1) was observed near the posterior end of the axostyle. Occasionally, one or two smaller vacuoles were seen in the area close to the flagellar pocket (V2) and located near the end of the longitudinal groove (V3) respectively. When comparing the location of these vacuoles with the findings of

Benisch (1936) and Joyon & Lom (1969), it is likely that V1 and V3 are food vacuoles, while V2 is a contractile vacuole. In trophozoites, a prominent vacuole was occasionally seen posterior to the nucleus in the cell. The location is similar to V1 in the free-swimming form and may represent a food vacuole, as suggested by Schubert (1966, 1968) from transmission electron microscopy (TEM) studies.

Kinetoplasts are DNA-rich regions of the extensive mitochondrion in the cell (Joyon & Lom 1969). These regions have been described as 4-25 rod-shaped chromatoid bodies or spherical granules (Davis 1943, Tavolga & Nigrelli 1947) or as numerous as 50-70 (Lom & Dyková 1992) with no regular pattern in distribution. In the present study, numbers of kinetoplasts in *Ichthyobodo* cells from the different populations varied over a wide range with a high degree of overlap. The kinetoplasts were also relatively dispersed, but there seem to be fewer in the area of the cytostome in both free forms and trophozoites. The number of kinetoplasts appears to be too uncertain and variable to be used as a character. The degree of fusion and numbers of kinetoplasts varies during the cell cycle (Joyon & Lom 1969), which might explain the wide range in numbers of visible kinetoplasts.

Overall, only *Ichthyobodo* cell dimensions showed notable variation between micro- and macro habitats in the present study. Since SSU-rDNA sequences of salmon gill and skin *Ichthyobodo* from the hatchery were identical, as was isolates from local sticklebacks, it appears likely that the differences detected in this study represent intraspecific variation of the form designated *Ichthyobodo* sp. I by Todal *et al.* (in press). *Ichthyobodo* sp. II, found by Todal *et al*. to be associated with the gills in salmon, occur both in fresh- and seawater, leading them to suggest this flagellate to be a species adapted to anadromous salmonid hosts. The studied lakes are barraged to anadromous salmonids, adding substantiation to the assumption that only one *Ichthyobodo* species occur in the watercourse. However, since few *Ichthyobodo* populations were studied, a good picture of intraspecific variation is still needed.

Among the wild fish, *Ichthyobodo* infections were more prevalent and intense on the skin and gills of the sticklebacks compared to salmon and brown trout. Since Todal *et al*. (in press) provide strong evidence that the *Ichthyobodo* on these hosts are conspecific, it is likely that the sticklebacks may act as a reservoir host.

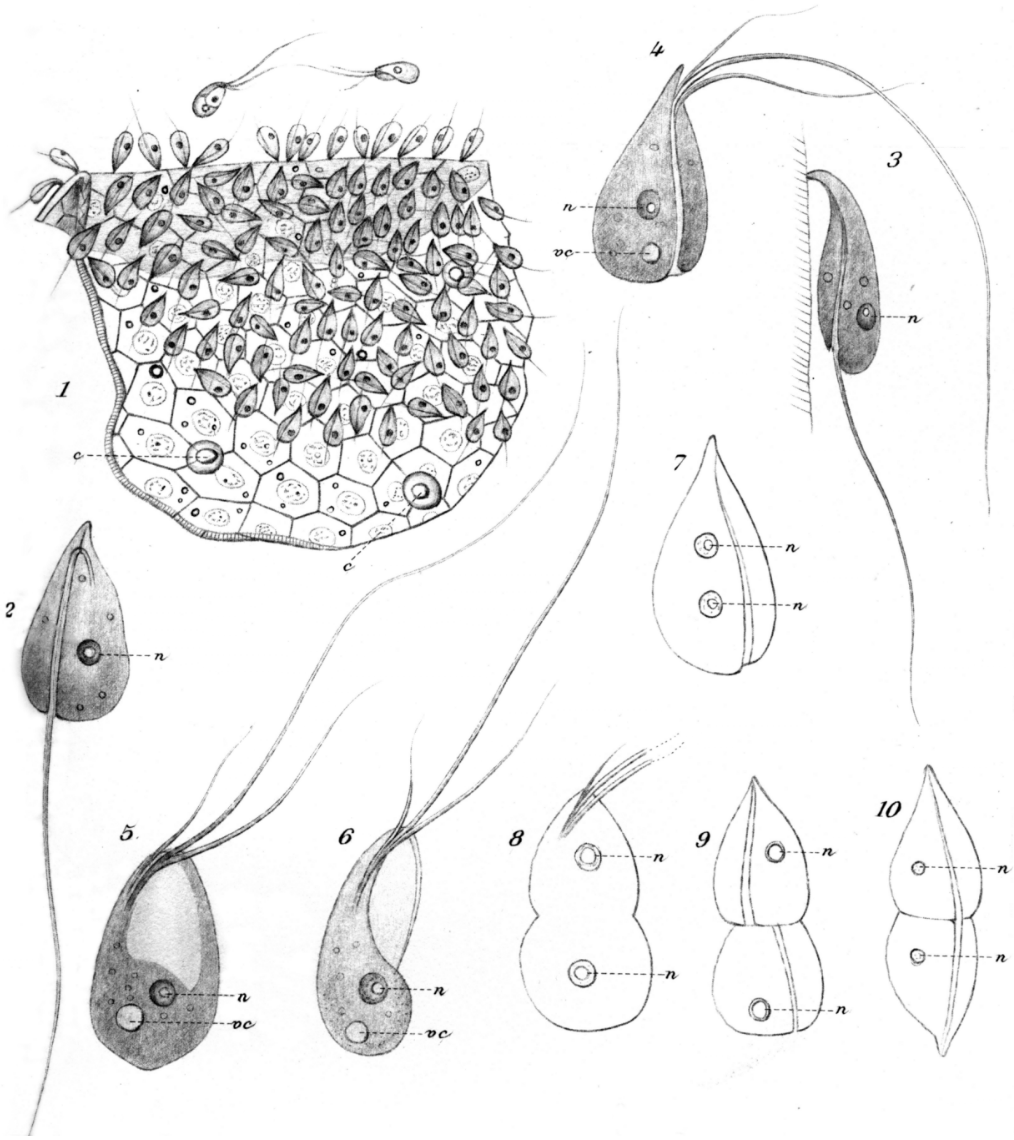


Figure 41 Copy of the original figure from Henneguy (1883). *Bodo necator* (syn. *Ichthyobodo necator*) from infected brown trout (*Salmo trutta*) fry, reared in tanks at the College de France. Dimensions of the free-swimming forms was given as 0.01 x 0.02 mm.

Table 18 Dimensions of free forms of *Ichthyobodo* spp. from skin and gills of different hosts in freshwater. Names of the hosts and symbionts are given according to information presented by the authors. Cell diameters are given as range (min – max) and/or mean in parenthesis.

Original designation	Host	Cell diameter (µm)	Reference
Bodo necator	*Salmo trutta*	10 x 20	Henneguy (1883)
Costia necatrix	Not given	3.7-13.6 x 5.9-14.8 (7.5 x 10.7)	Andai (1933)
Costia necatrix	Not given (likely salmonid)	(5.1 x 7.9)	Fish (1940)
Costia necatrix	*Cyprinus carpio*	5-8 x 7-14	Benisch (1936)
Costia necatrix	*Cyprinus carpio*	5-10 x 10-20	Schäperclaus (1929)
Ichtyobodo necator	*Cyprinus carpio*	6-10 x 8-12	Joyon & Lom (1969)
Costia necatrix	*Xiphophorus, hellerii, Carassius auratus*	6-8 x 10-12	Schubert (1966)
Costia necatrix	*Xiphophorus hellerii*	2.5-7.7 x 5-18 (4.4 x 9.6)	Tavolga & Nigrelli (1947)
Costia pyriformis	*Oncorhynchus mykiss, Salvelinus fontinalis*	5-8 x 9-14	Davis (1943)
Ichthyobodo necator	*Oncorhynchus keta*	8.0-11.5 x 8.5-13.0 (9.6 x 10.1)	Urawa & Kusakari (1990)

Table 19 Dimensions of trophozoites of *Ichthyobodo* spp. from gills of different hosts in fresh*- and seawater**. Names of the hosts and symbionts are given according to information presented by the authors. Cell diameters are given as range (min – max).

Symbiont	Host	Cell diameter (µm)	Reference
*Ichthyobodo necator**	*Oncorhynchus mykiss*	2.6-3.0 x 9.3-10.2	Bruno (1992)
*Ichthyobodo necator**	*Salmo salar*	2.5-2.9 x 9.1-9.3	Bruno (1992)
*Ichthyobodo necator**	*Salmo trutta*	2.3-2.4 x 9.0-9.5	Bruno (1992)
Ichthyobodo sp.**	*Salmo salar*	3-6 x 6-10	Ellis & Wootten (1978)
Ichthyobodo sp.**	*Salmo salar*	1.6-2.6 x 5.5-6.9	Bruno (1992)

Table 20 Morphometrics of *Trichodina* spp. from skin and gills of salmonids (*Salmo trutta, Oncorhynchus mykiss* and *Salvelinus fontinalis*) and three-spined stickleback (*Gasterosteus aculeatus*). Range (minimum-maximum) followed by mean ± SD in parenthesis. n= number of specimens measured.

	T. nigra	***T. kamchatika***	***T. domerguei***				***T. tenuidens***		
Host	*S. trutta* (n=3) *O.mykiss* (n=3)	*S. fontinalis*	*G. aculeatus*				*G. aculeatus*		
Microhabitat	Skin	Skin & gills	Skin	Skin, rarely gills	Skin, rarely gills	Skin	Gills	Gills, rarely skin	Gills, rarely skin
Diameter of:									
Adhesive disc (µm)	36.5-70.6 (43.0-57.4) n=103	45.9-69.8 (56.2±5.3) n=25	37-55 (45) n=34	43-61 (51) n= ?	51.6-68.3 (59.8±4.3) n=24	39.8-46.5 (43.7±2.5) n=6	34-59 (48) n=49	40-62 (50) n= ?	52.3-78.6 (70.8±6.3) n=16
Denticulate ring (µm)	22.6-34.4 (25.7-29.3) n=101	25.4-33.0 (30.5±1.7) n=25	23-32 (28) n=34	28-33 (31) n= ?	27.8-40.8 (32.3±3.3) n=24	25.6-29.8 (27.9±1.5) n=6	24-39 (31) n=49	25-40 (31) n= ?	30.8-45.6 (40.7±3.9) n=16
Number of:									
Denticles	16-26 (20-25) n=103	24-26 (24.6±0.6) n=25	19-26 (22) n=34	22-28 (24) n= ?	23 – 31 (24) n=24	23-27 (27) n=6	26-34 (30) n=49	25-33 (28) n= ?	29-38 (37) n=16
Radial pins per denticle	8-12 (9.6-10.7) n=100	10-13 - n=25	-	9-10 - n= ?	8-11 (9.75±0.8) n=6	8-11 (9.2±1.2) n=6	-	8-9 - n= ?	9-12 (9.5±0.1) n=15
References	Gaze & Wootten 1998	Arthur & Cone 1994	Levsen 1992	Lom & Shtein 1966	Gaze & Wootten 1998		Levsen 1992	Lom & Shtein 1966	Gaze & Wootten 1998

Ciliates

Phylum **Ciliophora** Doflein, 1901

Order **Peritrichida** Stein, 1859

Suborder **Mobilina** Kahl, 1933

Trichodinidae Raabe, 1959

Genus ***Trichodina*** Ehrenberg, 1838

Trichodina specimens of the farmed salmon were very similar to those observed on the skin of wild caught salmon and brown trout, with high overlaps in diameters of the adhesive disc and the denticulate ring. Also, the numbers of denticles were within a range of 24-28, and numbers of radial pins (10-11) appear to be similar. Overall, these features conform to the descriptions of both *T. nigra* (Lom, 1960) and *T. kamchatika* (Konovalov, Shevlyakov et Krasin, 1970) from salmonids (Tab. 20), but the narrower range in numbers of denticles in *T. kamchatika* is more in agreement with the present observations.

The trichodinids (species I and II) observed on skin and gills of sticklebacks differed from those of salmonids in dimensions of the cells and numbers of denticles. In addition, the clear centre of the silver impregnated adhesive disc distinguishes the stickleback trichodinids from those on the salmonids. *Trichodina* sp. I from the skin and gills[1] of sticklebacks agree with descriptions of *T. domerguei* (Wallengren, 1897), while species II (gill[2]) fits the descriptions of *T. tenuidens* (Fauré-Fremiet, 1905) (Tab.20).

These findings indicate that wild salmonids are the likely source of *Trichodina* infection to the farmed salmon.

Suborder **Sessilina** Kahl, 1935

Epistylididae Kahl, 1935

Genus ***Apiosoma*** Blanchard, 1885

The cell body of *Apiosoma* varies in size and shape during the development cycle and under different micro- and macro environmental conditions (Lom 1966, Banina 1969). According to Lom (1966), fixation of the smears changes the shape and dimensions of these ciliates and measurements should, for this reason, only be carried out on dying specimens where the nuclei are visible. In the present study, the length and width of *Apiosoma* cells measured live were within the range of the specimens measured from stained smears, but the shape of the macronucleus appeared more rounded in smears stained with Diff-Quick® or Haematoxylin. The shape and position of the macronucleus observed on smears from the skin of salmon (present study) were similar to the description of *Apiosoma piscicola* from the skin of different hosts (Blanchard 1885, Lom 1966, Banina 1968). That is, the cone- or triangular shaped macronucleus is tapered downward against the scopula, and the pectinellar wreath is secant or tangent to the broader part of this nucleus. In addition, the scopula is described as relatively small and the cell body elongated with a slim stem below the macronucleus. According to Lom (1966) the position of the micronucleus in relation to macronucleus might serve as a differentiating feature. However, the position of the micronucleus differs in the descriptions of *A. piscicola*. Lom (1966) described the micronucleus in *A. piscicola* as being located closely to the upper part of the macronucleus, while Banina (1969) illustrates it at the side of the lower part of the macronucleus, i.e. more in agreement with the present findings.

In the present study, *Apiosoma* observed on the skin of farmed salmon were morphological similar to specimens observed on the skin of wild caught brown trout, though the *Apiosoma* cells from the brown trout were larger in size. Overall, the features of *A. piscicola* Blanchard, 1885 sensu Banina (1968, 1969, 1984) agree best with the present observations and measurements of *Apiosoma* from salmon and brown trout.

The *Apiosoma* observed on the skin and the gills of sticklebacks differed morphologically from those observed on the salmonids. The stem below the macronucleus was relatively short

and, on some occasions, a stalk bearing the ciliate was present. The macronucleus was not as tapered as those observed in *Apiosoma* of the salmonids, and the micronucleus (when observed in stained smears) was usually located below the macronucleus.
In addition, the position of the macronucleus (in relation to the pectinellar wreath and to the length of the cell body) in *Apiosoma*-cells from the skin and the gills of sticklebacks was different compared to that observed on the salmonids. The morphology of *Apiosoma* cells observed on sticklebacks conforms to the descriptions of *Apiosoma gasterostei* (Fauré-Fremiet, 1905 sensu Banina 1984).
Hence the body of salmonids and sticklebacks in the studied watercourse appears to be colonised by different *Apiosoma* species.

In addition to *Apiosoma*, a second genus of Epistylididae, *Epistylis*, occurred on the skin and gills of sticklebacks. These sessilines were attached to the substrate directly with a stalk, simple or branched (bearing one or two zooids) and appeared morphologically similar to *Epistylis kronwerci* as outlined by Banina (1984). No such sessilines were observed on the skin or the gills of salmonids in the present study, but species within this genus (*Epistylis*) have been reported from salmon in Norway (Sterud 1999), and may be harmful to salmonids in freshwater (Bruno & Poppe 1996).

Scyphidiidae Kahl, 1935

Genus ***Riboscyphidia*** Yankovskii, 1985

In the literature, detailed descriptions of *Riboscyphidia* from skin or gills of salmonids in freshwater are rare. The dimensions and features of *Riboscyphidia*-cells from the skin of salmon and brown trout in the present study are, however, in agreement with the description of *Scyphidia* sp. Pickering, Strong et Pollard, 1985 from the skin of brown trout (*Salmo trutta*) in England (Pickering *et al.* 1985). These ciliates are solitary, stalk-less and attached to the substrate by a scopula in the same way as *Apiosoma* sp. from the salmonids described in the present study.
The position and shape of the macronucleus is the most characteristic feature that distinguishes the genus *Riboscyphidia* from *Apiosoma*. In addition, the cell body of *Riboscyphidia* does not possess a slim stem as observed on *Apiosoma* from the skin of salmonids. The relatively broad scopula of the *Riboscyphidia* specimens gives the cell body a more barrel-like shape compared to the conical shaped *Apiosoma*-cell.

The macronucleus shape also distinguishes *Riboscyphidia* telotrochs from those of *Apiosoma*. Telotroch are disc shaped free-swimming migratory stages of detached sessiline ciliates that are able to move to another host or site (Lom & Dyková 1992). According to Davis (1947), these telotrochs are formed by budding from adult peritrich sessilines and subsequently act as microconjugants in a sexual reproduction.

Riboscyphidia specimens were not observed on the skin or the gills of sticklebacks, so wild salmonids (salmon, brown trout, and rainbow trout) probably represent the source of telotrochs, infecting for the hatchery-reared salmon.

Order **Suctorida** Claparède and Lachmann, 1858

Trichophryidae Fraipont, 1878

Genus ***Capriniana*** Mazzarelli, 1906

According to Lom & Dyková (1992) only a single species within the order Suctorida, namely *Capriniana piscium* (Bütschli, 1889), should be recognised as a gill symbiont on fish in freshwater, and species like *Trichophrya intermedia* and *T. salvelinus* described from salmonids are regarded as synonyms to *C. piscium*.

Dimensions and features of *Capriniana* cells from salmonids in the present study conform to the descriptions of *C. piscium* given in the literature, regarding shape and size of the cell, number of tentacles, shape of macro- and micronuclei and the contents of granules in cytoplasm (Calenius 1980, Shul'man & Yankovskii 1984, Lom & Dyková 1992).

Capriniana piscium was observed on the gills (and rarely skin) of wild salmonids (salmon, brown trout, and rainbow trout) caught in Lake Henangervatn, while no suctorians were observed on the sticklebacks. Hence, the wild salmonids are the likely source of swarmers (free swimming larval stage) infecting the farmed fish.

Patterns of infection

The dynamics of symbiont infections on the tank-reared salmon was studied until an outbreak of a bacterial disease caused an elimination of all fish (mid August). There were no clinical signs of the bacterial disease (increased mortality, reduced appetite, listless, pale gills, etc.) in the fish tanks involved in this study, nor was the agent detected. To get insight into the infection dynamics during autumn, fish of the same cohort reared in net pens in the watercourse was studied.

There are differences in the rearing conditions when comparing the tanks and the net pen involved in this study. Notably, the fish reared in tanks were more crowded with the highest rearing density in the period July-August, while the fish reared in net pens might be more exposed to infections being closer to the source of infection (wild fish).

Flagellates

Ichthyobodo was the first ectosymbiont that appeared on juvenile salmon in this study. This flagellate first occurred on skin and gills of salmon after commencement of first feeding (fry) in March and then again 20-30 weeks later in July-September on parr and pre-smolt. Among the first-feeders, the larger ones seemed to be more prone to infection on skin, while infections on gills were more common among the smaller fish. Generally, *Ichthyobodo* infections were more prevalent on skin than on gills in the present study, and as for the larger fish (pre-smolt in September), *Ichthyobodo* did not occur on gills at all. These observations are in agreement with those of Robertson (1979) and Buchmann & Bresciani (1997), who also found that small fish appeared more susceptible to gill infections. Robertson (1979) suggests that *Ichthyobodo* initially infest the gills via the respiratory inflow of water and subsequently extend to the body surface of the fish. According to Urawa *et al*. (1991), direct skin infections probably occur as well. Similar patterns showing increase and decrease of infections on skin and gills of salmonid fry and parr have also been reported in the literature (Robertson 1979, Wootten & Smith 1980, Urawa 1992a, Rintamaki-Kinnunen & Valtonen 1997). Robertson (1979) suggests that the disappearance of *Ichthyobodo* after the first peak of infection of salmonid fry (*S. salar* and *O. mykiss*) might be a result of some changes of the skin or the gills, preventing multiplication of the parasite, or from development of immunity. He also suggests that the re-infection of *Ichthyobodo* in rainbow trout 12 weeks after the first peak of infection might be related to a drop in the water temperature resulting in an immune suppression. Callahan and Noga (2002) found that an outbreak of ichthyobodosis occurred in hybrid striped bass (*Morone saxatilis* x *M. chrysops*) when the temperature was increased by several degrees over a 24-hour period. A temperature change like this may, in addition to stressing the fish, also promote more rapid parasite multiplication. During increases of *Ichthyobodo* infections in the present study, no significant changes in the water quality were detected that could be assumed to provoke a severe stress reaction of the fish.

Other conceivable stress factors (e.g. handling and crowding) were apparently not as important as the fish size, regarding susceptibility of *Ichthyobodo* infection. According to Urawa (1995), overcrowding does not influence the *Ichthyobodo* density on the host, but infection in combination with environmental stress factors intensifies the pathological potential of this parasite.

The *Ichthyobodo* infection observed in March declined to zero after a formalin treatment, but the parasite also disappeared in the untreated tanks within a month without causing disease. Later, during July-August when the second infection occurred, the prevalence of infection increased in spite of two treatments with formalin in this period. The use of formalin has been reported to be the most effective treatment for *Ichthyobodo* infections (Tojo *et al.* 1994, Ostland & Byrne 1995). However, extensive *Ichthyobodo* infections should be treated once a day during a 3-4 days period (Holm 2002). An insufficient formalin treatment might explain the increased *Ichthyobodo* infection observed in the summer months.

During autumn, prevalence of infection reached a maximum among pre-smolt in late September, but declined to zero after the fish routinely had been vaccinated with the use of tricaine as anaesthetic. Tricaine[1] (ethyl m-aminobenzoate methanesulfonate) and benzocaine (ethyl p-aminobenzoate) are the two most common anaesthetical agents used in fish farming in Norway (Lunestad 2003). Tricaine, which is chemically close to benzocaine (both being derivatives of p- aminobenzoic acid), is acidic and freely soluble in water. Callahan and Noga (2002) found that the use of unbuffered tricaine in euthanizing fish decreases the motility of *Ichthyobodo necator* in low concentrations (50 mg/L) and causes the flagellates to completely detach at higher doses (1000 mg/L). There was no such effect when using buffered tricaine, and the pH values alone did not have an impact on the infection. Benzocaine was used to euthanase the salmon in the present study. Unlike tricaine, benzocaine (s) is insoluble in water and has to be dissolved in an organic solvent (e.g. ethanol) prior to mixing it with water. Benzocaine gives a neutral solution in water (no buffering required). By comparing the motility of the flagellates in two different wet-mounts that had added water or benzocaine

[1] Synonyms: Metacaine, MS 222, tricaine methane sulphonate

(same concentration used as for euthanasia), the effect of the anaesthetic on *Ichthyobodo* sp. in infected skin smears of salmon was tested. The flagellates were still alive and swimming in both smears after half an hour (pers. obs.). In addition, there were apparently no differences in the degree of detachments of the trophozoites in these two wet mounts, suggesting that benzocaine has no impact, as the unbuffered tricaine, on the motility of these protozoans. When considering the findings of Callahan and Noga (2002), the use of tricaine as an anaesthetic during routine vaccination in autumn might explain the absence of the flagellate on the skin of the salmon from the sample taken one week after the vaccination.

Ciliates

The pulses of ciliate infections were apparently not affected by routine formalin treatments, as the untreated tanks showed a similar infection pattern as the treated ones. Although some authors have reported that treatment of protozoan ectosymbiont using formalin are insufficient in some cases (Valtonen & Koskivaara 1994, Noble & Summerfelt 1996, Madsen *et al.* 2000b), it appears to be widely agreed that formalin is an effective anti-ectoparasitic bath treatment, and it is likely that these symbionts might be controlled by proper formalin-treatment procedures (Vassvik 1981, Robertson 1985, Smith *et al.* 1987, Tojo *et al.* 1994, Rintamaki-Kinnunen & Valtonen 1997, Holm 2002).

Johansson (1978) found that protozoan infections (*Ichthyobodo, Trichodina, Chilodonella, Ichthyophthirius*) on cultured salmonids (*S. salar, S. trutta*) in Sweden were more prevalent during the period of the year when the water temperature was high. In the present study, no significant correlations between infections and environmental factors like water temperature and pH were found. Although the ciliates were abundant during the summer (the warmer period of the year), they did occur in a relatively wide range of water temperatures and pH, suggesting that there are other environmental factors or a complex of factors (e.g. crowding, immune response of the host, carbon flux in food sources of the symbiont) affecting the pattern of infections.

Crowding might facilitate transmission of parasites and then initiate disease outbreaks under certain circumstances when for instance stress factors like poor water quality and handling have weakened the host (Schäperclaus 1992). In addition, crowding itself also serves as a stress factor and may increase fish susceptibility to infection (Woo 1994), though Urawa (1995) found that parasite density was not affected by the fish density but rather by unfavourable rearing conditions.

The most common symbionts observed on the skin of salmon were two sessiline peritrichs, *Apiosoma* sp. and *Riboscyphidia* sp., while the suctorian *Capriniana piscium* was the most common symbiont on the gills. Overall*, Riboscyphidia* sp. was the most commonly observed symbiont of both farmed salmon and wild salmonids. The pattern of infection was similar to reports of *Scyphidia* infections on the skin of salmon and brown trout in United Kingdom, with a prevalence increasing throughout the summer and autumn (Wootten & Smith 1980, Pickering *et al.* 1985).

Prevalence and intensity of *Apiosoma* infection peaked in July (mid-summer), but the infection declined markedly in mid-August, coinciding with a similarly marked increase of *Riboscyphidia* sp. prevalence. The causes of such a pattern of infection among these ciliates might be a random event, but can also reflect a characteristic succession in infection. It could be of importance to acquire insight into what mass occurrence of these symbionts indicate, for instance about water quality. *Apiosoma* sp. observed on the salmon might be more opportunistic regarding the environment (i.e. flourishing only under certain environmental circumstances) compared to *Riboscyphidia*, which occurred and flourished in a wider temperature- and pH range. There were a significantly positive association between the occurrences of *Apiosoma* and *Capriniana*, which might indicate that these ciliates use similar strategies and flourish under similar environmental conditions. The food sources of the suctorians and the sessiline peritrichs differ. It is well established that *Capriniana piscium* feeds on free ciliates from water (Lom 1971, Woo 1994), which again can be bacterivores and indicate deteriorating water quality. All the sessilines have relatively small food vacuoles, so they likely feed on bacteria or microplankton (Lom & Dyková 1992, Woo 1994, Halmetoja *et al.* 2000). In the present study, peaks of bacteria concentrations in water samples from the lake, fish tanks and net pen occurred in a period of 2-5 weeks before the peak occurrences of the sessiline ciliates. Bacteria flux in the water (lake, fish tanks etc.) might be an environmental factor that directly or indirectly influences on the proliferation of ciliate symbionts on fish. Small green-coloured particles were seen inside the food vacuoles of *Riboscyphidia.* These particles might be chlorophyll pigments from preyed phototrophic microplankton, suggesting that phytoplankton is a possible food source of this sessiline. Also, a cross immunity hypothesis can perhaps explain the *Apiosoma – Riboscyphidia* succession, for instance if the opportunistic *Apiosoma* is replaced by a host specialist, *Riboscyphidia*.

The effect on the host

No significant mortalities can be ascribed to any of the detected symbionts. The highest rate of mortality occurred during the first two months after hatching, and especially in the period of first feeding when *Ichthyobodo* infections first appeared. This period is critical to the salmon (Pottinger & Mosuwe 1994), and parasite infections or other stressors might be most harmful to fry if they cause a delayed onset of exogenous feeding, prolonging the critical period after resorption of the yolk sac. It is not clear from the present results whether the weak fish are more prone to infection or if it is the infections that have weakened the fish. *Ichthyobodo* infection might have contributed to mortality in this period, although formalin treatments against this parasite may also cause mortality among weakened fish (Holm 2002). Anyhow, *Ichthyobodo* have been reported as harmful to farmed salmonids worldwide (Tab. 21), especially to fry (Robertson 1979, Castillo *et al.* 1991, Rintamaki-Kinnunen & Valtonen 1997). Severe infections might cause death to hosts, due to damages in the epidermis, resulting in osmoregulatory breakdown and haemodilution. Excessive mucus production in early stages of infections, followed by sloughing in a prolonged and intensive infection, might be defence mechanisms of the host (Robertson *et al.* 1981, Urawa 1992a). Clinical signs, that could be associated with *Ichthyobodo* infection, like greyish coating on the body surface of the fish and "flashing" were most frequently observed among the infected parr and pre-smolt in August and September in the present study. *Ichthyobodo* infections were associated with scale losses and small ulcers in the skin. These wounds were most commonly observed on *Ichthyobodo* infected parr and pre-smolt and were located laterally in the area below the dorsal fin on one side of the fish only. The present study cannot ascertain whether it was ectoparasites that caused these wounds or if wounds cause these symbionts to flourish in this particular area (i.e. a secondary infection; see Benisch, 1936). Scale losses and small ulcers might be a result of physical injury caused by handling or by the fish scraping themselves against substrates (such as walls or bottom in tanks and net pens) or a combination of both. Haemorrhages and ulcers in the epidermis might be critical to smolt when being transferred from freshwater to seawater, since destruction of the skin might cause osmoregulatory failure and thereby reduce survival (Urawa 1993).

In addition, there were negative correlations between intensity of infection and both hematocrit values and the condition factor, which might indicate a pathogenic effect on the host. Furthermore, these correlations seemed to be stronger when only infections on gills were regarded, suggesting that gill-infections are more harmful than skin infections.

Table 21 Review of *Ichthyobodo* on salmonids in freshwater. Pathogenicities are ranked by the authors' observations or conclusions. The mark X in parenthesis is pathogenicity under certain circumstances. Harmful means that the symbiont obviously has caused damage to the host or the symbiont was associated with mortality. In cases where the flagellate was believed to be a secondary pathogen or a stress factor to the fish are ranked as less harmful. No damage or clinical signs in the presence of the symbionts are classified as harmless.

Host	**Country**	**Pathogenicities**			**References**
		Harmful	Less harmful	Harmless	
Salmo salar	Scotland			x	Wootten & Smith (1980)
Salmo trutta	Spain	x			Castillo *et al.* (1991)
Salmo salar, Salmo trutta	Finland	x			Rintamaki-Kinnunen & Valtonen (1997)
Salmo salar, Oncorhynchus mykiss	Scotland	x			Robertson 1979, Roubal *et al.* (1987)
Salmo trutta, Oncorhynchus mykiss	England		x		Pottinger & Mosuwe (1994)
Oncorhynchus mykiss	Denmark	(x)	x		Buchmann & Bresciani (1997)
Oncorhynchus mykiss	Canada		x		Ostland & Byrne (1995)
Oncorhynchus keta	Japan	x			Urawa (1992a, 1993, 1995)
Salvelinus fontinalis	Canada			x	Richardson (1937/38)
Salvelinus fontinalis	Slovenia	x			Ocvirk & Bravnicar (1985)

Although ciliates observed in the present study appeared harmless, several species have been reported to be pathogenic or a stress factor to salmonids in freshwater (Tab. 22). Urawa (1992c) found in an experimental infection that *Trichodina truttae* could cause mass mortality among heavy infected juvenile chum salmon (*Oncorhynchus keta*). The mortalities were attributed to stress arising from intense irritation and epidermal damage. Trichodinosis might give similar clinical signs as described for ichthyobodosis (Richardson 1937/38, Lom & Dyková 1992, Urawa 1992c), i.e. flashing and greyish coating on the body surface. Sessiline peritrichs are mostly regarded as ectocommensals (Lom 1973, Lom & Dyková 1992). In the present study, clinical signs like flashing was observed among salmon parr and pre-smolt infected with *Ichthyobodo* or *Riboscyphidia* or both. If flashing indicates a skin irritation, then it is likely to assume that heavy infections of sessiline peritrichs may be a significant stress factor. Pottinger *et al*. (1984) found that *Scyphidia* infection on the skin of brown trout (*Salmo trutta*) promoted an epidermal demucification similar to *Trichodina* infections, which substantiates the assumption that sessiline peritrichs are able to cause skin irritation that might be sufficient to stress the host.

Table 22 Review of ciliate ectosymbionts on salmonids (*Salmo, Salvelinus, Oncorhynchus*) in freshwater. Pathogenicities are ranked by the authors' observations or conclusions. The mark X in parenthesis is pathogenicity under certain circumstances. Harmful means that the symbiont obviously has caused damage to the host or the symbiont was associated with mortality. Symbionts that are thought to be a secondary pathogen or a stress factor to the fish are ranked as less harmful. No damage or clinical signs in the presence of the symbionts are classified as harmless.

Host	Symbiont	Country	Pathogenicities			References
			Harmful	Less harmful	Harmless	
S. fontinalis	*Trichodina* sp.	Canada	(x)	x		Richardson (1937/38)
O. mykiss	*Trichodina fultoni*	Denmark		x		Buchmann & Bresciani (1997)
O. mykiss	*Trichodina mutabilis*	Denmark			x	Buchmann & Bresciani (1997)
O. mykiss	*Trichodina nigra*	Denmark			x	Buchmann & Bresciani (1997)
S. trutta	*Trichodina* sp.	England	(x)	x		Pottinger *et al.* (1984)
S. salar, S. trutta	*Trichodina* sp.	Finland			x	Rintamaki-Kinnunen & Valtonen (1997)
O.keta	*Trichodina truttae*	Japan	x			Urawa (1992c)
S. salar	*Trichodina* sp.	Norway	(x)	x		Bristow (1993b)
S. salar	*Trichodina* sp.	Scotland			x	Wootten & Smith (1980)
S. fontinalis	*Apiosoma piscicola*	Canada			x	Cone & Odense (1987)
O. mykiss	*Apiosoma* sp.	Denmark			x	Buchmann & Bresciani (1997)
S. salar, S. trutta	*Apiosoma piscicola*	Finland			x	Rintamaki-Kinnunen & Valtonen (1997)
S. salar	*Apiosoma* sp.	Norway	(x)	x		Bristow (1993b)
S. salar	*Apiosoma* sp.	Scotland			x	Wootten & Smith (1980)
O. mykiss	*Epistylis* sp.	Denmark			x	Buchmann & Bresciani (1997)
S. salar, S. trutta	*Epistylis iwoffi*	Finland			x	Rintamaki-Kinnunen & Valtonen (1997)
S. trutta	*Scyphidia* sp.	England	(x)	x		Pottinger *et al.* 1984)
S. salar, S. trutta	*Riboscyphidia artica*	Finland			x	Rintamaki-Kinnunen & Valtonen (1997)
S. salar	*Scyphidia* sp.	Scotland			x	Wootten & Smith (1980)
S. salar	*Trichophrya piscium*	Canada		x		Hare & Frantsi (1974)
O. mykiss, S. salar, S. trutta	*Capriniana* sp.	Denmark			x	Buchmann & Bresciani (1997)
O. mykiss, S. salar, S. trutta	*Capriniana piscium*	Finland			x	Rintamaki-Kinnunen & Valtonen (1997)
S. salar, S. trutta	*Capriniana piscium*	Finland			x	Valtonen & Koskivaara (1994)
O. mykiss	*Trichophrya intermedia*	Holland		x		Balm *et al.* (1996)
S. salar	*Trichophrya piscium*	Norway	x			Bristow (1993b)
S. clarki	*Trichophrya clarki*	USA		x		Heckmann & Caroll (1985)

CONCLUSIONS AND FUTURE WORKS

Five genera of protozoan ectosymbionts, the flagellate *Ichthyobodo* and the ciliates *Trichodina, Apiosoma, Riboscyphidia* and *Capriniana*, were found to infect the cultivated salmon. No symbionts were detected on eyed eggs or alevins. Wild salmonids are probably the most important source of ciliate infections, but also the three-spined stickleback is a likely reservoir host of *Ichthyobodo*.

The flagellates appeared to belong to a single species, most likely *Ichthyobodo necator*. *Ichthyobodo* specimens from the skin and gills of farmed salmon were morphological similar at light microscope level, although mean size of gill-*Ichthyobodo* was smaller than skin-*Ichthyobodo*. Different hosts, microhabitat or abiotic factors like water temperature may affect growth and generation times of *Ichthyobodo*, and hence morphological characteristics. Further *Ichthyobodo* populations from different micro- and macrohabitats should be examined to appreciate the intraspecific variations in the morphology of these flagellates, perhaps allowing us to distinguish species discerned by molecular methods.

Ichthyobodo infections occurred on both the skin and gills of fry and parr, but only on the skin of the larger salmon. The cause of this is obscure, but may be a result of epidermal changes in the skin and gills or development of immunity. Infections on fry appeared and disappeared untreated, questioning the prevailing comprehension of the flagellate as a primary pathogen.

Still, *Ichthyobodo* infections were associated with clinical signs such as flashing, greyish coating on the body surface, small skin ulcers and areas of scale loss, and correlated negatively with host condition and hematocrit. Hence it is possible that the flagellate may proliferate in irritated or damaged areas of the body surface, adding to the irritation and damage. These aspects need to be examined and should be addressed in controlled experimental infections in the laboratory. Prophylactic and therapeutic formalin treatments are extensively used to avoid ichthyobodosis, with negative effects such as increased fish-stress, costs and health hazards to the hatchery employees. The present results do not suggest these are effective against the parasite.

Trichodina infections were detected on salmon from the hatchery, likely belonging to the species *T. kamchatika*. Examination of wild fish suggested that the source of infection is wild salmonids, sticklebacks being infected with specific *Trichodina* spp.

Sessiline ciliates, *Apiosoma piscicola* and *Riboscyphidia* sp., were common on the skin of the salmon. These ciliates also infected wild salmonids, while sticklebacks hosted other sessilines. The sessiline peritrichs appeared on salmon parr in summer, with a peak in *Apiosoma* infections in July succeeded by *Riboscyphidia* in August persisting during autumn. It is believed mass occurrence of these ciliates reflect aspects of water quality, likely bacterial and algal concentrations. Hence these may prove useful indicator species, an aspect that needs further study.

The suctorian ciliate *Capriniana piscium* was the most common gill symbiont, occurring on both the farmed salmon and wild salmonids. The suctorian appeared in the hatchery in June, showed peak infections in July but persisted during autumn. *Capriniana piscium* capture other ciliates from the water, so mass occurrence should also in this case reflect aspects of water quality.

Despite at times heavy infections of *A. piscicola*, *Riboscyphidia* sp., and *C. piscium*, no negative effects on the host were apparent. They seem to be harmless commensals, although mass occurrence may serve as a stress factor to salmon.

References

Andai G (1933) Über *Costia necatrix*. Archiv fuer Protistenkunde 79:283-297

Appleby C, Mo TA (1997) Population dynamics of *Gyrodactylus salaris* (Monogenea) infecting Atlantic salmon, *Salmo salar*, parr in the river Batnfjordselva, Norway. Journal of Parasitology 83:23-30

Arthur JR, Cone DK (1994) Redescription of *Trichodina kamchatika* Konovalov, Shevlyakov et Krasin, 1970 (Ciliophora, Peritrichida) from the brook trout (*Salvelinus fontinalis*) of eastern Canada. Folia Parasitologica 41:39-43

Balm PHM, Carrick TR, Coenen AJM, Pottinger TG (1996) *Trichophrya intermedia* on the gills of rainbow trout acclimating to low ambient pH. Journal of Fish Biology 48:147-150

Banina NN (1968) *Apiosoma* from fresh-water fishes in the European part of the Soviet Union (systematic review). Acta Protozoologica 6:245-262

Banina NN (1969) Changebility of ciliates of the genus *Apiosoma*. Folia Parasitologica 16:289-295

Banina NN (1984) Suborder Sessilina (Kahl, 1933). In: Shul'man SS (ed) Keys to the parasites of freshwater fishes of the USSR fauna. Vol.1. Parasitic Protozoa, Vol 1, p 281-321(in Russian)

Barton BA, Iwama GK (1991) Physiological changes in fish from stress in aquaculture with emphasis on the response and effects of corticosteroids. Annual Review of Fish Diseases 1:3-26

Benisch J (1936) Untersuchungen über *Costia necatrix* Leclerq. Zeitscrift für Fischrei und deren Hilfswissenscaften 34:755-770

Bhattacharyya GK (1977) Statistical concepts and methods. Johnson RA (ed). Wiley, New York, pp 639

Blanchard R (1885) Sur un infusoire péritriche, ectoparasite des poissons d'eau douce. Bulletin de la Société zoologique de France 10:277-280

Bristow GA (1990) Costiose: En oversikt og resultater av en undersøkelse gjort i Hordaland. Bulletinen - Norsk Forening for Akvakulturforskning 3:8-10

Bristow GA (1993a) *Gasterosteus aculeatus* as a reservoir for *Ichthyobodo necator* in western Norway. Bulletin of the Scandinavian Society for Parasitology 3:23

Bristow GA (1993b) Parasites of Norwegian fresh-water salmonids and interactions with farmed salmon - A review. Fisheries Research 17:219-227

Bruno DW (1992) *Ichtyobodo* sp. on farmed Atlantic Salmon, *Salmo salar* L., reared in the marine environment. Journal of Fish Diseases 15:349-351

Bruno DW, Poppe T (1996) A colour atlas of salmonid diseases. Poppe T (ed). Academic Press, London, pp 194

Buchmann K, Bresciani J (1997) Parasitic infections in pond-reared rainbow trout *Oncorhynchus mykiss* in Denmark. Diseases of Aquatic Organisms 28:125-138

Buchmann K, Bresciani J (1998) Microenvironment of *Gyrodactylus derjavini* rainbow trout *Oncorhynchus mykiss*: association between mucous cell density in skin and site selection. Parasitology Research 84:17-24

Buchmann K, Uldal A, Lyholt HCK (1995) Parasite infections in Danish trout farms. Acta Veterinaria Scandinavica 36:283-298

Bush AO, Lafferty KD, Lotz JM, Shostak AW (1997) Parasitology meets ecology on its own terms: Margolis *et al.* revisited. Journal of Parasitology 83:575-583

Calenius G (1980) Parasites of fish in Finland. Acta Academiae Aboensis (Ser.B) 40

Callahan HA, Noga EJ (2002) Tricaine dramatically reduces the ability to diagnose protozoan ectoparasite (*Ichthyobodo necator*) infections. Journal of Fish Diseases 25:433-437

Castillo J, Peribañez M, Lucientes J (1991) Seasonal variations of *Ichthyobodo necator* (Henneguy, 1883) in feral brown trout and associated mortalities in cultured fish. Bulletin of the European Association of Fish Pathologists 11:217-218

Cone DK, Odense PH (1987) Occurrence of *Heteropolaria lwoffi* (Fauré-Fremiet, 1943) and *Apiosoma piscicola* Blanchard, 1885 (Ciliata) on *Salvelinus fontinalis* (Mitchill) in Nova Scotia, Canada. Canadian Journal of Zoology 65:2426-2429

Davis H (1943) A new polymastigine flagellate, *Costia pyriformis*, parasitic on trout. Journal of Parasitology 19:385-386

Davis HS (1947) Studies of the Protozoan parasites of fresh-water fishes. United States Fish and Wildlife Service Fishery Bulletin 41 51:29 pp

Diamant A (1987) Ultrastructure and pathogenesis of *Ichthyobodo* sp. from wild common dab, *Limanda limanda* L., in the North sea. Journal of Fish Diseases 10:241-247

Eklöv AG, Greenberg LA, Bronmark C, Larsson P, Berglund O (1999) Influence of water quality, habitat and species richness on brown trout populations. Journal of Fish Biology 54:33-43

Ellis AE, Wootten R (1978) Costiasis of Atlantic salmon, *Salmo salar* L. smolts in seawater. Journal of Fish Diseases 1:389-393

Fish FF (1940) Notes on *Costia necatrix*. Transactions of the American Fisheries Society 70:441-445
Fonnes GA (1999) Signaturar for vekst og fysiologisk tilstand hjå bakteriar. Thesis in microbiology for the degree of *Candidata scientiarum*. Department of Microbiology, University of Bergen, Norway, pp 109
Gaze WH, Wootten R (1998) Ectoparasitic species of the genus *Trichodina* (Ciliophora: Peritrichida) parasitising British freshwater fish. Folia Parasitologica 45:177-190
Halmetoja A, Valtonen ET, Koskenniemi E (2000) Perch (*Perca fluviatilis* L.) parasites reflect ecosystem conditions: a comparison of a natural lake and two acidic reservoirs in Finland. International Journal for Parasitology 30:1437-1444
Hare G, Frantsi C (1974) Abundance and potential pathology of parasites infecting salmonids in Canadian maritime hatcheries. Journal Fisheries Research Board of Canada 31:1031-1036
Heckmann R (1996) Protozoan parasites of fish, part I. Aquaculture: 44-57
Heckmann RA, Caroll T (1985) Host-parasite studies of *Trichophrya* infesting cutthroat trout (*Salmo clarki*) and longnose suckers (*Catostomus catostomus*) from Yellowstone Lake, Wyoming. Great Basin Naturalist 45:255-265
Henneguy LF (1883) Sur un Infusoire flagelle, ectoparasite des Poissons. Comptes rendus hebdomadaires des séances de l'Académie des sciences 96:658-660
Holm JA (2002) Formalin - effektivt mot parasitter på fisk. Aquavisa. 2-2002. Cited: 20.06 2003. Online: http://www.europharma.no/fiskehelse/datablad/Aquavisa202.pdf
Johansson N (1978) Seasonal variations related to water temperature in the occurrence of some bacterial and protozoan infections in Swedish salmon stations. Laxforskningsinstitutet Meddelande 3:1-8
Joyon L, Lom J (1969) Étude cytologique, systématique et pathologique *d'Ichthyobodo necator* (Henneguy, 1883) Pinto, 1928 (Zooflagelle). Journal of Protozoology
Karlsbakk E, Nylund A, Nilsen F (1999) Kompendium i fiskesykdommer. Fiskeparasitter. Department of Fisheries and Marine Biology, University of Bergen, Norway, pp 185
Klein BM (1958) The "dry" silver method and its proper use. Journal of Protozoology 5:99-103
Larsen T, Lund F (2000) Parasites of Atlantic salmon (*Salmo salar* L.) parr from the regulated Alta river, northern Norway. Bulletin of the Scandinavian Society for Parasitology 10:5-13
Levsen A (1992) Parasites of the three-spined stickleback *Gasterosteus aculeatus* from Norway, with emphasis on trichodinid ciliates. Fauna 45:40-48(in Norwegian)
Lom J (1966) Sessiline Peritrichs from the surface of some freshwater fishes. Folia Parasitologica 13:36-56
Lom J (1971) *Trichophrya piscium*: A pathogen or an ectocommensal? An ultrastructural study. Folia Parasitologica 18:197-205
Lom J (1973) The mode of attachment and relation to the host in *Apiosoma piscicola* Blanchard and *Epistylis lwoffi* Faure-Fremiet, ectocommensales of freshwater fish. Folia Parasitologica 20:105-112
Lom J, Dyková I (1992) Protozoan parasites of fishes. Developments in aquaculture and fisheries science,vol 26. Elsevier, Amsterdam, pp 315
Lom J, Shtein GA (1966) Trichodinids from sticklebacks and a remark on the taxonomic position of *Trichodina domerguei* (Wall.). Acta Societatis Zoologicae Bohemoslovenicae:39-48
Lunestad BT (2003) Therapeutic agents in Norwegian aquaculture, consumption and residue control. Fiskets gang. 13.03 2003 (15:57). Cited 20.06 2003. Online: http://www.fiskeridir.no/fisketsgang/nyheter/03/medisinrapport.pdf
MacMillan JR (1991) Biological factors impinging upon control of external protozoan fish parasites. Annual Review of Fish Diseases 1:119-131
Madsen HCK, Buchmann K, Mellergaard S (2000a) Association between trichodiniasis in eel (*Anguilla anguilla*) and water quality in recirculation systems. Aquaculture 187:275-281
Madsen HCK, Buchmann K, Mellergaard S (2000b) Treatment of trichodiniasis in eel (*Anguilla anguilla*) reared in recirculation systems in Denmark: alternatives to formaldehyde. Aquaculture 186:221-231
McLeay DJ, Gordon MR (1977) Leucocrit: A simple hematological technique for measuring acute stress in salmonid fish, including stressful concentrations of pulpmill effluent. Journal of the Fisheries Research Board of Canada:2164-2175
Meyer FP (1970) Seasonal fluctuations in the incidence of disease on fish farms. In: Snieszko SF (ed) A Symposium on diseases of fishes and shellfishes / prepared by the Symposium Committee ; Stanislas F. Snieszko, chairman and editor., Washington, D.C, p 21-29
Miyazaki T, Rogers W, Plumb J (1986) Histopathological studies on parasitic protozoan diseases of the channel catfish in the United States. Bulletin of the Faculty of Fisheries. Mie University: 1-9
Mo TA (1992) Seasonal variations in the prevalence and intensity of *Gyrodactylus salaris* Malmberg, 1957 (Monogenea, Gyrodactylidae) on Atlantic salmon parr, *Salmo salar* L., in the river Batnfjordselva, Norway. Journal of Fish Biology 41:697-707
Noble AC, Summerfelt ST (1996) Diseases encountered in rainbow trout cultured in recirculating systems. Annual Review of Fish Diseases 6:65-92

Ocvirk J, Bravnicar D (1985) Health problem in brook trout (*Salvelinus fontinalis*) production in Slovenia, Yugoslavia. In: Ellis AE, Christensen NO (eds) Fish and shellfish pathology. Academic Press., London, p 55-58

Ostland VE, Byrne PJ (1995) Comparison of formalin and chloramin-T for control of a mixed gill infection (Bacterial Gill Disease and Ichthyobodiasis) in rainbow trout. Journal of aquatic animal health 7:118-123

Patino R, Schreck CB, Banks JL, Zaugg WS (1986) Effects of rearing conditions on the developmental physiology of smolting coho salmon. Transactions of the American Fisheries Society 115:828-837

Pickering AD (1992) Rainbow trout husbandry - Management of the stress response. Aquaculture 100:125-139

Pickering AD, Richards RH (1980) Factors influencing the structure, function and biota of the salmonid epidermis. Proceedings of the Royal Society of Edinburgh:93-104

Pickering AD, Strong AJ, Pollard J (1985) Differences in the susceptibility of brown trout, *Salmo trutta* L., and American brook trout, *Salvelinus fontinalis* (Mitchill), to infestation by the peritrich ciliate, *Scyphidia* sp. Journal of Fish Biology 26:201-208

Porter KG, Feig YS (1980) The use of DAPI for identifying and counting aquatic microflora. Limnology and Oceanography 25:943-948

Pottinger TG, Mosuwe E (1994) The corticosteroidogenic response of brown trout and rainbow trout alevins and fry to environmental stress during a "critical period". General and Comparative Endocrinology 95:350-362

Pottinger TG, Pickering AD, Blackstock N (1984) Ectoparasite induced changes in epidermal mucification of the brown trout, *Salmo trutta* L. Journal of Fish Biology 25:123-128

Poynton SL, Bennett CE (1985) Parasitic infections and their interactions in wild and cultured brown trout and cultured rainbow trout from river Itchen, Hampshire. In: Ellis AE (ed) Fish and shellfish pathology. Academic Press., London, p 353-357

Richardson LR (1937/38) Observation on trichodinid infection (cyclochaetosis) of *Salvelinus fontinalis* (Mitchill). Transactions of the American Fisheries Society 67:228-231

Rintamaki-Kinnunen P (1997) Parasitic and bacterial diseases at salmonid fish farms in northern Finland. Acta Universitatis Ouluensis A 294. Department of Biology, University of Oulu, Finland

Rintamaki-Kinnunen P, Valtonen ET (1997) Epizootiology of protozoans in farmed salmonids at northern latitudes. International Journal for Parasitology 27:89-99

Robertson DA (1979) Host-parasite interactions between *Ichtyobodo necator* (Henneguy, 1883) and farmed salmonids. Journal of Fish Diseases 2:481-491

Robertson DA (1985) A review of *Ichthyobodo necator* (Henneguy, 1883) an important and damaging fish parasite. In: Muir JF, Roberts RJ (eds) Recent Advances in Aquaculture. Croom Helm, London, p 1-30

Robertson DA, Roberts RJ, Bullock AM (1981) Pathogenesis and autoradiographic studies of the epidermis of salmonids infested with *Ichtyobodo necator* (Henneguy, 1883). Journal of Fish Diseases 4:113-125

Rogers WA, Gaines JLJ (1975) Lesions of protozoan diseases in fish. In: Ribelin WE, Migaki G (eds) The Pathology of fishes / edited by William E. Ribelin, George Migaki. University of Wisconsin Press., Madison, p 117-141

Roubal FR, Bullock AM, Robertson DA, Roberts RJ (1987) Ultrastructural aspects of infestation by *Ichthyobodo necator* (Henneguy, 1883) on the skin and gills of the salmonids *Salmo salar* L. and *Salmo gairdneri* Richardson. Journal of Fish Diseases 10:181-192

Schisler GJ, Walker PG, Chittum LA, Bergersen EP (1999) Gill ectoparasites of juvenile rainbow trout and brown trout in the upper Colorado River. Journal of Aquatic Animal Health 11:170-174

Schubert G (1966) Zur ultracytologie von *Costia necatrix* Leclerq. Unter besonderer berücksichtigung des kinetoplast mitochonrions. Zeitschrift fur Parasitenkunde 27:271-286

Schubert G (1968) The injurious effects of Costia necatrix. Bulletin - Office International des épizooties. 69:1171-1178

Schäperclaus W (1929) Die Costienkrankheit der Fische. Wochenschrift für Aquarien- und Terrarlenkunde 22:329-333

Schäperclaus W (1992) Fish diseases. Schäperclaus W, Kulow H, Schreckenbach K (eds).2 [5th corrected, revised and substantially enlarged edition]. A.A. Balkema, Rotterdam

Shul'man SS, Yankovskii AV (1984) Ciliophora (Doflein, 1901). In: Shul'man SS (ed) Keys to the parasites of freshwater fishes of the USSR fauna. Vol.1. Parasitic Protozoa, p 252-280 (in Russian)

Siegel S, Castellan N (1988) Measures of association and their tests of significance. In: Anker JD (ed) Nonparametric statistics for the behavioural sciences, p 254-262

Smith SD, Gould RW, Zaugg WS, Harrell LW, Mahnken CVW (1987) Safe prerelease disease treatment with formalin for fall chinook salmon smolts. Progressive Fish-Culturist 49:96-99

Snieszko SF (1974) The effects of environmental stress on outbreaks of infectious diseases of fishes. Journal of Fish Biology 6:197-208

Sterud E (1999) Parasitter hos norske ferskvannsfisk., Rapport nr.7, Norsk Zoologisk Forening, Oslo, pp.22
Stevens A, Wilson I (1992) The haematoxylins and eosin. In: Amin AB, Mortensen L, Poppe T (eds) Histology atlas: Normal structure of salmonids. Akvapatologisk laboratorium, Bodø
Tavolga W, Nigrelli R (1947) Studies on *Costia necatrix* (Henneguy). Transactions of the American Microscopical Society 66:366-378
Todal JA, Karlsbakk E, Isaksen TE, Plarre H, Urawa S, Mouton A, Hoel E, Koren C, Nylund A (In press) Flagellates in a jig-saw puzzle: *Ichthyobodo necator* (Kinetoplastida) is a complex of sibling species. Diseases of Aquatic Organisms
Tojo JL, Santamarina MT, Leiro J, Ubeira FM, Sanmartin ML (1994) Pharmacological treatments against *Ichthyobodo necator* (Henneguy, 1883) in Rainbow trout, *Oncorhynchus mykiss* (Walbaum). Journal of Fish Diseases 17:135-143
Urawa S (1992a) Epidermal responses of Chum Salmon (*Oncorhynchus keta*) fry to the ectoparasitic flagellate *Ichthyobodo necator*. Canadian Journal of Zoology 70:1567-1575
Urawa S (1992b) Host range and geographical distribution of the ectoparasitic protozoans *Ichthyobodo necator, Trichodina truttae* and *Chilodonella piscicola* on hatchery reared salmonids. Scientific reports of the Hokkaido salmon hatchery: 175-203
Urawa S (1992c) *Trichodina Truttae* Mueller, 1937 (Ciliophora, Peritrichida) on juvenile Chum Salmon (*Oncorhychus Keta*) - pathogenicity and host-parasite interactions. Fish Pathology 27:29-37
Urawa S (1993) Effects of *Ichthyobodo necator* infections on seawater survival of juvenile Chum Salmon (*Oncorhynchus keta*). Aquaculture 110:101-110
Urawa S (1995) Effects of rearing conditions on growth and mortality of juvenile chum salmon (*Oncorhynchus keta*) infected with *Ichthyobodo necator*. Canadian Journal of Fisheries and Aquatic Sciences 52:18-23
Urawa S, Kusakari M (1990) The survivability of the ectoparasitic flagellate *Ichthyobodo necator* on Chum salmon fry (*Oncorhynchus keta*) in seawater and comparison to *Ichthyobodo* sp. on Japanese flounder (*Paralichthys olivaceus*). Journal of Parasitology 76:33-40
Urawa S, Ueki N, Nakai T, Yamasaki H (1991) High mortality of cultured juvenile Japanese flounder, *Paralichthys olivaceus* (Temminck & Schlegel), caused by the parasitic flagellate *Ichthyobodo* sp. Journal of Fish Diseases 14:489-494
Valtonen ET, Koskivaara M (1994) Relationships between the parasites of some wild and cultured fishes in 2 lakes and a fish farm in central Finland. International Journal for Parasitology 24:109-118
Vassvik V (1981) Formalin eller salt som forebyggende tiltak mot parasitter hos lakseunger. Norsk Fiskeoppdrett 6:10-11
Weiss NA (1996) Elementary statistics, 3rd edition. Addison-Wesley, Reading, Massachusetts, pp 742
Woo PTK (1994) Flagellate parasites of fish. In: Kreier (ed) Parasitic Protozoa, 2nd edition, Vol 8. Academic press, New York, USA
Woo PTK (1997) Immunization against parasitic diseases of fish. Developments in Biological Standardization 90:233-241
Woo PTK, Poynton SL (1995) Diplomonadida, Kinetoplastida and Amoebida (Phylum Sarcomastigophora). In: Woo PTK (ed) Fish diseases and disorders, Vol 1: Protozoan and Metazoan Infections. CAB International, Wallingford, UK, p 27-96
Wood JW (1979) Diseases of Pacific salmon: their prevention and treatment, 3rd edition. State of Washington. Department of Fisheries, Hatchery Division, Olympia, Washington
Wootten R, Smith JW (1980) Studies on the parasite fauna of juvenile Atlantic salmon, *Salmo salar* L., cultured in fresh water in eastern Scotland. Zeitschrif für Parasitenkunde 63:221-231
Zapata AG, Torroba M, Varas A, Jimenez E (1997) Immunity in fish larvae. Developments in Biological Standardization 90:23-32

APPENDIX A. Environment

I. Climate

Daily temperatures (mean, C°) and precipitation (mm) for the period January – November 2000, measured at a weather station located in Omastrand (Hordaland county, western Norway). Minimum (min), maximum (max), mean, and mean standard deviation (SD) is given for each month. All measurements are obtained from the Norwegian Meteorological Institute (DNMI).

Date	January		February		March		April		May		June		July		August		September		October		November	
	C°	mm	C°	mm	C°	mm	C°	mm	C°	mm	C°	mm	C°	mm	C°	mm	C°	mm	C°	mm	C°	mm
1	4.1	22.3	-1.3	1.1	3.9	9.9	4.9	0	13.9	0.3	9	12.7	18.2	3.5	14.9	0	14.3	0	14.7	0	7.8	29.5
2	6.2	35.7	2.3	24.7	0.7	1.3	2.8	3.4	10.7	4.4	8.9	25.7	14.9	10.6	15.9	0	14.1	0	14	0	5.9	4.5
3	5.9	6	1.8	9.2	1.5	18.6	2.4	4.9	9.9	5.4	8.2	10.6	16.1	0.1	16.3	0.1	12.8	0	12.8	3.4	9.9	1.4
4	2.5	19.7	5.1	26.4	-1.7	0.2	1.9	0	10.6	0	10	2.5	15.4	0	13.8	0.4	11.1	0	13.8	0.2	8.8	0.1
5	4.3	14.7	6.9	61.5	-1.4	0.6	1.1	0.1	12.1	0	12.4	0	15.3	0	14.3	3.7	11.9	0	11.8	2.9	4.7	4.9
6	6.3	33.8	6.6	48.3	6.1	39.1	5.2	12.2	12.9	0	12.4	0	14.1	0	12.7	8.6	12.4	0	12	4.3	6.3	0.6
7	6.3	20.2	5.9	13	3.4	39	6.3	41.1	12.5	0	10.8	0	11.5	0	11.2	9.4	13.4	18.5	12.3	0.2	9.9	0
8	7.2	60.1	2.5	15.6	0.8	2	5.9	3.5	14.2	0	11.1	8.4	11.3	0	12	1.8	13.9	7.6	12.2	0	10.4	0
9	3.9	23.5	3.3	0	0.6	33	4.8	0.4	14.7	0	15.8	4.9	13.9	3.2	12.6	0	12.3	21.3	8.1	3.1	9.8	0.2
10	5.1	13.4	5.7	3.5	-1.3	0	4.9	0	12.2	0	13.9	2	15.2	0.1	12.9	0	11.1	34.4	12	3.2	7.3	0
11	6.3	26.6	5.6	36.6	2.5	11.9	5.6	0.1	10.9	0	11.6	7.5	15	0.1	14.5	22.7	9.5	9.3	12.8	0	7.8	0
12	5.4	36.7	3.3	15.7	1.7	1.5	8	0.1	11.7	0.1	10.8	12.3	13.2	2.6	13.8	0.6	10	0	13.5	0	8.1	8.6
13	1.4	11.2	1.4	34.4	4.1	11.2	8.7	0	14.5	0	11.4	45	12.9	0.1	14.6	0	11.7	0	11.2	0.1	7.4	17.1
14	1	0	0	10.7	1.5	23.2	5.5	0	14.2	0	10	23.3	12.7	0	14.4	3.8	13.6	0	10.7	0.1	5.4	0.2
15	-0.4	0	2.4	13.7	-0.4	8.4	4.9	11.3	14.5	0	8.5	24	14.8	0.3	15.6	31.2	13.3	0.7	11.1	7	4.2	0.1
16	4.3	9.9	0.9	4.7	0	2.1	5.2	0.8	15.5	0	9.2	13.4	18.6	0	14.9	4.6	12.2	3.9	13.7	0.2	8.9	0
17	6.1	16.4	-0.5	0	1.9	12.4	7.1	0	13.2	24.4	10.4	0.3	15.1	0	14.1	1.2	11.1	7.9	12.1	1	8	0
18	3.1	4.2	-0.7	0	5.1	4.7	6.8	4.4	10.1	18.6	10.3	2.6	14.4	0	12.1	15.4	14.6	7.8	10.6	5.1	7	0.3
19	1.8	0	-2.4	0	2.6	0	8.2	11.2	9.5	3.7	12.8	0.9	13.1	0	13.8	8.6	14.9	5.7	8.8	5.1	3	8.6
20	4.5	16.3	-2.7	0	5.5	18.1	10.5	0	8.6	12.3	13.9	7	14.5	0	14.4	1.7	14.3	0	8.5	23.5	8.4	5.3
21	0.2	2.4	-2.7	0	4.2	10.1	8.6	11.7	10.6	5.9	15	0.3	15.8	0	12.8	2.7	14	0	9.7	1.2	10.2	0.2
22	0.8	4	0.6	4.1	2.5	13.1	9.2	23.8	10.5	0	13.6	12.8	16.5	0	12.4	12.4	14.2	0	8.5	27.4	8.4	0
23	-1.3	0	1.4	0.3	0.3	9.5	8.6	2.4	11.6	0.8	12.7	19.4	17.9	0	11	0	13.9	0.4	9.8	1.1	7.4	1.3
24	-1.3	0.4	3.8	6.4	1.4	0.2	8.1	1.9	10.4	12.4	14	2.3	18.4	0	12.6	22.1	13	0	9.1	32.3	9.2	0.9
25	0.6	1	2	19.6	3.3	0	8.4	0	10.9	4.4	14.4	1.7	20.7	0	12.9	7	10.5	0	8.5	28.5	8.5	5.4
26	2.2	0	5.7	21.4	4.2	4.6	8.1	1.2	10.3	0	12.5	0	17.5	0	14.5	0	10.4	0	8.3	2.8	10.3	0
27	4.3	6.9	5.6	3.8	5.3	0	9.7	7	10	0.1	11.4	0	15.7	7.6	15.1	0	12.6	0	7.4	1.8	7	0.1
28	1.3	18.6	5	54.7	2.7	0	14.2	2	9.3	24	10.9	1.5	16.4	3.1	15	0.5	14.2	6.7	7.9	9.7	5.7	4.3
29	4.8	25.3	5.2	24.7	5.1	0	16.5	0	8.7	10.7	14.2	0.2	17.2	0	14	2	12.3	12.3	8.2	4.7	7.8	3.2
30	-0.5	40.8			4.5	0	14.3	0	8.9	8	16.1	0	15.8	0	14.7	25.4	14.2	3.5	10.1	16.9	9	9.9
31	-0.8	12			5.9	0			7.4	2.5			15.4	0	13.4	0.8			8.3	9.5		
n	31	31	29	29	31	31	30	30	31	31	30	30	31	31	31	31	30	30	31	31	30	30
Min.	-1.3	0.0	-2.7	0.0	-1.7	0.0	1.1	0.0	7.4	0.0	8.2	0.0	11.3	0.0	11.0	0.0	9.5	0.0	7.4	0.0	3.0	0.0
Max.	7.2	60.1	6.9	61.5	6.1	39.1	16.5	41.1	15.5	24.4	16.1	45.0	20.7	10.6	16.3	31.2	14.9	34.4	14.7	32.3	10.4	29.5
Mean	3.1	15.6	2.5	15.7	2.5	8.9	7.2	4.8	11.5	4.5	11.9	8.0	15.4	1.0	13.8	6.0	12.7	4.7	10.7	6.3	7.8	3.6
SD	2.6	14.7	2.9	17.4	2.2	11.4	3.5	8.8	2.1	7.1	2.2	10.6	2.1	2.4	1.3	8.6	1.5	8.0	2.2	9.3	1.9	6.3

II. Watertemperatures and pH

Temperatures (C°) measured in hatching trough (T), fish tanks (A, B, and C), and by a net pen (P) for the period January-November (2000). Values of pH were recorded for the inlet water to the hatchery in the period January-August, and in the net pen in September and November. Minimum (min), maximum (max), mean, and mean standard deviation (SD) is given for each month.

Date	January		February			March			April			
	T	pH	T	A	pH	A	C1 & C2	pH	A	B1	C1 & C2	pH
1	4.1	6.13	7.8	-	-	13.6	10.2	-	-	-	-	-
2	4.2	-	7.9	-	-	13.8	10.2	-	-	-	15.3	-
3	4.4	-	7.9	-	-	14.8	11	-	-	-	15.1	-
4	6.5	-	7.9	-	-	15.1	11	-	-	-	15.3	-
5	6.9	6.07	8.3	-	-	15.1	11	-	-	-	15	-
6	6.6	-	8.5	-	-	15.2	11	6.16	-	-	15.1	-
7	6.4	-	8.3	-	-	15.1	13	-	-	-	15.1	6.21
8	7.6	-	8.4	-	-	14.8	14.6	-	-	-	15.2	-
9	7.6	-	8.4	-	-	14.3	14.6	-	15.7	15.7	15	-
10	7.6	-	9.5	-	-	14.9	14.5	-	13.8	13.8	14.2	-
11	7.9	6.09	9.7	-	6.09	14.8	15	6.16	15.5	15.5	-	-
12	7.9	6.09	10	-	-	14	15	6.16	15.6	15.6	-	-
13	7.8	6.09	9.6	-	-	15.8	15	6.16	15.9	15.9	13.9	-
14	7.7	6.09	9.7	-	-	15.8	14.8	6.16	16.1	16.1	14.3	-
15	7.6	6.09	9.8	-	6.09	15.8	15	6.16	15.7	15.7	14	-
16	7.7	6.09	9.6	-	6.11	15.5	14.9	6.16	15.4	15.4	14.1	-
17	7.8	-	10.3	-	-	15.4	14.8	6.17	15.5	15.5	16.2	-
18	7.9	-	10.4	-	-	16.1	15	-	15.3	15.3	14.4	-
19	7.8	-	10.4	-	-	16.4	14.8	-	16.2	16.2	15.5	-
20	7.9	-	10.4	-	-	15.5	14.7	6.16	16.5	16.5	16.5	-
21	7.9	-	10.2	-	6.16	15.9	14.8	6.16	16	16	15.5	6.26
22	7.6	-	-	11	6.16	16	15.3	6.16	15.3	15.3	15.2	-
23	7.4	-	-	8.9	6.16	16.1	15.2	6.16	15.7	15.7	15.3	-
24	7.6	-	-	11.8	-	15.9	15.2	-	16	16	15.3	-
25	7.9	-	-	11.9	6.16	15.9	15.2	-	15.1	15.1	16	-
26	7.9	-	-	12.1	-	15.5	15.2	-	15.3	15.3	16.1	-
27	7.9	-	-	12	-	15.5	15.4	-	15.4	15.4	15.7	6.27
28	7.9	-	-	12.5	-	15.8	14.5	6.21	15.4	15.4	16.4	-
29	7.9	-	-	-	-	16.2	15.1	-	15.2	15.2	16.3	-
30	7.9	-	-	-	-	16.3	15.2	-	14.5	14.5	14.9	6.34
31	7.9	-	-	-	-	-	-	-	-	-	-	-
n	31	8	21	7	7	30	30	13	22	22	27	4
Min.	4.1	6.07	7.8	8.9	6.09	13.6	10.2	6.16	13.8	13.8	13.9	6.21
Max.	7.9	6.13	10.4	12.5	6.16	16.4	15.4	6.21	16.5	16.5	16.5	6.34
Mean	7.3	6.09	9.2	11.5	6.13	15.4	14.0	6.16	15.5	15.5	15.2	6.27
SD	1.1	0.02	1.0	1.2	0.03	0.7	1.7	0.01	0.6	0.6	0.7	0.05

Date	May						June				July				August				September		October		November	
	A	B1	B2	C1 & C2	C3	pH	A	B2	C3	pH	A	B2	C4	pH	A	B2	C4	pH	P	pH	P	pH	P	pH
1	15	15	-	15	-	-	13.5	10.1	14.1	-	17.7	-	14.1	-	17	17.1	17.1	6.37	-	-	-	-	8.7	-
2	14	14	-	15.1	-	-	13.5	10.1	14.1	6.55	16.6	13.3	13.6	-	16.9	16.8	17.2	6.32	-	-	-	-	8.5	-
3	15.9	15.9	-	14.7	-	-	13.5	10.2	14.5	-	17.2	14.3	14.2	6.25	16.7	16.1	-	-	14.9	-	-	-	6.5	5.70
4	16	16	-	13.9	-	6.33	13.6	10.5	15.4	-	16.9	13.6	14.1	6.29	16.1	16	17.1	6.2	-	-	-	-	-	-
5	16.1	16.1	-	13.8	-	-	13.7	10.7	14.7	-	15.8	14.2	13.3	-	-	15.9	16.8	-	-	-	-	-	-	-
6	16.3	16.3	-	15.3	-	-	14	10.9	15	-	17.3	14.1	13.5	-	-	16.1	16.1	6.19	-	-	-	-	-	-
7	16.1	16.1	-	15.4	-	-	14.1	12.5	16	-	17.5	13.3	13.9	6.44	-	16	16	-	15.4	6.15	-	-	-	-
8	16.6	16.6	-	15.2	-	-	16.3	13.3	16.7	-	17.5	13.5	14.7	-	-	15.9	15.9	-	-	-	-	-	-	-
9	16	16	-	14.4	-	6.45	16	12.2	16.6	-	17.1	13.9	14.8	-	-	16.1	16.1	-	-	-	-	-	-	-
10	16.4	16.4	-	14.5	-	-	16.1	11	16	-	17.2	14.7	-	-	-	16.3	16.3	-	-	-	-	-	-	-
11	16.4	16.4	-	15.4	-	-	14.5	10.2	14.6	-	16.9	14.8	14.5	-	-	15.9	15.9	-	-	-	-	-	-	-
12	16.4	16.4	-	-	15.4	-	8.9	7.5	14	-	16.6	14.5	14.2	-	-	15.9	15.9	-	-	-	-	-	-	-
13	16.4	16.4	-	-	15.6	-	14.2	9.6	15.1	6.33	16.9	14.5	14.8	-	-	16.4	16.4	-	-	-	-	-	-	-
14	16.8	16.8	-	-	14.6	-	15.2	10.3	16.2	-	17.5	14.2	15.3	-	-	16.2	16.2	-	14.4	6.14	-	-	-	-
15	16.8	16.8	-	-	15.4	-	15.9	10.8	16.1	-	17.4	14.8	15.6	-	16.1	15.8	15.8	-	-	-	-	-	-	-
16	16.8	16.8	-	-	15.6	-	15.5	11.1	15.9	-	17.2	15.3	15.3	-	-	16.1	16.1	-	-	-	-	-	-	-
17	14.9	14.9	-	-	15.5	-	15.8	11.1	16.1	-	17	15.6	15.2	-	-	-	-	-	-	-	-	-	-	-
18	16.5	16.5	-	-	15.3	-	15.8	10.8	14.7	-	17.3	15.3	15.3	-	-	-	-	6.22	-	-	-	-	-	-
19	16.4	16.4	-	-	14.7	-	16.6	12.4	15.2	-	16.9	15.2	15.4	-	-	-	-	-	-	-	-	-	-	-
20	16.4	16.4	-	-	12.5	-	16.1	11.2	14.1	6.3	16.9	15.3	15.8	-	-	-	-	-	-	-	-	-	-	-
21	16.4	16.4	-	-	15.2	-	16	12.3	13.5	-	16.6	15.4	16.4	-	-	-	-	-	-	-	-	-	-	-
22	16	16	-	-	15.3	-	16	11.6	14.2	-	16.9	15.8	16.7	-	-	-	-	-	-	-	-	-	-	-
23	14.5	14.5	-	-	15.4	6.76	17	11.7	14.2	6.34	18.4	16.4	17.2	-	-	-	-	-	-	-	-	-	-	-
24	14	14	-	-	14.9	-	17.1	11.6	14.2	-	-	16.7	17.8	-	-	-	-	-	-	-	-	-	-	-
25	14.4	14.4	-	-	15.3	6.8	-	11.6	14.1	-	-	17.2	17.6	-	-	-	-	-	-	-	-	-	-	-
26	14.2	14.2	-	-	15.3	-	17.6	12.2	14.2	6.3	17.8	17.8	17.8	-	-	-	-	-	13.2	6.24	-	-	-	-
27	13.1	13.1	-	-	11.7	6.69	17.8	12.6	14.2	-	-	17.6	17.5	-	-	-	-	-	-	-	-	-	-	-
28	14.2	14.2	-	-	14.6	6.49	17.7	13.5	-	-	-	17.8	17	-	-	-	-	-	11.9	-	-	-	-	-
29	13.7	13.7	-	-	14.6	-	17.6	-	15	6.36	16.7	17.5	17.1	-	-	-	-	-	-	-	-	-	-	-
30	13.7	-	10.7	-	14.8	-	17.3	-	15.3	6.38	16.9	17	-	-	-	-	-	-	-	-	-	-	-	-
31	13.8	-	10.8	-	14.7	-	-	-	-	-	17	-	-	6.36	-	-	-	-	-	-	-	-	-	-
n	31	29	2	11	20	6	29	28	29	7	27	29	28	4	5	16	15	5	5	3	0	0	3	1
Min.	13.1	13.1	10.7	13.8	11.7	6.33	8.9	7.5	13.5	6.30	15.8	13.3	13.3	6.25	16.1	15.8	15.8	6.19	11.9	6.14			6.5	5.70
Max.	16.8	16.8	10.8	15.4	15.6	6.80	17.8	13.5	16.7	6.55	18.4	17.8	17.8	6.44	17	17.1	17.2	6.37	15.4	6.24			8.7	5.70
Mean	15.5	15.6	10.8	14.8	14.8	6.59	15.4	11.2	15.0	6.37	17.1	15.3	15.5	6.34	16.6	16.2	16.3	6.26	14.0	6.18			7.9	5.70
SD	1.2	1.1	0.1	0.6	1.0	0.19	1.9	1.2	0.9	0.09	0.5	1.4	1.4	0.08	0.4	0.4	0.5	0.08	1.4	0.06			1.2	

III. Water quality

Total counts of bacteria in freshwater with the use of epifluroescence microscope and a fluorescent dye, DAPI (4’6-diamidino-2-phenylindole). Numbers of bacteria cells counted in 10 fields of a gridfield under the microscope. 50 ml of water sampled from fish tanks (A, B and C), by a net pen (P), and in the watersource of the fish tank (lake) were filtered for bacteria counts.

Date	A	B1	B2	C1	C2	C3	C4	P	Lake
08 March	92	-	-	-	-	-	-	-	66
	82	-	-	-	-	-	-	-	76
	42	-	-	-	-	-	-	-	58
	46	-	-	-	-	-	-	-	70
	50	-	-	-	-	-	-	-	44
	82	-	-	-	-	-	-	-	66
	28	-	-	-	-	-	-	-	54
	72	-	-	-	-	-	-	-	60
	76	-	-	-	-	-	-	-	74
	76	-	-	-	-	-	-	-	46
25 March	78	-	-	114	98	-	-	-	54
	78	-	-	68	84	-	-	-	68
	90	-	-	122	104	-	-	-	72
	126	-	-	94	112	-	-	-	56
	94	-	-	82	138	-	-	-	56
	84	-	-	120	90	-	-	-	70
	118	-	-	94	70	-	-	-	60
	124	-	-	88	106	-	-	-	28
	98	-	-	98	104	-	-	-	58
	78	-	-	84	108	-	-	-	74
10 April	96	-	-	122	102	-	-	-	104
	96	-	-	86	80	-	-	-	70
	106	-	-	100	98	-	-	-	84
	104	-	-	76	66	-	-	-	78
	104	-	-	96	78	-	-	-	72
	116	-	-	76	84	-	-	-	72
	76	-	-	82	74	-	-	-	80
	122	-	-	88	66	-	-	-	66
	110	-	-	70	82	-	-	-	72
	114	-	-	102	76	-	-	-	88
28 April	96	70	-	92	88	-	-	-	100
	98	108	-	90	80	-	-	-	76
	114	62	-	94	98	-	-	-	88
	92	72	-	76	100	-	-	-	72
	96	60	-	80	70	-	-	-	70
	116	120	-	104	68	-	-	-	72
	76	100	-	92	100	-	-	-	84
	94	90	-	104	118	-	-	-	100
	84	96	-	78	102	-	-	-	72
	94	90	-	78	100	-	-	-	64
30 May	130	138	-	-	-	214	-	-	96
	118	150	-	-	-	278	-	-	126
	102	112	-	-	-	210	-	-	84
	138	118	-	-	-	204	-	-	120
	142	150	-	-	-	210	-	-	84
30 May	102	70	-	-	-	160	-	-	102
	96	158	-	-	-	226	-	-	122
	98	40	-	-	-	128	-	-	112
	166	110	-	-	-	226	-	-	106
	122	122	-	-	-	172	-	-	54
	-	146	-	-	-	-	-	-	-
	-	112	-	-	-	-	-	-	-
	-	148	-	-	-	-	-	-	-
16 June	106	-	162	-	-	172	-	-	92
	186	-	180	-	-	184	-	-	96
	184	-	178	-	-	202	-	-	124
	132	-	162	-	-	192	-	-	114
	156	-	198	-	-	162	-	-	142
	182	-	210	-	-	130	-	-	70
	172	-	200	-	-	166	-	-	94
	116	-	174	-	-	106	-	-	64
	212	-	170	-	-	166	-	-	32
	126	-	154	-	-	124	-	-	48
03 July	134	-	162	-	-	174	-	-	128
	114	-	124	-	-	150	-	-	108
	118	-	114	-	-	130	-	-	88
	126	-	124	-	-	190	-	-	102
	142	-	118	-	-	98	-	-	72
	150	-	170	-	-	146	-	-	106
	156	-	142	-	-	130	-	-	88
	144	-	144	-	-	122	-	-	70
	116	-	152	-	-	58	-	-	120
	94	-	122	-	-	134	-	-	106
25 July	108	-	38	-	-	-	146	-	52
	90	-	52	-	-	-	78	-	60
	116	-	30	-	-	-	96	-	30
	116	-	30	-	-	-	78	-	56
	96	-	26	-	-	-	104	-	42
	106	-	62	-	-	-	124	-	28
	96	-	44	-	-	-	92	-	32
	100	-	64	-	-	-	98	-	38
	106	-	54	-	-	-	110	-	34
	74	-	32	-	-	-	64	-	30
08 August	86	-	128	-	-	-	126	-	68
	88	-	78	-	-	-	98	-	54
	96	-	100	-	-	-	98	-	56
	116	-	94	-	-	-	72	-	66
	114	-	92	-	-	-	78	-	58
	78	-	92	-	-	-	80	-	62
	116	-	74	-	-	-	104	-	34
08 August	76	-	96	-	-	-	78	-	70
	102	-	98	-	-	-	90	-	42
	86	-	94	-	-	-	100	-	46
15 August	120	-	84	-	-	-	72	-	-
	114	-	80	-	-	-	72	-	-
	70	-	114	-	-	-	64	-	-
	80	-	82	-	-	-	42	-	-
	80	-	70	-	-	-	72	-	-
	76	-	70	-	-	-	48	-	-
	72	-	76	-	-	-	62	-	-
	90	-	76	-	-	-	64	-	-
	78	-	90	-	-	-	86	-	-
	80	-	48	-	-	-	70	-	-
20 August	62	-	54	-	-	-	102	-	86
	80	-	88	-	-	-	114	-	84
	72	-	72	-	-	-	92	-	74
	72	-	74	-	-	-	96	-	80
	72	-	58	-	-	-	102	-	108
	82	-	56	-	-	-	82	-	76
	90	-	100	-	-	-	78	-	88
	52	-	102	-	-	-	68	-	84
	66	-	70	-	-	-	80	-	90
	74	-	76	-	-	-	72	-	66
07 September	-	-	-	-	-	-	-	98	-
	-	-	-	-	-	-	-	74	-
	-	-	-	-	-	-	-	70	-
	-	-	-	-	-	-	-	68	-
	-	-	-	-	-	-	-	56	-
	-	-	-	-	-	-	-	68	-
	-	-	-	-	-	-	-	72	-
	-	-	-	-	-	-	-	72	-
	-	-	-	-	-	-	-	60	-
	-	-	-	-	-	-	-	76	-
28 September	-	-	-	-	-	-	-	100	-
	-	-	-	-	-	-	-	76	-
	-	-	-	-	-	-	-	118	-
	-	-	-	-	-	-	-	110	-
	-	-	-	-	-	-	-	114	-
	-	-	-	-	-	-	-	96	-
	-	-	-	-	-	-	-	98	-
	-	-	-	-	-	-	-	74	-
	-	-	-	-	-	-	-	96	-
	-	-	-	-	-	-	-	96	-

APPENDIX B. Farmed salmon

Measured sizes (length and weight) and hematocrit (Hct) of examined salmon (hosts) reared in hatching trough (T), tanks (A, B and C) and net pen (P). Skin damage (i.e. scale losses or small ulcers) present or not present on the lateral side of the fish body are denoted as “Yes” or “No”. Ectosymbiont infections on the skin and the gills are categorised on a scale from 0-3: 0 = none infection; 1 = slight; 2 = moderate; 3 = heavy infection.

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
1	T001	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T002	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T003	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T004	2.3	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T005	2.3	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T006	2.3	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T007	2.3	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T008	2.3	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T009	2.3	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T010	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T011	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T012	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T013	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T014	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T015	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T016	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T017	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T018	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T019	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T020	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T021	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T022	2.3	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T023	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T024	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T025	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T026	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T027	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T028	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T029	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T030	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T031	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T032	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T033	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T034	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T035	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T036	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T037	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T038	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T039	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T040	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T041	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T042	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T043	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T044	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T045	2.3	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T046	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T047	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T048	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T049	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T050	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T051	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T052	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T053	2.3	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T054	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T055	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T056	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T057	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T058	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T059	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T060	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T061	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T062	2.3	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T063	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T064	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T065	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T066	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T067	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T068	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T069	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T070	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
1	T071	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T072	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T073	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T074	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T075	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T076	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T077	2.3	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T078	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T079	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T080	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T081	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T082	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T083	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T084	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T085	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T086	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T087	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T088	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T089	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T090	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T091	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T092	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T093	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T094	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T095	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T096	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T097	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T098	-	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T099	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
1	T100	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T101	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T102	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T103	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T104	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T105	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T106	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T107	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T108	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T109	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T110	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T111	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T112	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T113	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T114	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T115	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T116	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T117	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T118	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T119	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T120	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T121	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T122	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T123	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T124	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T125	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T126	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T127	2.8	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T128	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T129	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T130	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T131	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T132	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T133	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T134	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T135	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T136	2.8	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T137	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T138	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T139	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T140	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T141	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T142	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T143	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T144	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T145	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T146	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T147	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T148	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T149	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T150	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
2	T151	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T152	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T153	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T154	2.8	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T155	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T156	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T157	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T158	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T159	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T160	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T161	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T162	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T163	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T164	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T165	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T166	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T167	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T168	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T169	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T170	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T171	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T172	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T173	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T174	2.5	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T175	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T176	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T177	2.8	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T178	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T179	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T180	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T181	2.8	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T182	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T183	2.4	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T184	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T185	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T186	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T187	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T188	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T189	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T190	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T191	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T192	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T193	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T194	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T195	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T196	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T197	2.6	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T198	2.7	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T199	-	-	-	No	0	0	0	0	0	0	0	0	0	0
2	T200	-	-	-	No	0	0	0	0	0	0	0	0	0	0
3	A201	2.95	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A202	2.9	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A203	2.9	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A204	2.9	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A205	2.5	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A206	3.02	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A207	2.8	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A208	2.95	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A209	2.9	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A210	3	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A211	2.85	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A212	3.05	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A213	2.85	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A214	2.85	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A215	2.83	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A216	2.96	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A217	2.78	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A218	2.82	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A219	2.75	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A220	2.88	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A221	2.88	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A222	2.97	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A223	3	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A224	2.97	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A225	2.93	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A226	2.93	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A227	2.83	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A228	2.82	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A229	2.75	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A230	2.8	0.2	-	No	0	0	0	0	0	0	0	0	0	0

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
3	A231	2.8	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A232	2.86	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A233	2.88	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A234	2.95	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A235	2.83	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A236	2.75	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A237	3.02	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A238	2.8	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A239	2.9	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A240	2.95	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A241	2.85	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A242	2.87	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A243	2.9	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A244	2.88	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A245	2.77	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A246	2.72	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A247	2.82	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A248	2.72	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A249	2.82	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A250	2.72	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A251	2.89	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A252	2.87	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A253	2.9	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A254	3.04	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A255	3	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A256	2.75	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A257	2.95	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A258	2.82	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A259	2.95	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A260	2.97	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A261	3	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A262	2.73	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A263	2.76	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A264	2.85	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A265	2.95	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A266	2.87	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A267	3.04	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A268	3	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A269	2.96	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A270	2.91	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A271	2.93	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A272	2.82	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A273	3	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A274	3	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A275	2.85	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A276	2.91	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A277	3	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A278	2.95	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A279	2.85	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A280	3	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A281	2.9	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A282	3	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A283	2.9	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A284	3	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A285	2.91	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A286	3.05	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A287	2.95	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A288	3.1	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A289	2.91	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A290	3.05	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A291	3.01	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A292	2.95	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A293	3	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A294	3.03	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A295	2.93	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A296	2.92	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A297	3.03	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A298	2.81	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A299	2.96	0.2	-	No	0	0	0	0	0	0	0	0	0	0
3	A300	2.83	0.2	-	No	0	0	0	0	0	0	0	0	0	0
4	A301	3.1	0.3	-	No	0	0	0	0	0	0	0	0	0	0
4	A302	3.3	0.4	-	No	0	0	0	0	0	0	0	0	0	0
4	A303	3.2	0.3	-	No	0	0	0	0	0	0	0	0	0	0
4	A304	3.6	0.4	-	No	0	0	0	0	0	0	0	0	0	0
4	A305	3.55	0.4	-	No	0	0	0	0	0	0	0	0	0	0
4	A306	3.05	0.3	-	No	0	0	0	0	0	0	0	0	0	0
4	A307	3.6	0.4	-	No	1	0	0	0	0	0	0	0	0	0
4	A308	3.45	0.3	-	No	2	0	0	0	0	0	0	0	0	0
4	A309	3.8	0.4	-	No	0	0	0	0	0	0	0	0	0	0
4	A310	3.6	0.4	-	No	1	0	0	0	0	0	0	0	0	0

Host						*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
4	A311	3.4	0.3	-	No	1	0	0	0	0	0	0	0	0	0
4	A312	3.2	0.3	-	No	0	0	0	0	0	0	0	0	0	0
4	A313	3.5	0.4	-	No	0	0	0	0	0	0	0	0	0	0
4	A314	3.45	0.4	-	No	0	0	0	0	0	0	0	0	0	0
4	A315	3.2	0.3	-	No	0	0	0	0	0	0	0	0	0	0
4	A316	3.6	0.4	-	No	0	0	0	0	0	0	0	0	0	0
4	A317	3.4	0.4	-	No	0	0	0	0	0	0	0	0	0	0
4	A318	3.9	0.5	-	No	3	0	0	0	0	0	0	0	0	0
4	A319	3.45	0.4	-	No	0	0	0	0	0	0	0	0	0	0
4	A320	3.5	0.4	-	No	0	0	0	0	0	0	0	0	0	0
4	A321	3.1	0.3	-	No	0	0	0	0	0	0	0	0	0	0
4	A322	3.75	0.5	-	No	0	0	0	0	0	0	0	0	0	0
4	A323	3.7	0.5	-	No	1	0	0	0	0	0	0	0	0	0
4	A324	3.5	0.5	-	No	0	0	0	0	0	0	0	0	0	0
4	A325	3.7	0.5	-	No	0	0	0	0	0	0	0	0	0	0
4	A326	3.5	0.4	-	No	0	0	0	0	0	0	0	0	0	0
4	A327	3.45	0.3	-	No	2	0	0	0	0	0	0	0	0	0
4	A328	3.85	0.6	-	No	2	0	0	0	0	0	0	0	0	0
4	A329	3.4	0.3	-	No	0	0	0	0	0	0	0	0	0	0
4	A330	3.1	0.3	-	No	0	1	0	0	0	0	0	0	0	0
4	A331	3	0.3	-	No	0	0	0	0	0	0	0	0	0	0
4	A332	3.8	0.5	-	No	0	0	0	0	0	0	0	0	0	0
4	A333	3.6	0.5	-	No	0	0	0	0	0	0	0	0	0	0
4	A334	3.6	0.4	-	No	2	0	0	0	0	0	0	0	0	0
4	A335	3.6	0.4	-	No	0	0	0	0	0	0	0	0	0	0
4	A336	3.35	0.4	-	No	0	0	0	0	0	0	0	0	0	0
4	A337	3.2	-	-	No	0	2	0	0	0	0	0	0	0	0
4	A338	2.8	0.2	-	No	0	0	0	0	0	0	0	0	0	0
4	A339	3.2	0.3	-	No	0	1	0	0	0	0	0	0	0	0
4	A340	3.4	0.3	-	No	0	1	0	0	0	0	0	0	0	0
4	A341	3.8	0.4	-	No	0	0	0	0	0	0	0	0	0	0
4	A342	3.45	0.3	-	No	0	0	0	0	0	0	0	0	0	0
4	A343	3.5	-	-	No	1	0	0	0	0	0	0	0	0	0
4	A344	3.35	0.3	-	No	0	0	0	0	0	0	0	0	0	0
4	A345	2.95	0.2	-	No	0	0	0	0	0	0	0	0	0	0
4	A346	2.95	0.2	-	No	0	0	0	0	0	0	0	0	0	0
4	A347	3.3	0.3	-	No	0	0	0	0	0	0	0	0	0	0
4	A348	3.15	0.3	-	No	0	1	0	0	0	0	0	0	0	0
4	A349	3.1	0.3	-	No	1	0	0	0	0	0	0	0	0	0
4	A350	3.5	0.4	-	No	3	1	0	0	0	0	0	0	0	0
4	A351	3.6	0.4	-	No	0	1	0	0	0	0	0	0	0	0
4	A352	3.4	0.3	-	No	0	0	0	0	0	0	0	0	0	0
4	A353	3.25	0.3	-	No	0	2	0	0	0	0	0	0	0	0
4	A354	3.35	0.3	-	No	0	2	0	0	0	0	0	0	0	0
4	A355	3	0.2	-	No	1	0	0	0	0	0	0	0	0	0
4	A356	3.5	0.4	-	No	0	0	0	0	0	0	0	0	0	0
4	A357	3	0.3	-	No	0	1	0	0	0	0	0	0	0	0
4	A358	-	-	-	No	1	0	0	0	0	0	0	0	0	0
4	A359	3.45	0.3	-	No	0	0	0	0	0	0	0	0	0	0
4	A360	3.1	0.3	-	No	0	0	0	0	0	0	0	0	0	0
5	A361	3.5	0.4	-	No	0	0	0	0	0	0	0	0	0	0
5	A362	4.5	0.9	-	No	0	0	0	0	0	0	0	0	0	0
5	A363	4.35	0.8	-	No	0	0	0	0	0	0	0	0	0	0
5	A364	4.55	0.9	-	No	0	0	0	0	0	0	0	0	0	0
5	A365	4.2	0.7	-	No	0	0	0	0	0	0	0	0	0	0
5	A366	4.5	0.8	-	No	0	0	0	0	0	0	0	0	0	0
5	A367	4.65	1.0	-	No	0	0	0	0	0	0	0	0	0	0
5	A368	3.1	0.3	-	No	0	0	0	0	0	0	0	0	0	0
5	A369	4.95	1.0	-	No	0	0	0	0	0	0	0	0	0	0
5	A370	4.9	1.1	-	No	0	0	0	0	0	0	0	0	0	0
5	A371	4.1	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A372	4.05	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A373	4.95	1.2	-	No	0	0	0	0	0	0	0	0	0	0
5	A374	4.5	0.8	-	No	0	0	0	0	0	0	0	0	0	0
5	A375	4.1	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A376	3.85	0.5	-	No	0	0	0	0	0	0	0	0	0	0
5	A377	4.5	0.7	-	No	0	0	0	0	0	0	0	0	0	0
5	A378	5	1.1	-	No	0	0	0	0	0	0	0	0	0	0
5	A379	3.8	0.5	-	No	0	0	0	0	0	0	0	0	0	0
5	A380	4.15	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A381	4.25	0.7	-	No	0	0	0	0	0	0	0	0	0	0
5	A382	3.55	0.4	-	No	0	0	0	0	0	0	0	0	0	0
5	A383	4.2	0.7	-	No	0	0	0	0	0	0	0	0	0	0
5	A384	4.5	0.8	-	No	0	0	0	0	0	0	0	0	0	0
5	A385	4	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A386	4.45	0.9	-	No	0	0	0	0	0	0	0	0	0	0
5	A387	3.6	0.4	-	No	0	0	0	0	0	0	0	0	0	0
5	A388	4.6	0.9	-	No	0	0	0	0	0	0	0	0	0	0
5	A389	3.75	0.5	-	No	0	0	0	0	0	0	0	0	0	0
5	A390	4.05	0.6	-	No	0	0	0	0	0	0	0	0	0	0

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
5	A391	3.8	0.5	-	No	0	0	0	0	0	0	0	0	0	0
5	A392	4.45	0.8	-	No	0	0	0	0	0	0	0	0	0	0
5	A393	4	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A394	4.4	0.8	-	No	0	0	0	0	0	0	0	0	0	0
5	A395	4.8	1.0	-	No	0	0	0	0	0	0	0	0	0	0
5	A396	4.55	0.9	-	No	0	0	0	0	0	0	0	0	0	0
5	A397	3.65	0.4	-	No	0	0	0	0	0	0	0	0	0	0
5	A398	4.75	1.1	-	No	0	0	0	0	0	0	0	0	0	0
5	A399	4.6	1.0	-	No	0	0	0	0	0	0	0	0	0	0
5	A400	4.6	0.9	-	No	0	0	0	0	0	0	0	0	0	0
5	A401	3.55	0.5	-	No	0	0	0	0	0	0	0	0	0	0
5	A402	3.95	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A403	4.95	1.1	-	No	0	0	0	0	0	0	0	0	0	0
5	A404	4.15	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A405	3.9	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A406	4.5	0.8	-	No	0	0	0	0	0	0	0	0	0	0
5	A407	4.2	0.7	-	No	0	0	0	0	0	0	0	0	0	0
5	A408	4.95	1.3	-	No	0	0	0	0	0	0	0	0	0	0
5	A409	4.15	0.7	-	No	0	0	0	0	0	0	0	0	0	0
5	A410	4.3	0.8	-	No	0	0	0	0	0	0	0	0	0	0
5	A411	4	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A412	4.2	0.8	-	No	0	0	0	0	0	0	0	0	0	0
5	A413	4.1	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A414	3.9	0.5	-	No	0	0	0	0	0	0	0	0	0	0
5	A415	3.9	0.5	-	No	0	0	0	0	0	0	0	0	0	0
5	A416	3.75	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A417	4.3	0.8	-	No	0	0	0	0	0	0	0	0	0	0
5	A418	4.55	0.9	-	No	0	0	0	0	0	0	0	0	0	0
5	A419	4.3	0.8	-	No	0	0	0	0	0	0	0	0	0	0
5	A420	4	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A421	4.35	0.5	-	No	0	0	0	0	0	0	0	0	0	0
5	A422	4	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A423	4.4	0.8	-	No	0	0	0	0	0	0	0	0	0	0
5	A424	4.15	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A425	4.05	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A426	4.35	0.8	-	No	0	0	0	0	0	0	0	0	0	0
5	A427	4.15	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A428	4.35	0.9	-	No	0	0	0	0	0	0	0	0	0	0
5	A429	4.1	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A430	4.4	0.8	-	No	0	0	0	0	0	0	0	0	0	0
5	A431	4.65	1.0	-	No	0	0	0	0	0	0	0	0	0	0
5	A432	4.6	0.9	-	No	0	0	0	0	0	0	0	0	0	0
5	A433	4.1	0.7	-	No	0	0	0	0	0	0	0	0	0	0
5	A434	4.4	-	-	No	0	0	0	0	0	0	0	0	0	0
5	A435	4.7	1.1	-	No	0	0	0	0	0	0	0	0	0	0
5	A436	4.25	0.7	-	No	0	0	0	0	0	0	0	0	0	0
5	A437	4.4	0.8	-	No	0	0	0	0	0	0	0	0	0	0
5	A438	4.9	1.1	-	No	0	0	0	0	0	0	0	0	0	0
5	A439	4.65	1.0	-	No	0	0	0	0	0	0	0	0	0	0
5	A440	3.6	0.5	-	No	0	0	0	0	0	0	0	0	0	0
5	A441	5	1.2	-	No	0	0	0	0	0	0	0	0	0	0
5	A442	4.35	0.8	-	No	0	0	0	0	0	0	0	0	0	0
5	A443	4.15	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A444	4.2	0.8	-	No	0	0	0	0	0	0	0	0	0	0
5	A445	4.3	0.8	-	No	0	0	0	0	0	0	0	0	0	0
5	A446	4.75	1.0	-	No	0	0	0	0	0	0	0	0	0	0
5	A447	4.2	0.7	-	No	0	0	0	0	0	0	0	0	0	0
5	A448	3.8	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A449	4.1	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A450	3.8	0.5	-	No	0	0	0	0	0	0	0	0	0	0
5	A451	4.5	1.0	-	No	0	0	0	0	0	0	0	0	0	0
5	A452	4.1	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A453	4.8	1.1	-	No	0	0	0	0	0	0	0	0	0	0
5	A454	4.9	1.0	-	No	0	0	0	0	0	0	0	0	0	0
5	A455	5	1.2	-	No	0	0	0	0	0	0	0	0	0	0
5	A456	4.2	0.7	-	No	0	0	0	0	0	0	0	0	0	0
5	A457	3.9	0.6	-	No	0	0	0	0	0	0	0	0	0	0
5	A458	4.05	0.7	-	No	0	0	0	0	0	0	0	0	0	0
5	A459	4.95	1.1	-	No	0	0	0	0	0	0	0	0	0	0
5	A460	4.1	0.6	-	No	0	0	0	0	0	0	0	0	0	0
6	C001	4.31	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C002	4.25	0.7	-	No	1	0	0	0	0	0	0	0	0	0
6	C003	4.9	1.1	-	No	0	0	0	0	0	0	0	0	0	0
6	C004	4.35	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C005	4.4	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C006	4	0.6	-	No	0	0	0	0	0	0	0	0	0	0
6	C007	4.25	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C008	4.3	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C009	3.8	0.5	-	No	0	0	0	0	0	0	0	0	0	0
6	C010	4.1	0.7	-	No	0	0	0	0	0	0	0	0	0	0

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
6	C011	-	-	-	No	0	0	0	0	0	0	0	0	0	0
6	C012	-	-	-	No	0	0	0	0	0	0	0	0	0	0
6	C013	4.6	0.9	-	No	0	0	0	0	0	0	0	0	0	0
6	C014	4.4	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C015	4.4	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C016	3.6	0.4	-	No	0	0	0	0	0	0	0	0	0	0
6	C017	4.2	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C018	4.4	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C019	4.85	1.1	-	No	0	0	0	0	0	0	0	0	0	0
6	C020	4.5	0.9	-	No	0	0	0	0	0	0	0	0	0	0
6	C021	4.1	0.6	-	No	0	0	0	0	0	0	0	0	0	0
6	C022	4.6	0.9	-	No	0	0	0	0	0	0	0	0	0	0
6	C023	4.3	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C024	4.5	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C025	4	0.5	-	No	0	0	0	0	0	0	0	0	0	0
6	C026	4.25	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C027	4.3	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C028	4	0.6	-	No	0	0	0	0	0	0	0	0	0	0
6	C029	4.5	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C030	4.3	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C031	4.65	0.9	-	No	0	0	0	0	0	0	0	0	0	0
6	C032	4.1	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C033	4.7	0.9	-	No	0	0	0	0	0	0	0	0	0	0
6	C034	4.5	0.9	-	No	0	0	0	0	0	0	0	0	0	0
6	C035	4.4	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C036	4.4	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C037	4.5	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C038	4.25	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C039	4.35	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C040	3.8	0.5	-	No	0	0	0	0	0	0	0	0	0	0
6	C041	3.6	0.4	-	No	0	0	0	0	0	0	0	0	0	0
6	C042	4.15	0.9	-	No	0	0	0	0	0	0	0	0	0	0
6	C043	4.5	0.9	-	No	0	0	0	0	0	0	0	0	0	0
6	C044	4	0.6	-	No	0	0	0	0	0	0	0	0	0	0
6	C045	4.4	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C046	4.35	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C047	4.25	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C048	4.8	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C049	4.5	1.0	-	No	0	0	0	0	0	0	0	0	0	0
6	C050	4.35	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C051	4.2	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C052	4.4	0.9	-	No	0	0	0	0	0	0	0	0	0	0
6	C053	4.1	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C054	4.8	1.0	-	No	0	0	0	0	0	0	0	0	0	0
6	C055	4.3	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C056	4.2	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C057	4.15	0.9	-	No	0	0	0	0	0	0	0	0	0	0
6	C058	4.95	1.0	-	No	0	0	0	0	0	0	0	0	0	0
6	C059	4	0.9	-	No	0	0	0	0	0	0	0	0	0	0
6	C060	5.1	1.2	-	No	0	0	0	0	0	0	0	0	0	0
6	C061	3.9	0.6	-	No	0	0	0	0	0	0	0	0	0	0
6	C062	4.2	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C063	4.55	0.9	-	No	0	0	0	0	0	0	0	0	0	0
6	C064	4.75	1.0	-	No	0	0	0	0	0	0	0	0	0	0
6	C065	4.8	0.9	-	No	0	0	0	0	0	0	0	0	0	0
6	C066	4.7	0.9	-	No	0	0	0	0	0	0	0	0	0	0
6	C067	4.25	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C068	4	0.6	-	No	0	0	0	0	0	0	0	0	0	0
6	C069	4.3	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C070	4.4	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C071	4.4	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C072	3.25	0.3	-	No	0	0	0	0	0	0	0	0	0	0
6	C073	4.05	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C074	4.25	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C075	4.05	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C076	4	0.5	-	No	0	0	0	0	0	0	0	0	0	0
6	C077	4.5	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C078	5	1.1	-	No	0	0	0	0	0	0	0	0	0	0
6	C079	4.3	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C080	3.95	0.6	-	No	0	0	0	0	0	0	0	0	0	0
6	C081	4.5	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C082	4.3	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C083	4.55	0.9	-	No	0	0	0	0	0	0	0	0	0	0
6	C084	4.5	0.9	-	No	0	0	0	0	0	0	0	0	0	0
6	C085	4.2	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C086	4.65	1.0	-	No	1	0	0	0	0	0	0	0	0	0
6	C087	4.5	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C088	4.8	1.0	-	No	0	0	0	0	0	0	0	0	0	0
6	C089	4.65	0.9	-	No	1	0	0	0	0	0	0	0	0	0
6	C090	4.1	0.6	-	No	0	0	0	0	0	0	0	0	0	0

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
6	C091	4.6	1.0	-	No	0	0	0	0	0	0	0	0	0	0
6	C092	4.2	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C093	4.3	0.7	-	No	3	0	0	0	0	0	0	0	0	0
6	C094	4.4	0.8	-	No	0	0	0	0	0	0	0	0	0	0
6	C095	4.7	1.0	-	No	0	0	0	0	0	0	0	0	0	0
6	C096	4.05	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C097	4.4	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C098	4.35	0.7	-	No	0	0	0	0	0	0	0	0	0	0
6	C099	3.9	0.6	-	No	0	0	0	0	0	0	0	0	0	0
6	C100	4.4	0.8	-	No	0	0	0	0	0	0	0	0	0	0
7	A461	5.3	1.4	-	No	0	0	0	0	0	0	0	0	0	0
7	A462	5.2	1.4	-	No	0	0	0	0	0	0	0	0	0	0
7	A463	5.45	1.4	-	No	0	0	0	0	0	0	0	0	0	0
7	A464	6.1	2.3	-	No	0	0	0	0	0	0	0	0	0	0
7	A465	4.1	0.7	-	No	0	0	0	0	0	0	0	0	0	0
7	A466	5	1.2	-	No	0	0	0	0	0	0	0	0	0	0
7	A467	5.65	1.7	-	No	0	0	0	0	0	0	0	0	0	0
7	A468	6	2.1	-	No	0	0	0	0	0	0	0	0	0	0
7	A469	4.8	1.0	-	No	0	0	0	0	0	0	0	0	0	0
7	A470	4.85	0.8	-	No	0	0	0	0	0	0	0	0	0	0
7	A471	5	1.2	-	No	0	0	0	0	0	0	0	0	0	0
7	A472	5.4	1.6	-	No	0	0	0	0	0	0	0	0	0	0
7	A473	4.7	1.0	-	No	0	0	0	0	0	0	0	0	0	0
7	A474	5.85	2.0	-	No	0	0	0	0	0	0	0	0	0	0
7	A475	6	2.2	-	No	0	0	0	0	0	0	0	0	0	0
7	A476	4.3	1.0	-	No	0	0	0	0	0	0	0	0	0	0
7	A477	4.85	1.1	-	No	0	0	0	0	0	0	0	0	0	0
7	A478	5.7	1.8	-	No	0	0	0	0	0	0	0	0	0	0
7	A479	5.5	1.7	-	No	0	0	0	0	0	0	0	0	0	0
7	A480	4.6	0.9	-	No	0	0	0	0	0	0	0	0	0	0
7	A481	4.95	1.2	-	No	0	0	0	0	0	0	0	0	0	0
7	A482	5	1.2	-	No	0	0	0	0	0	0	0	0	0	0
7	A483	5.7	1.8	-	No	0	0	0	0	0	0	0	0	0	0
7	A484	5.4	1.5	-	No	0	0	0	0	0	0	0	0	0	0
7	A485	6.2	2.5	-	No	0	0	0	0	0	0	0	0	0	0
7	A486	4.7	1.1	-	No	0	0	0	0	0	0	0	0	0	0
7	A487	5.5	1.3	-	No	0	0	0	0	0	0	0	0	0	0
7	A488	5.1	1.4	-	No	0	0	0	0	0	0	0	0	0	0
7	A489	5.2	1.4	-	No	0	0	0	0	0	0	0	0	0	0
7	A490	4.8	1.1	-	No	0	0	0	0	0	0	0	0	0	0
7	A491	5.2	1.5	-	No	0	0	0	0	0	0	0	0	0	0
7	A492	5	1.3	-	No	0	0	0	0	0	0	0	0	0	0
7	A493	4.95	1.2	-	No	0	0	0	0	0	0	0	0	0	0
7	A494	5.5	1.6	-	No	0	0	0	0	0	0	0	0	0	0
7	A495	5.65	1.8	-	No	0	0	0	0	0	0	0	0	0	0
7	A496	5.9	2.0	-	No	0	0	0	0	0	0	0	0	0	0
7	A497	5.45	1.6	-	No	0	0	0	0	0	0	0	0	0	0
7	A498	5.7	1.7	-	No	0	0	0	0	0	0	0	0	0	0
7	A499	5.1	1.3	-	No	0	0	0	0	0	0	0	0	0	0
7	A500	5.1	1.3	-	No	0	0	0	0	0	0	0	0	0	0
7	A501	4.5	0.9	-	No	0	0	0	0	0	0	0	0	0	0
7	A502	4.9	1.3	-	No	0	0	0	0	0	0	0	0	0	0
7	A503	5.15	1.4	-	No	0	0	0	0	0	0	0	0	0	0
7	A504	4.45	1.0	-	No	0	0	0	0	0	0	0	0	0	0
7	A505	5.3	1.6	-	No	0	0	0	0	0	0	0	0	0	0
7	A506	4.95	1.1	-	No	0	0	0	0	0	0	0	0	0	0
7	A507	4.4	0.9	-	No	0	0	0	0	0	0	0	0	0	0
7	A508	5.4	1.5	-	No	0	0	0	0	0	0	0	0	0	0
7	A509	5.3	1.4	-	No	0	0	0	0	0	0	0	0	0	0
7	A510	5.1	1.3	-	No	0	0	0	0	0	0	0	0	0	0
7	A511	5.8	1.8	-	No	0	0	0	0	0	0	0	0	0	0
7	A512	5.8	1.9	-	No	0	0	0	0	0	0	0	0	0	0
7	A513	5.3	1.4	-	No	0	0	0	0	0	0	0	0	0	0
7	A514	5.6	1.8	-	No	0	0	0	0	0	0	0	0	0	0
7	A515	5	1.2	-	No	0	0	0	0	0	0	0	0	0	0
7	A516	4.5	0.9	-	No	0	0	0	0	0	0	0	0	0	0
7	A517	4.5	0.9	-	No	0	0	0	0	0	0	0	0	0	0
7	A518	5.9	2.0	-	No	0	0	0	0	0	0	0	0	0	0
7	A519	5.1	1.2	-	No	0	0	0	0	0	0	0	0	0	0
7	A520	4.35	0.7	-	No	0	0	0	0	0	0	0	0	0	0
7	A521	5.8	1.8	-	No	0	0	0	0	0	0	0	0	0	0
7	A522	5.2	1.3	-	No	0	0	0	0	0	0	0	0	0	0
7	A523	4.7	1.1	-	No	0	0	0	0	0	0	0	0	0	0
7	A524	4.5	0.8	-	No	0	0	0	0	0	0	0	0	0	0
7	A525	5.6	1.7	-	No	0	0	0	0	0	0	0	0	0	0
7	A526	4.3	0.8	-	No	0	0	0	0	0	0	0	0	0	0
7	A527	5.7	1.8	-	No	0	0	0	0	0	0	0	0	0	0
7	A528	5.1	1.2	-	No	0	0	0	0	0	0	0	0	0	0
7	A529	4.95	1.1	-	No	0	0	0	0	0	0	0	0	0	0
7	A530	4.9	1.1	-	No	0	0	0	0	0	0	0	0	0	0

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
7	A531	5.5	1.6	-	No	0	0	0	0	0	0	0	0	0	0
7	A532	4.6	0.9	-	No	0	0	0	0	0	0	0	0	0	0
7	A533	5.2	1.1	-	No	0	0	0	0	0	0	0	0	0	0
7	A534	4.7	0.9	-	No	0	0	0	0	0	0	0	0	0	0
7	A535	4.8	1.0	-	No	0	0	0	0	0	0	0	0	0	0
7	A536	6.4	2.7	-	No	0	0	0	0	0	0	0	0	0	0
7	A537	4.4	0.7	-	No	0	0	0	0	0	0	0	0	0	0
7	A538	5.7	1.9	-	No	0	0	0	0	0	0	0	0	0	0
7	A539	4.9	1.2	-	No	0	0	0	0	0	0	0	0	0	0
7	A540	6	2.2	-	No	0	0	0	0	0	0	0	0	0	0
7	A541	5.25	1.5	-	No	0	0	0	0	0	0	0	0	0	0
7	A542	4.4	1.0	-	No	0	0	0	0	0	0	0	0	0	0
7	A543	5.5	1.6	-	No	0	0	0	0	0	0	0	0	0	0
7	A544	5.3	1.4	-	No	0	0	0	0	0	0	0	0	0	0
7	A545	5.15	1.5	-	No	0	0	0	0	0	0	0	0	0	0
7	A546	5.4	1.5	-	No	0	0	0	0	0	0	0	0	0	0
7	A547	5.1	1.3	-	No	0	0	0	0	0	0	0	0	0	0
7	A548	4.7	1.0	-	No	0	0	0	0	0	0	0	0	0	0
7	A549	4.4	0.7	-	No	0	0	0	0	0	0	0	0	0	0
7	A550	5.8	2.0	-	No	0	0	0	0	0	0	0	0	0	0
7	A551	4.8	1.1	-	No	0	0	0	0	0	0	0	0	0	0
7	A552	4.9	1.2	-	No	0	0	0	0	0	0	0	0	0	0
7	A553	4.5	0.9	-	No	0	0	0	0	0	0	0	0	0	0
7	A554	4.6	0.9	-	No	0	0	0	0	0	0	0	0	0	0
7	A555	4.65	0.9	-	No	0	0	0	0	0	0	0	0	0	0
7	A556	5.4	1.5	-	No	0	0	0	0	0	0	0	0	0	0
7	A557	4.9	1.2	-	No	0	0	0	0	0	0	0	0	0	0
7	A558	4.45	0.9	-	No	0	0	0	0	0	0	0	0	0	0
7	A559	4.5	0.8	-	No	0	0	0	0	0	0	0	0	0	0
7	A560	4.5	0.8	-	No	0	0	0	0	0	0	0	0	0	0
8	C101	5.5	1.6	-	No	0	0	0	0	0	0	0	0	0	0
8	C102	5.25	1.4	-	No	0	0	0	0	0	0	0	0	0	0
8	C103	5.15	1.2	-	No	0	0	0	0	0	0	0	0	0	0
8	C104	5	1.2	-	No	0	0	0	0	0	0	0	0	0	0
8	C105	5.05	1.3	-	No	0	0	0	0	0	0	0	0	0	0
8	C106	5.3	1.5	-	No	0	0	0	0	0	0	0	0	0	0
8	C107	5.2	1.3	-	No	0	0	0	0	0	0	0	0	0	0
8	C108	5.5	1.6	-	No	0	0	0	0	0	0	0	0	0	0
8	C109	5.5	1.6	-	No	0	0	0	0	0	0	0	0	0	0
8	C110	5.75	1.8	-	No	0	0	0	0	0	0	0	0	0	0
8	C111	5.8	1.7	-	No	0	0	0	0	0	0	0	0	0	0
8	C112	5.9	1.8	-	No	0	0	0	0	0	0	0	0	0	0
8	C113	5.95	1.8	-	No	0	0	0	0	0	0	0	0	0	0
8	C114	5	1.1	-	No	0	0	0	0	0	0	0	0	0	0
8	C115	5.5	1.6	-	No	0	0	0	0	0	0	0	0	0	0
8	C116	5.45	1.5	-	No	0	0	0	0	0	0	0	0	0	0
8	C117	6	2.1	-	No	0	0	0	0	0	0	0	0	0	0
8	C118	5.7	1.7	-	No	0	0	0	0	0	0	0	0	0	0
8	C119	5.1	1.2	-	No	0	0	0	0	0	0	0	0	0	0
8	C120	5.3	1.3	-	No	0	0	0	0	0	0	0	0	0	0
8	C121	5.05	1.2	-	No	0	0	0	0	0	0	0	0	0	0
8	C122	6.25	2.2	-	No	0	0	0	0	0	0	0	0	0	0
8	C123	4.9	1.1	-	No	0	0	0	0	0	0	0	0	0	0
8	C124	5.6	1.6	-	No	0	0	0	0	0	0	0	0	0	0
8	C125	5	1.2	-	No	0	0	0	0	0	0	0	0	0	0
8	C126	5.5	1.6	-	No	0	0	0	0	0	0	0	0	0	0
8	C127	5.3	1.4	-	No	0	0	0	0	0	0	0	0	0	0
8	C128	5.15	1.2	-	No	0	0	0	0	0	0	0	0	0	0
8	C129	5.3	1.4	-	No	0	0	0	0	0	0	0	0	0	0
8	C130	6	2.2	-	No	0	0	0	0	0	0	0	0	0	0
8	C131	5.6	1.7	-	No	0	0	0	0	0	0	0	0	0	0
8	C132	6	2.1	-	No	0	0	0	0	0	0	0	0	0	0
8	C133	5	1.2	-	No	0	0	0	0	0	0	0	0	0	0
8	C134	5.8	1.9	-	No	0	0	0	0	0	0	0	0	0	0
8	C135	5.6	1.7	-	No	0	0	0	0	0	0	0	0	0	0
8	C136	5.2	1.3	-	No	0	0	0	0	0	0	0	0	0	0
8	C137	5.85	2.0	-	No	0	0	0	0	0	0	0	0	0	0
8	C138	5.7	1.8	-	No	0	0	0	0	0	0	0	0	0	0
8	C139	5.45	1.6	-	No	0	0	0	0	0	0	0	0	0	0
8	C140	5.5	1.7	-	No	0	0	0	0	0	0	0	0	0	0
8	C141	6	2.1	-	No	0	0	0	0	0	0	0	0	0	0
8	C142	4.5	0.9	-	No	0	0	0	0	0	0	0	0	0	0
8	C143	4.7	1.0	-	No	0	0	0	0	0	0	0	0	0	0
8	C144	4.9	1.1	-	No	0	0	0	0	0	0	0	0	0	0
8	C145	4.2	0.7	-	No	0	0	0	0	0	0	0	0	0	0
8	C146	5.4	1.4	-	No	0	0	0	0	0	0	0	0	0	0
8	C147	5.3	1.4	-	No	0	0	0	0	0	0	0	0	0	0
8	C148	5.3	1.5	-	No	0	0	0	0	0	0	0	0	0	0
8	C149	5.8	1.8	-	No	0	0	0	0	0	0	0	0	0	0
8	C150	5.3	1.5	-	No	0	0	0	0	0	0	0	0	0	0

Host						*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
8	C151	6.4	2.6	-	No	0	0	0	0	0	0	0	0	0	0
8	C152	6.2	2.4	-	No	0	0	0	0	0	0	0	0	0	0
8	C153	6.25	2.4	-	No	0	0	0	0	0	0	0	0	0	0
8	C154	5.3	1.4	-	No	0	0	0	0	0	0	0	0	0	0
8	C155	6	2.1	-	No	0	0	0	0	0	0	0	0	0	0
8	C156	5.9	2.2	-	No	0	0	0	0	0	0	0	0	0	0
8	C157	6.1	2.2	-	No	0	0	0	0	0	0	0	0	0	0
8	C158	6.05	2.0	-	No	0	0	0	0	0	0	0	0	0	0
8	C159	5.6	1.7	-	No	0	0	0	0	0	0	0	0	0	0
8	C160	5.2	1.3	-	No	0	0	0	0	0	0	0	0	0	0
8	C161	5.7	1.7	-	No	0	0	0	0	0	0	0	0	0	0
8	C162	5.75	1.8	-	No	0	0	0	0	0	0	0	0	0	0
8	C163	5.4	1.5	-	No	0	0	0	0	0	0	0	0	0	0
8	C164	5.3	1.3	-	No	0	0	0	0	0	0	0	0	0	0
8	C165	5.7	1.8	-	No	0	0	0	0	0	0	0	0	0	0
8	C166	6.3	2.3	-	No	0	0	0	0	0	0	0	0	0	0
8	C167	5.6	1.8	-	No	0	0	0	0	0	0	0	0	0	0
8	C168	5.7	1.9	-	No	0	0	0	0	0	0	0	0	0	0
8	C169	6.1	2.2	-	No	0	0	0	0	0	0	0	0	0	0
8	C170	5.75	1.8	-	No	0	0	0	0	0	0	0	0	0	0
8	C171	6.3	2.5	-	No	0	0	0	0	0	0	0	0	0	0
8	C172	6.1	2.3	-	No	0	0	0	0	0	0	0	0	0	0
8	C173	6.1	2.3	-	No	0	0	0	0	0	0	0	0	0	0
8	C174	5	1.2	-	No	0	0	0	0	0	0	0	0	0	0
8	C175	5.8	1.8	-	No	0	0	0	0	0	0	0	0	0	0
8	C176	6	2.0	-	No	0	0	0	0	0	0	0	0	0	0
8	C177	6.4	2.6	-	No	0	0	0	0	0	0	0	0	0	0
8	C178	6.5	2.7	-	No	0	0	0	0	0	0	0	0	0	0
8	C179	5.8	1.8	-	No	0	0	0	0	0	0	0	0	0	0
8	C180	5.2	1.4	-	No	0	0	0	0	0	0	0	0	0	0
8	C181	4.6	1.0	-	No	0	0	0	0	0	0	0	0	0	0
8	C182	5.5	1.6	-	No	0	0	0	0	0	0	0	0	0	0
8	C183	5.35	1.3	-	No	0	0	0	0	0	0	0	0	0	0
8	C184	5.65	1.7	-	No	0	0	0	0	0	0	0	0	0	0
8	C185	5.35	1.4	-	No	0	0	0	0	0	0	0	0	0	0
8	C186	5.3	1.5	-	No	0	0	0	0	0	0	0	0	0	0
8	C187	5.55	1.7	-	No	0	0	0	0	0	0	0	0	0	0
8	C188	5.75	1.9	-	No	0	0	0	0	0	0	0	0	0	0
8	C189	5.5	1.6	-	No	0	0	0	0	0	0	0	0	0	0
8	C190	6.1	2.3	-	No	0	0	0	0	0	0	0	0	0	0
8	C191	6.2	2.2	-	No	0	0	0	0	0	0	0	0	0	0
8	C192	5	1.2	-	No	0	0	0	0	0	0	0	0	0	0
8	C193	6.4	2.5	-	No	0	0	0	0	0	0	0	0	0	0
8	C194	6.25	2.4	-	No	0	0	0	0	0	0	0	0	0	0
8	C195	5.25	1.2	-	No	0	0	0	0	0	0	0	0	0	0
8	C196	5	1.2	-	No	0	0	0	0	0	0	0	0	0	0
8	C197	5.3	1.5	-	No	0	0	0	0	0	0	0	0	0	0
8	C198	5	1.2	-	No	0	0	0	0	0	0	0	0	0	0
8	C199	4.6	0.9	-	No	0	0	0	0	0	0	0	0	0	0
8	C200	5.3	1.6	-	No	0	0	0	0	0	0	0	0	0	0
9	A561	6.5	3.1	-	No	0	0	0	0	0	0	0	0	0	0
9	A562	6.5	2.7	-	No	0	0	0	0	0	0	0	0	0	0
9	A563	5.6	1.8	-	No	0	0	0	0	0	0	0	0	0	0
9	A564	6.1	2.3	-	No	0	0	0	0	0	0	0	0	0	0
9	A565	6.4	2.4	-	No	0	0	0	0	0	0	0	0	0	0
9	A566	6.65	3.1	-	No	0	0	0	0	0	0	0	0	0	0
9	A567	4.8	1.1	-	No	0	0	0	0	0	0	0	0	0	0
9	A568	5.05	1.3	-	No	0	0	0	0	0	0	0	0	0	0
9	A569	5.95	2.2	-	No	0	0	0	0	0	0	0	0	0	0
9	A570	5.65	1.8	-	No	0	0	0	0	0	0	0	0	0	0
9	A571	7.3	3.5	-	No	0	0	0	0	0	0	0	0	0	0
9	A572	6.9	3.3	-	No	0	0	0	0	0	0	0	0	0	0
9	A573	6.1	2.4	-	No	0	0	0	0	0	0	0	0	0	0
9	A574	5.2	1.4	-	No	0	0	0	0	0	0	0	0	0	0
9	A575	6.3	2.5	-	No	0	0	0	0	0	0	0	0	0	0
9	A576	5.3	1.5	-	No	0	0	0	0	0	0	0	0	0	0
9	A577	5.6	1.7	-	No	0	0	0	0	0	0	0	0	0	0
9	A578	6.85	3.5	-	No	0	0	0	0	0	0	0	0	0	0
9	A579	7.5	4.4	-	No	0	0	0	0	0	0	0	0	0	0
9	A580	7.7	4.8	-	No	0	0	0	0	0	0	0	0	0	0
9	A581	7.1	4.0	-	No	0	0	0	0	0	0	0	0	0	0
9	A582	7.6	4.2	-	No	0	0	0	0	0	0	0	0	0	0
9	A583	5	1.2	-	No	0	0	0	0	0	0	0	0	0	0
9	A584	6.4	2.6	-	No	0	0	0	0	0	0	0	0	0	0
9	A585	7	3.5	-	No	0	0	0	0	0	0	0	0	0	0
9	A586	7.3	4.1	-	No	0	0	0	0	0	0	0	0	0	0
9	A587	5.2	1.4	-	No	0	0	0	0	0	0	0	0	0	0
9	A588	5.8	2.0	-	No	0	0	0	0	0	0	0	0	0	0
9	A589	6.8	3.3	-	No	0	0	0	0	0	0	0	0	0	0
9	A590	6.6	3.0	-	No	0	0	0	0	0	0	0	0	0	0

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
9	A591	7.7	4.8	-	No	0	0	0	0	0	0	0	0	0	0
9	A592	6	2.2	-	No	0	0	0	0	0	0	0	0	0	0
9	A593	5.8	1.8	-	No	0	0	0	0	0	0	0	0	0	0
9	A594	6.7	2.9	-	No	0	0	0	0	0	0	0	0	0	0
9	A595	6.25	2.6	-	No	0	0	0	0	0	0	0	0	0	0
9	A596	6.75	2.9	-	No	0	0	0	0	0	0	0	0	0	0
9	A597	5.2	1.4	-	No	0	0	0	0	0	0	0	0	0	0
9	A598	5.3	1.4	-	No	0	0	0	0	0	0	0	0	0	0
9	A599	6.9	3.3	-	No	0	0	0	0	0	0	0	0	0	0
9	A600	7.5	4.4	-	No	0	0	0	0	0	0	0	0	0	0
9	A601	5.2	1.4	-	No	0	0	0	0	0	0	0	0	0	0
9	A602	5.6	1.8	-	No	0	0	0	0	0	0	0	0	0	0
9	A603	7	3.5	-	No	0	0	0	0	0	0	0	0	0	0
9	A604	5.5	1.7	-	No	0	0	0	0	0	0	0	0	0	0
9	A605	6.7	3.1	-	No	0	0	0	0	0	0	0	0	0	0
9	A606	6.7	3.0	-	No	0	0	0	0	0	0	0	0	0	0
9	A607	8.3	5.7	-	No	0	0	0	0	0	0	0	0	0	0
9	A608	8.1	5.8	-	No	0	0	0	0	0	0	0	0	0	0
9	A609	7.5	4.5	-	No	0	0	0	0	0	0	0	0	0	0
9	A610	5.1	1.4	-	No	0	0	0	0	0	0	0	0	0	0
10	B001	7	3.4	-	No	0	0	0	0	0	0	0	0	0	0
10	B002	7.3	3.7	-	No	0	0	0	0	0	0	0	0	0	0
10	B003	7.7	4.6	-	No	0	0	0	0	0	0	0	0	0	0
10	B004	6.2	2.7	-	No	0	0	0	0	0	0	0	0	0	0
10	B005	6.7	3.4	-	No	0	0	0	0	0	0	0	0	0	0
10	B006	6.6	3.0	-	No	0	0	0	0	0	0	0	0	0	0
10	B007	8.4	6.4	-	No	0	0	0	0	0	0	0	0	0	0
10	B008	8.15	5.9	-	No	0	0	0	0	0	0	0	0	0	0
10	B009	7.35	4.6	-	No	0	0	0	0	0	0	0	0	0	0
10	B010	6.5	3.0	-	No	0	0	0	0	0	0	0	0	0	0
10	B011	7.2	4.4	-	No	0	0	0	0	0	0	0	0	0	0
10	B012	6.8	3.4	-	No	0	0	0	0	0	0	0	0	0	0
10	B013	7.6	5.1	-	No	0	0	0	0	0	0	0	0	0	0
10	B014	8	6.0	-	No	0	0	0	0	0	0	0	0	0	0
10	B015	7.35	4.3	-	No	0	0	0	0	0	0	0	0	0	0
10	B016	5.3	1.4	-	No	0	0	0	0	0	0	0	0	0	0
10	B017	7.35	4.4	-	No	0	0	0	0	0	0	0	0	0	0
10	B018	7.5	4.3	-	No	0	0	0	0	0	0	0	0	0	0
10	B019	7.4	3.9	-	No	0	0	0	0	0	0	0	0	0	0
10	B020	6.4	2.8	-	No	0	0	0	0	0	0	0	0	0	0
10	B021	6.5	3.1	-	No	0	0	0	0	0	0	0	0	0	0
10	B022	7.9	5.4	-	No	0	0	0	0	0	0	0	0	0	0
10	B023	7	3.6	-	No	0	0	0	0	0	0	0	0	0	0
10	B024	6.3	2.5	-	No	0	0	0	0	0	0	0	0	0	0
10	B025	6.7	2.9	-	No	0	0	0	0	0	0	0	0	0	0
10	B026	6.1	2.4	-	No	0	0	0	0	0	0	0	0	0	0
10	B027	6.2	2.7	-	No	0	0	0	0	0	0	0	0	0	0
10	B028	7	3.7	-	No	0	0	0	0	0	0	0	0	0	0
10	B029	6.9	3.8	-	No	0	0	0	0	0	0	0	0	0	0
10	B030	6.5	2.8	-	No	0	0	0	0	0	0	0	0	0	0
10	B031	7	3.7	-	No	0	0	0	0	0	0	0	0	0	0
10	B032	6.9	3.3	-	No	0	0	0	0	0	0	0	0	0	0
10	B033	7	3.5	-	No	0	0	0	0	0	0	0	0	0	0
10	B034	7.5	4.8	-	No	0	0	0	0	0	0	0	0	0	0
10	B035	5.8	2.2	-	No	0	0	0	0	0	0	0	0	0	0
10	B036	5.6	1.9	-	No	0	0	0	0	0	0	0	0	0	0
10	B037	6.1	3.3	-	No	0	0	0	0	0	0	0	0	0	0
10	B038	6.6	3.0	-	No	0	0	0	0	0	0	0	0	0	0
10	B039	7.3	4.2	-	No	0	0	0	0	0	0	0	0	0	0
10	B040	6.7	3.1	-	No	0	0	0	0	0	0	0	0	0	0
10	B041	6.6	3.0	-	No	0	0	0	0	0	0	0	0	0	0
10	B042	6.2	2.6	-	No	0	0	0	0	0	0	0	0	0	0
10	B043	6.8	3.3	-	No	0	0	0	0	0	0	0	0	0	0
10	B044	7.1	3.7	-	No	0	0	0	0	0	0	0	0	0	0
10	B045	6.3	2.6	-	No	0	0	0	0	0	0	0	0	0	0
10	B046	7.6	4.6	-	No	0	0	0	0	0	0	0	0	0	0
10	B047	7.2	4.4	-	No	0	0	0	0	0	0	0	0	0	0
10	B048	7.9	5.7	-	No	0	0	0	0	0	0	0	0	0	0
10	B049	7.8	4.6	-	No	0	0	0	0	0	0	0	0	0	0
10	B050	6.6	2.8	-	No	0	0	0	0	0	0	0	0	0	0
11	C201	7.1	3.6	-	No	0	0	0	0	0	0	0	0	0	0
11	C202	8.2	5.7	-	No	0	0	0	0	0	0	0	0	0	0
11	C203	7.7	4.3	-	No	0	0	0	0	0	0	0	0	0	0
11	C204	6.9	2.9	-	No	0	0	0	0	0	0	0	0	0	0
11	C205	7.2	3.6	-	No	0	0	0	0	0	0	0	0	0	0
11	C206	7.7	4.2	-	No	0	0	0	0	0	0	0	0	0	0
11	C207	6.75	3.0	-	No	0	0	0	0	0	0	0	0	0	0
11	C208	7.1	3.5	-	No	0	0	0	0	0	0	0	0	0	0
11	C209	7	3.1	-	No	0	0	0	0	0	0	0	0	0	0
11	C210	7	3.0	-	No	0	0	0	0	0	0	0	0	0	0

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
11	C211	8.4	5.9	-	No	0	0	0	0	0	0	0	0	0	0
11	C212	7	3.2	-	No	0	0	0	0	0	0	0	0	0	0
11	C213	6.7	2.8	-	No	0	0	0	0	0	0	0	0	0	0
11	C214	6.5	2.8	-	No	0	0	0	0	0	0	0	0	0	0
11	C215	5.75	1.8	-	No	0	0	0	0	0	0	0	0	0	0
11	C216	7.3	3.8	-	No	0	0	0	0	0	0	0	0	0	0
11	C217	6.8	2.8	-	No	0	0	0	0	0	0	0	0	0	0
11	C218	8.1	5.4	-	No	0	0	0	0	0	0	0	0	0	0
11	C219	6.75	3.1	-	No	0	0	0	0	0	0	0	0	0	0
11	C220	7.8	4.4	-	No	0	0	0	0	0	0	0	0	0	0
11	C221	7.4	4.0	-	No	0	0	0	0	0	0	0	0	0	0
11	C222	6	1.9	-	No	0	0	0	0	0	0	0	0	0	0
11	C223	6.2	2.2	-	No	0	0	0	0	0	0	0	0	0	0
11	C224	7.3	3.7	-	No	0	0	0	0	0	0	0	0	0	0
11	C225	6.7	2.7	-	No	0	0	0	0	0	0	0	0	0	0
11	C226	6.5	2.5	-	No	0	0	0	0	0	0	0	0	0	0
11	C227	6.5	2.4	-	No	0	0	0	0	0	0	0	0	0	0
11	C228	7.2	4.0	-	No	0	0	0	0	0	0	0	0	0	0
11	C229	6.3	2.3	-	No	0	0	0	0	0	0	0	0	0	0
11	C230	7.3	3.9	-	No	0	0	0	0	0	0	0	0	0	0
11	C231	6.1	2.1	-	No	0	0	0	0	0	0	0	0	0	0
11	C232	7.1	3.5	-	No	0	0	0	0	0	0	0	0	0	0
11	C233	6.1	2.1	-	No	0	0	0	0	0	0	0	0	0	0
11	C234	6.2	2.2	-	No	0	0	0	0	0	0	0	0	0	0
11	C235	7.4	4.0	-	No	0	0	0	0	0	0	0	0	0	0
11	C236	7.8	4.8	-	No	0	0	0	0	0	0	0	0	0	0
11	C237	7.7	4.3	-	No	0	0	0	0	0	0	0	0	0	0
11	C238	7.1	3.3	-	No	0	0	0	0	0	0	0	0	0	0
11	C239	6.5	2.8	-	No	0	0	0	0	0	0	0	0	0	0
11	C240	6	2.0	-	No	0	0	0	0	0	0	0	0	0	0
11	C241	5.5	1.6	-	No	0	0	0	0	0	0	0	0	0	0
11	C242	6.9	3.0	-	No	0	0	0	0	0	0	0	0	0	0
11	C243	7.2	3.7	-	No	0	0	0	0	0	0	0	0	0	0
11	C244	6.3	2.4	-	No	0	0	0	0	0	0	0	0	0	0
11	C245	7.55	4.2	-	No	0	0	0	0	0	0	0	0	0	0
11	C246	8.3	5.6	-	No	0	0	0	0	0	0	0	0	0	0
11	C247	6.4	2.5	-	No	0	0	0	0	0	0	0	0	0	0
11	C248	7.3	3.9	-	No	0	0	0	0	0	0	0	0	0	0
11	C249	7.2	3.5	-	No	0	0	0	0	0	0	0	0	0	0
11	C250	6.2	2.4	-	No	0	0	0	0	0	0	0	0	0	0
11	C251	6.4	2.4	-	No	0	0	0	0	0	0	0	0	0	0
11	C252	8	5.4	-	No	0	0	0	0	0	0	0	0	0	0
11	C253	7.9	4.8	-	No	0	0	0	0	0	0	0	0	0	0
11	C254	6.2	2.3	-	No	0	0	0	0	0	0	0	0	0	0
11	C255	8	5.6	-	No	0	0	0	0	0	0	0	0	0	0
11	C256	7.3	3.6	-	No	0	0	0	0	0	0	0	0	0	0
11	C257	7.95	5.0	-	No	0	0	0	0	0	0	0	0	0	0
11	C258	7.6	4.4	-	No	0	0	0	0	0	0	0	0	0	0
11	C259	7.95	4.6	-	No	0	0	0	0	0	0	0	0	0	0
11	C260	6.8	3.3	-	No	0	0	0	0	0	0	0	0	0	0
11	C261	8.15	5.7	-	No	0	0	0	0	0	0	0	0	0	0
11	C262	7.5	4.4	-	No	0	0	0	0	0	0	0	0	0	0
11	C263	6.2	2.2	-	No	0	0	0	0	0	0	0	0	0	0
11	C264	7.5	4.1	-	No	0	0	0	0	0	0	0	0	0	0
11	C265	7	3.5	-	No	0	0	0	0	0	0	0	0	0	0
11	C266	6.7	2.8	-	No	0	0	0	0	0	0	0	0	0	0
11	C267	6.8	3.3	-	No	0	0	0	0	0	0	0	0	0	0
11	C268	7.2	3.6	-	No	0	0	0	0	0	0	0	0	0	0
11	C269	7.9	5.2	-	No	0	0	0	0	0	0	0	0	0	0
11	C270	6.8	3.0	-	No	0	0	0	0	0	0	0	0	0	0
11	C271	6.9	3.2	-	No	0	0	0	0	0	0	0	0	0	0
11	C272	7.45	3.9	-	No	0	0	0	0	0	0	0	0	0	0
11	C273	5.7	1.8	-	No	0	0	0	0	0	0	0	0	0	0
11	C274	7.9	5.0	-	No	0	0	0	0	0	0	0	0	0	0
11	C275	7.4	3.9	-	No	0	0	0	0	0	0	0	0	0	0
11	C276	7.2	3.5	-	No	0	0	0	0	0	0	0	0	0	0
11	C277	6.8	3.2	-	No	0	0	0	0	0	0	0	0	0	0
11	C278	7	3.4	-	No	0	0	0	0	0	0	0	0	0	0
11	C279	7.7	4.3	-	No	0	0	0	0	0	0	0	0	0	0
11	C280	6.7	2.9	-	No	0	0	0	0	0	0	0	0	0	0
11	C281	7.4	3.9	-	No	0	0	0	0	0	0	0	0	0	0
11	C282	7.7	4.6	-	No	0	0	0	0	0	0	0	0	0	0
11	C283	7.4	3.7	-	No	0	0	0	0	0	0	0	0	0	0
11	C284	6.5	2.7	-	No	0	0	0	0	0	0	0	0	0	0
11	C285	6.2	2.2	-	No	0	0	0	0	0	0	0	0	0	0
11	C286	7.7	4.5	-	No	0	0	0	0	0	0	0	0	0	0
11	C287	6.6	2.9	-	No	0	0	0	0	0	0	0	0	0	0
11	C288	7.5	4.3	-	No	0	0	0	0	0	0	0	0	0	0
11	C289	6.4	2.8	-	No	0	0	0	0	0	0	0	0	0	0
11	C290	4.9	1.2	-	No	0	0	0	0	0	0	0	0	0	0

Host						*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
11	C291	7.5	4.2	-	No	0	0	0	0	0	0	0	0	0	0
11	C292	7.4	4.0	-	No	0	0	0	0	0	0	0	0	0	0
11	C293	7.7	4.4	-	No	0	0	0	0	0	0	0	0	0	0
11	C294	6.15	2.2	-	No	0	0	0	0	0	0	0	0	0	0
11	C295	7.4	4.1	-	No	0	0	0	0	0	0	0	0	0	0
11	C296	6.4	2.4	-	No	0	0	0	0	0	0	0	0	0	0
11	C297	6.7	3.0	-	No	0	0	0	0	0	0	0	0	0	0
11	C298	7.2	3.5	-	No	0	0	0	0	0	0	0	0	0	0
11	C299	6.35	2.5	-	No	0	0	0	0	0	0	0	0	0	0
11	C300	5.55	1.7	-	No	0	0	0	0	0	0	0	0	0	0
12	A611	7.6	4.2	-	No	0	0	0	0	0	0	0	0	0	0
12	A612	9.1	8.3	-	No	0	0	0	0	0	0	0	0	0	0
12	A613	9.6	10.0	-	No	0	0	0	0	0	0	0	0	0	0
12	A614	8	5.2	-	No	0	0	0	0	0	0	0	0	0	0
12	A615	8.7	7.4	-	No	0	0	0	0	0	0	0	0	0	0
12	A616	9.2	8.9	-	No	0	0	0	0	0	0	0	0	0	0
12	A617	8.5	7.3	-	No	0	0	0	0	0	0	0	0	0	0
12	A618	9	8.7	-	No	0	0	0	0	0	0	0	0	0	0
12	A619	8.6	7.0	-	No	0	0	0	0	0	0	0	0	0	0
12	A620	10.9	14.3	-	No	0	0	0	0	0	0	0	0	0	0
12	A621	8.2	6.1	-	No	0	0	0	0	0	0	0	0	0	0
12	A622	8	5.7	-	No	0	0	0	0	0	0	0	0	0	0
12	A623	7.3	4.2	-	No	0	0	0	0	0	0	0	0	0	0
12	A624	10.5	11.6	-	No	0	0	0	0	0	0	0	0	0	0
12	A625	9.4	9.0	-	No	0	0	0	0	0	0	0	0	0	0
12	A626	7.3	4.1	-	No	0	0	0	0	0	0	0	0	0	0
12	A627	6.9	3.0	-	No	0	0	0	0	0	0	0	0	0	0
12	A628	6.6	3.0	-	No	0	0	0	0	0	0	0	0	0	0
12	A629	8.2	6.5	-	No	0	0	0	0	0	0	0	0	0	0
12	A630	7	3.7	-	No	0	0	0	0	0	0	0	0	0	0
12	A631	9.3	9.0	-	No	0	0	0	0	0	0	0	0	0	0
12	A632	8.7	7.6	-	No	0	0	0	0	0	0	0	0	0	0
12	A633	7.2	4.1	-	No	0	0	0	0	0	0	0	0	0	0
12	A634	7.1	3.8	-	No	0	0	0	0	0	0	0	0	0	0
12	A635	7.8	5.0	-	No	0	0	0	0	0	0	0	0	0	0
12	A636	9.4	8.5	-	No	0	0	0	0	0	0	0	0	0	0
12	A637	8.7	7.1	-	No	0	0	0	0	0	0	0	0	0	0
12	A638	7.5	4.5	-	No	0	0	0	0	0	0	0	0	0	0
12	A639	7.8	4.6	-	No	0	0	0	0	0	0	0	0	0	0
12	A640	6.2	2.5	-	No	0	0	0	0	0	0	0	0	0	0
12	A641	6.7	3.3	-	No	0	0	0	0	0	0	0	0	0	0
12	A642	8.9	7.8	-	No	0	0	0	0	0	0	0	0	0	0
12	A643	7.9	5.5	-	No	0	0	0	0	0	0	0	0	0	0
12	A644	8.8	7.6	-	No	0	0	0	0	0	0	0	0	0	0
12	A645	8.4	6.0	-	No	0	0	0	0	0	0	0	0	0	0
12	A646	7.9	5.3	-	No	0	0	0	0	0	0	0	0	0	0
12	A647	9.5	9.2	-	No	0	0	0	0	0	0	0	0	0	0
12	A648	7.5	4.7	-	No	0	0	0	0	0	0	0	0	0	0
12	A649	9.2	9.1	-	No	0	0	0	0	0	0	0	0	0	0
12	A650	8.1	6.0	-	No	0	0	0	0	0	0	0	0	0	0
12	A651	10.4	12.4	-	No	0	0	0	0	0	0	0	0	0	0
12	A652	7.1	4.0	-	No	0	0	0	0	0	0	0	0	0	0
12	A653	8	5.6	-	No	0	0	0	0	0	0	0	0	0	0
12	A654	6.7	3.6	-	No	0	0	0	0	0	0	0	0	0	0
12	A655	7.8	5.4	-	No	0	0	0	0	0	0	0	0	0	0
12	A656	7.2	4.2	-	No	0	0	0	0	0	0	0	0	0	0
12	A657	7.7	5.0	-	No	0	0	0	0	0	0	0	0	0	0
12	A658	7.6	4.8	-	No	0	0	0	0	0	0	0	0	0	0
12	A659	8.1	5.9	-	No	0	0	0	0	0	0	0	0	0	0
12	A660	6.8	3.1	-	No	0	0	0	0	0	0	0	0	0	0
13	B051	8.3	6.2	-	No	0	0	0	0	0	0	0	0	0	0
13	B052	6.6	3.0	-	No	0	0	0	0	0	0	0	0	0	0
13	B053	8.4	6.5	-	No	0	0	0	0	0	0	0	0	0	0
13	B054	8.7	6.8	-	No	0	0	0	0	0	0	0	0	0	0
13	B055	8.7	7.2	-	No	0	0	0	0	0	0	0	0	0	0
13	B056	8.4	6.0	-	No	0	0	0	0	0	0	0	0	0	0
13	B057	8.3	5.8	-	No	0	0	0	0	0	0	0	0	0	0
13	B058	6.3	2.5	-	No	0	0	0	0	0	0	0	0	0	0
13	B059	6.8	3.2	-	No	0	0	0	0	0	0	0	0	0	0
13	B060	7.3	3.9	-	No	0	0	0	0	0	0	0	0	0	0
13	B061	5.7	2.1	-	No	0	0	0	0	0	0	0	0	0	0
13	B062	7	3.6	-	No	0	0	0	0	0	0	0	0	0	0
13	B063	9.5	9.0	-	No	0	0	0	0	0	0	0	0	0	0
13	B064	9.5	9.4	-	No	0	0	0	0	0	0	0	0	0	0
13	B065	7.6	4.9	-	No	0	0	0	0	0	0	0	0	0	0
13	B066	6.2	2.5	-	No	0	0	0	0	0	0	0	0	0	0
13	B067	7.5	4.4	-	No	0	0	0	0	0	0	0	0	0	0
13	B068	7.6	4.5	-	No	0	0	0	0	0	0	0	0	0	0
13	B069	8	5.7	-	No	0	0	0	0	0	0	0	0	0	0
13	B070	6.5	3.0	-	No	0	0	0	0	0	0	0	0	0	0

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
13	B071	9.8	8.9	-	No	0	0	0	0	0	0	0	0	0	0
13	B072	8.1	5.7	-	No	0	0	0	0	0	0	0	0	0	0
13	B073	7.7	5.2	-	No	0	0	0	0	0	0	0	0	0	0
13	B074	7.6	4.5	-	No	0	0	0	0	0	0	0	0	0	0
13	B075	6.8	3.4	-	No	0	0	0	0	0	0	0	0	0	0
13	B076	7.8	4.8	-	No	0	0	0	0	0	0	0	0	0	0
13	B077	7.5	4.2	-	No	0	0	0	0	0	0	0	0	0	0
13	B078	7.8	4.9	-	No	0	0	0	0	0	0	0	0	0	0
13	B079	6.7	3.2	-	No	0	0	0	0	0	0	0	0	0	0
13	B080	8.1	5.1	-	No	0	0	0	0	0	0	0	0	0	0
13	B081	7.6	4.5	-	No	0	0	0	0	0	0	0	0	0	0
13	B082	7.9	5.1	-	No	0	0	0	0	0	0	0	0	0	0
13	B083	7	3.6	-	No	0	0	0	0	0	0	0	0	0	0
13	B084	9.5	9.3	-	No	0	0	0	0	0	0	0	0	0	0
13	B085	7.1	3.9	-	No	0	0	0	0	0	0	0	0	0	0
13	B086	7.4	4.1	-	No	0	0	0	0	0	0	0	0	0	0
13	B087	7.6	4.5	-	No	0	0	0	0	0	0	0	0	0	0
13	B088	7.2	4.2	-	No	0	0	0	0	0	0	0	0	0	0
13	B089	7.6	5.0	-	No	0	0	0	0	0	0	0	0	0	0
13	B090	7.6	5.1	-	No	0	0	0	0	0	0	0	0	0	0
13	B091	9.2	8.6	-	No	0	0	0	0	0	0	0	0	0	0
13	B092	7.7	4.9	-	No	0	0	0	0	0	0	0	0	0	0
13	B093	7.9	5.2	-	No	0	0	0	0	0	0	0	0	0	0
13	B094	8.1	5.6	-	No	0	0	0	0	0	0	0	0	0	0
13	B095	8.2	6.0	-	No	0	0	0	0	0	0	0	0	0	0
13	B096	6.7	3.3	-	No	0	0	0	0	0	0	0	0	0	0
13	B097	7.7	5.0	-	No	0	0	0	0	0	0	0	0	0	0
13	B098	8.1	5.8	-	No	0	0	0	0	0	0	0	0	0	0
13	B099	7.8	5.1	-	No	0	0	0	0	0	0	0	0	0	0
13	B100	7.2	4.0	-	No	0	0	0	0	0	0	0	0	0	0
13	B101	6.6	3.1	-	No	0	0	0	0	0	0	0	0	0	0
13	B102	7.3	4.2	-	No	0	0	0	0	0	0	0	0	0	0
13	B103	7.2	4.1	-	No	0	0	0	0	0	0	0	0	0	0
13	B104	7.9	5.2	-	No	0	0	0	0	0	0	0	0	0	0
13	B105	6.7	3.2	-	No	0	0	0	0	0	0	0	0	0	0
13	B106	7.7	4.6	-	No	0	0	0	0	0	0	0	0	0	0
13	B107	7.4	4.2	-	No	0	0	0	0	0	0	0	0	0	0
13	B108	6.4	2.7	-	No	0	0	0	0	0	0	0	0	0	0
13	B109	7.5	4.5	-	No	0	0	0	0	0	0	0	0	0	0
13	B110	7.9	5.3	-	No	0	0	0	0	0	0	0	0	0	0
13	B111	7	3.9	-	No	0	0	0	0	0	0	0	0	0	0
13	B112	6.5	2.8	-	No	0	0	0	0	0	0	0	0	0	0
14	C301	8.9	6.6	-	No	0	0	0	0	0	0	0	0	0	0
14	C302	7	3.2	28	No	0	0	0	0	0	0	0	0	0	0
14	C303	7.4	3.8	41	No	0	0	0	0	0	0	0	0	0	0
14	C304	7.3	3.9	52	No	0	0	0	0	0	0	0	0	0	0
14	C305	9.6	9.2	45	No	0	0	0	0	0	0	0	0	0	0
14	C306	6.9	3.5	41	No	0	0	0	0	0	0	0	0	0	0
14	C307	9.7	9.2	43	No	0	0	0	0	0	0	0	0	0	0
14	C308	5.15	1.3	36	No	0	0	0	0	0	0	0	0	0	0
14	C309	6.1	2.1	-	No	0	0	0	0	0	0	0	0	0	0
14	C310	9.15	7.8	61	No	0	0	0	0	0	0	0	0	0	0
14	C311	10.3	11.2	43	No	0	0	0	0	0	0	0	0	0	0
14	C312	7	3.2	44	No	0	0	0	0	0	0	0	0	0	0
14	C313	6.2	2.2	42	No	0	0	0	0	0	0	0	0	0	0
14	C314	6.3	2.5	44	No	0	0	0	0	0	0	0	0	0	0
14	C315	6.65	2.9	42	No	0	0	0	0	0	0	0	0	0	0
14	C316	8.8	7.3	36	No	0	0	0	0	0	0	0	0	0	0
14	C317	6.55	2.6	45	No	0	0	0	0	0	0	0	0	0	0
14	C318	7.6	4.9	49	No	0	0	0	0	0	0	0	0	0	0
14	C319	5.8	1.7	35	No	0	0	0	0	0	0	0	0	0	0
14	C320	7.5	4.0	47	No	0	0	0	0	0	0	0	0	0	0
14	C321	8.2	5.6	40	No	0	0	0	0	0	0	0	0	0	0
14	C322	9.7	9.4	-	No	0	0	0	0	0	0	0	0	0	0
14	C323	6.6	2.8	51	No	0	0	0	0	0	0	0	0	0	0
14	C324	8.2	5.5	50	No	0	0	0	0	0	0	0	0	0	0
14	C325	6.5	2.6	46	No	0	0	0	0	0	0	0	0	0	0
14	C326	8.8	6.6	41	No	0	0	0	0	0	0	0	0	0	0
14	C327	6.2	1.9	46	No	0	0	0	0	0	0	0	0	0	0
14	C328	7	3.3	-	No	0	0	0	0	0	0	0	0	0	0
14	C329	7.2	3.5	43	No	0	0	0	0	0	0	0	0	0	0
14	C330	9.2	7.7	49	No	0	0	0	0	0	0	0	0	0	0
14	C331	9.4	9.0	47	No	0	0	0	0	0	0	0	0	0	0
14	C332	7.4	4.1	56	No	0	0	0	0	0	0	0	0	0	0
14	C333	8.1	5.4	45	No	0	0	0	0	0	0	0	0	0	0
14	C334	9.5	9.1	49	No	0	0	0	0	0	0	0	0	0	0
14	C335	7.5	4.5	43	No	0	0	0	0	0	0	0	0	0	0
14	C336	7	3.8	-	No	0	0	0	0	0	0	0	0	0	0
14	C337	8.8	7.2	52	No	0	0	0	0	0	0	0	0	0	0
14	C338	6.1	2.4	-	No	0	0	0	0	0	0	0	0	0	0

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
14	C339	5.2	1.2	-	No	0	0	0	0	0	0	0	0	0	0
14	C340	8.3	5.9	59	No	0	0	0	0	0	0	0	0	0	0
14	C341	6.7	2.9	57	No	0	0	0	0	0	0	0	0	0	0
14	C342	8.9	6.9	55	No	0	0	0	0	0	0	0	0	0	0
14	C343	8.2	5.7	51	No	0	0	0	0	0	0	0	0	0	0
14	C344	7.5	4.0	49	No	0	0	0	0	0	0	0	0	0	0
14	C345	6.3	2.4	-	No	0	0	0	0	0	0	0	0	0	0
14	C346	5.6	1.6	-	No	0	0	0	0	0	0	0	0	0	0
14	C347	7.9	4.9	46	No	0	0	0	0	0	0	0	0	0	0
14	C348	8.5	5.8	48	No	0	0	0	0	0	0	0	0	0	0
14	C349	9.1	7.7	48	No	0	0	0	0	0	0	0	0	0	0
14	C350	6.9	3.0	51	No	0	0	0	0	0	0	0	0	0	0
14	C351	7.1	3.5	42	No	0	0	0	0	0	0	0	0	0	0
14	C352	8.6	5.6	53	No	0	0	0	0	0	0	0	0	0	0
14	C353	8	4.9	46	No	0	0	0	0	0	0	0	0	0	0
14	C354	5.8	2.0	-	No	0	0	0	0	0	0	0	0	0	0
14	C355	9.4	8.6	50	No	0	0	0	0	0	0	0	0	0	0
14	C356	6.4	2.7	45	No	0	0	0	0	0	0	0	0	0	0
14	C357	7.5	4.3	50	No	0	0	0	0	0	0	0	0	0	0
14	C358	7.8	5.5	48	No	0	0	0	0	0	0	0	0	0	0
14	C359	8.5	6.2	47	No	0	0	0	0	0	0	0	0	0	0
14	C360	6.8	2.9	49	No	0	0	0	0	0	0	0	0	0	0
14	C361	9.3	9.2	48	No	0	0	0	0	0	0	0	0	0	0
14	C362	8.8	7.0	50	No	0	0	0	0	0	0	0	0	0	0
14	C363	8.5	6.3	42	No	0	0	0	0	0	0	0	0	0	0
14	C364	9.5	9.8	47	No	0	0	0	0	0	0	0	0	0	0
14	C365	7	3.3	45	No	0	0	0	0	0	0	0	0	0	0
14	C366	9.3	8.5	44	No	0	0	0	0	0	0	0	0	0	0
14	C367	7.6	4.5	43	No	0	0	0	0	0	0	0	0	0	0
14	C368	9	7.7	43	No	0	0	0	0	0	0	0	0	0	0
14	C369	8	5.2	42	No	0	0	0	0	0	0	0	0	0	0
14	C370	8.5	6.0	51	No	0	0	0	0	0	0	0	0	0	0
14	C371	9.4	8.0	44	No	0	0	0	0	0	0	0	0	0	0
14	C372	7.7	4.7	47	No	0	0	0	0	0	0	0	0	0	0
14	C373	8	5.4	48	No	0	0	0	0	0	0	0	0	0	0
14	C374	6.6	2.7	48	No	0	0	0	0	0	0	0	0	0	0
14	C375	9.7	9.8	49	No	0	0	0	0	0	0	0	0	0	0
14	C376	7.8	4.9	51	No	0	0	0	0	0	0	0	0	0	0
14	C377	8.5	6.0	46	No	0	0	0	0	0	0	0	0	0	0
14	C378	9.9	9.5	51	No	0	0	0	0	0	0	0	0	0	0
14	C379	8.4	6.0	49	No	0	0	0	0	0	0	0	0	0	0
14	C380	7.6	4.3	46	No	0	0	0	0	0	0	0	0	0	0
14	C381	6.2	2.2	43	No	0	0	0	0	0	0	0	0	0	0
14	C382	7.6	4.4	46	No	0	0	0	0	0	0	0	0	0	0
14	C383	8.2	5.5	50	No	0	0	0	0	0	0	0	0	0	0
14	C384	8.1	5.7	48	No	0	0	0	0	0	0	0	0	0	0
14	C385	8.5	6.7	50	No	0	0	0	0	0	0	0	0	0	0
14	C386	5.5	1.6	44	No	0	0	0	0	0	0	0	0	0	0
14	C387	8.8	6.9	51	No	0	0	0	0	0	0	0	0	0	0
14	C388	8.1	5.4	49	No	0	0	0	0	0	0	0	0	0	0
14	C389	7.1	3.3	52	No	0	0	0	0	0	0	0	0	0	0
14	C390	8	5.3	52	No	0	0	0	0	0	0	0	0	0	0
14	C391	8.2	5.9	54	No	0	0	0	0	0	0	0	0	0	0
14	C392	8.1	5.6	54	No	0	0	0	0	0	0	0	0	0	0
14	C393	7.3	4.0	50	No	0	0	0	0	0	0	0	0	0	0
14	C394	8.1	5.4	54	No	0	0	0	0	0	0	0	0	0	0
14	C395	9.5	9.3	48	No	0	0	0	0	0	0	0	0	0	0
14	C396	7.4	4.1	45	No	0	0	0	0	0	0	0	0	0	0
14	C397	8	5.4	56	No	0	0	0	0	0	0	0	0	0	0
14	C398	7.1	3.6	54	No	0	0	0	0	0	0	0	0	0	0
14	C399	7.1	3.4	51	No	0	0	0	0	0	0	0	0	0	0
14	C400	6	2.2	45	No	0	0	0	0	0	0	0	0	0	0
15	A661	6.5	2.7	-	No	0	0	0	0	0	0	0	0	0	0
15	A662	7.3	4.0	-	No	0	0	0	0	0	0	0	0	0	0
15	A663	7.5	4.5	-	No	0	0	0	0	0	0	0	0	0	0
15	A664	8.2	6.1	-	No	0	0	0	0	0	0	0	0	0	0
15	A665	10.5	13.6	-	No	0	0	0	0	0	0	0	0	0	0
15	A666	11.8	18.9	-	No	0	0	0	0	0	0	0	0	0	0
15	A667	11.5	17.1	-	No	0	0	0	0	0	0	0	0	0	0
15	A668	7.2	3.8	-	No	0	0	0	0	0	0	0	0	0	0
15	A669	7.8	5.3	-	No	0	0	0	0	0	0	0	0	0	0
15	A670	7.5	4.2	-	No	0	0	0	0	0	0	0	0	0	0
15	A671	8.7	6.9	-	No	0	0	0	0	0	0	0	0	0	0
15	A672	7.4	4.1	-	No	0	0	0	0	0	0	0	0	0	0
15	A673	7.6	4.5	-	No	0	0	0	0	0	0	0	0	0	0
15	A674	7.9	5.0	-	No	0	0	0	0	0	0	0	0	0	0
15	A675	9.2	8.4	-	No	0	0	0	0	0	0	0	0	0	0
15	A676	10.7	13.3	-	No	0	0	0	0	0	0	0	0	0	0
15	A677	9.9	10.5	-	No	0	0	0	0	0	0	0	0	0	0
15	A678	8.6	7.1	-	No	0	0	0	0	0	0	0	0	0	0

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
15	A679	9.6	9.9	-	No	0	0	0	0	0	0	0	0	0	0
15	A680	10.9	14.5	-	No	0	0	0	0	0	0	0	0	0	0
15	A681	11.5	17.0	-	No	0	0	0	0	0	0	0	0	0	0
15	A682	10	10.9	-	No	0	0	0	0	0	0	0	0	0	0
15	A683	11.7	17.6	-	No	0	0	0	0	0	0	0	0	0	0
15	A684	9.2	8.8	-	No	0	0	0	0	0	0	0	0	0	0
15	A685	10.6	13.7	-	No	0	0	0	0	0	0	0	0	0	0
15	A686	7.8	5.2	-	No	0	0	0	0	0	0	0	0	0	0
15	A687	8.8	7.5	-	No	0	0	0	0	0	0	0	0	0	0
15	A688	9.5	9.4	-	No	0	0	0	0	0	0	0	0	0	0
15	A689	7.1	4.0	-	No	0	0	0	0	0	0	0	0	0	0
15	A690	8.6	7.1	-	No	0	0	0	0	0	0	0	0	0	0
15	A691	9	8.5	-	No	0	0	0	0	0	0	0	0	0	0
15	A692	8.4	6.3	-	No	0	0	0	0	0	0	0	0	0	0
15	A693	12.3	21.0	-	No	0	0	0	0	0	0	0	0	0	0
15	A694	10.5	12.8	-	No	0	0	0	0	0	0	0	0	0	0
15	A695	11.7	18.2	-	No	0	0	0	0	0	0	0	0	0	0
15	A696	8.7	7.1	-	No	0	0	0	0	0	0	0	0	0	0
15	A697	8.2	5.5	-	No	0	0	0	0	0	0	0	0	0	0
15	A698	10	11.0	-	No	0	0	0	0	0	0	0	0	0	0
15	A699	8.2	5.3	-	No	0	0	0	0	0	0	0	0	0	0
15	A700	8.2	5.8	-	No	0	0	0	0	0	0	0	0	0	0
15	A701	11	13.6	-	No	0	0	0	0	0	0	0	0	0	0
15	A702	8.7	7.3	-	No	0	0	0	0	0	0	0	0	0	0
15	A703	11.3	16.8	-	No	0	0	0	0	0	0	0	0	0	0
15	A704	8.3	6.0	-	No	0	0	0	0	0	0	0	0	0	0
15	A705	9.5	8.6	-	No	0	0	0	0	0	0	0	0	0	0
15	A706	10	10.2	-	No	0	0	0	0	0	0	0	0	0	0
15	A707	7.7	4.4	-	No	0	0	0	0	0	0	0	0	0	0
15	A708	8.1	5.4	-	No	0	0	0	0	0	0	0	0	0	0
15	A709	8.7	6.0	-	No	0	0	0	0	0	0	0	0	0	0
15	A710	7.9	4.9	-	No	0	0	0	0	0	0	0	0	0	0
16	B113	8.1	5.9	-	No	0	0	0	0	0	0	0	0	0	0
16	B114	8.5	6.6	-	No	0	0	0	0	0	0	0	0	0	0
16	B115	10.5	13.1	-	No	0	0	0	0	0	0	0	0	0	0
16	B116	7.2	4.2	-	No	0	0	0	0	0	0	0	0	0	0
16	B117	10.8	13.9	-	No	0	0	0	0	0	0	0	0	0	0
16	B118	6.8	3.4	-	No	0	0	0	0	0	0	0	0	0	0
16	B119	8.5	6.9	-	No	0	0	0	0	0	0	0	0	0	0
16	B120	9.2	8.5	-	No	0	0	0	0	0	0	0	0	0	0
16	B121	8.3	6.3	-	No	0	0	0	0	0	0	0	0	0	0
16	B122	11.6	18.4	-	No	0	0	0	0	0	0	0	0	0	0
16	B123	10.1	11.4	-	No	0	0	0	0	0	0	0	0	0	0
16	B124	6.8	3.4	-	No	0	0	0	0	0	0	0	0	0	0
16	B125	7.1	3.8	-	No	0	0	0	0	0	0	0	0	0	0
16	B126	7.5	4.5	-	No	0	0	0	0	0	0	0	0	0	0
16	B127	9.9	10.7	-	No	0	0	0	0	0	0	0	0	0	0
16	B128	7.2	3.9	-	No	0	0	0	0	0	0	0	0	0	0
16	B129	10.6	13.3	-	No	0	0	0	0	0	0	0	0	0	0
16	B130	8.5	6.8	-	No	0	0	0	0	0	0	0	0	0	0
16	B131	6.8	3.7	-	No	0	0	0	0	0	0	0	0	0	0
16	B132	7.4	4.4	-	No	0	0	0	0	0	0	0	0	0	0
16	B133	7.3	4.3	-	No	0	0	0	0	0	0	0	0	0	0
16	B134	8	6.0	-	No	0	0	0	0	0	0	0	0	0	0
16	B135	7.05	3.6	-	No	0	0	0	0	0	0	0	0	0	0
16	B136	10.2	11.4	-	No	0	0	0	0	0	0	0	0	0	0
16	B137	9.2	8.5	-	No	0	0	0	0	0	0	0	0	0	0
16	B138	7.5	4.8	-	No	0	0	0	0	0	0	0	0	0	0
16	B139	8.2	5.9	-	No	0	0	0	0	0	0	0	0	0	0
16	B140	8.2	5.9	-	No	0	0	0	0	0	0	0	0	0	0
16	B141	8.1	5.9	-	No	0	0	0	0	0	0	0	0	0	0
16	B142	7.3	4.0	-	No	0	0	0	0	0	0	0	0	0	0
16	B143	8.2	6.2	-	No	0	0	0	0	0	0	0	0	0	0
16	B144	10.5	12.7	-	No	0	0	0	0	0	0	0	0	0	0
16	B145	8.4	7.2	-	No	0	0	0	0	0	0	0	0	0	0
16	B146	9.2	8.4	-	No	0	0	0	0	0	0	0	0	0	0
16	B147	7.3	4.4	-	No	0	0	0	0	0	0	0	0	0	0
16	B148	7.1	3.8	-	No	0	0	0	0	0	0	0	0	0	0
16	B149	8.4	6.7	-	No	0	0	0	0	0	0	0	0	0	0
16	B150	8.3	6.2	-	No	0	0	0	0	0	0	0	0	0	0
16	B151	9	7.9	-	No	0	0	0	0	0	0	0	0	0	0
16	B152	5.9	2.1	-	No	0	0	0	0	0	0	0	0	0	0
16	B153	7.7	4.8	-	No	0	0	0	0	0	0	0	0	0	0
16	B154	8.1	5.8	-	No	0	0	0	0	0	0	0	0	0	0
16	B155	9.9	10.2	-	No	0	0	0	0	0	0	0	0	0	0
16	B156	9.4	9.6	-	No	0	0	0	0	0	0	0	0	0	0
16	B157	8	5.8	-	No	0	0	0	0	0	0	0	0	0	0
16	B158	7.5	4.4	-	No	0	0	0	0	0	0	0	0	0	0
16	B159	9.4	8.5	-	No	0	0	0	0	0	0	0	0	0	0
16	B160	7.3	4.3	-	No	0	0	0	0	0	0	0	0	0	0

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
16	B161	8.4	6.6	-	No	0	0	0	0	0	0	0	0	0	0
16	B162	8.3	6.6	-	No	0	0	0	0	0	0	0	0	0	0
16	B163	7.6	4.6	-	No	0	0	0	0	0	0	0	0	0	0
17	C401	10.4	11.6	45	No	0	0	0	0	0	0	0	0	0	0
17	C402	12.8	24.5	43	No	0	0	0	0	0	0	0	0	0	0
17	C403	7.3	4.2	48	No	0	0	0	0	0	0	0	0	0	0
17	C404	9.5	8.7	49	No	0	0	0	0	0	0	0	0	0	0
17	C405	9.8	9.9	50	No	0	0	0	0	0	0	0	0	0	0
17	C406	12.9	22.4	49	No	0	0	0	0	0	0	0	0	0	0
17	C407	8.9	7.2	48	No	0	0	0	0	0	0	0	0	0	0
17	C408	6.9	3.1	38	No	0	0	0	0	0	0	0	0	0	0
17	C409	9	7.1	53	No	0	0	0	0	0	0	0	0	0	0
17	C410	12.3	20.5	62	No	0	0	0	0	0	0	0	0	0	0
17	C411	8	5.1	57	No	0	0	0	0	0	0	0	0	0	0
17	C412	9.3	8.2	44	No	0	0	0	0	0	0	0	0	0	0
17	C413	12	18.8	47	No	0	0	0	0	0	0	0	0	0	0
17	C414	10.9	13.4	56	No	0	0	0	0	0	0	0	0	0	0
17	C415	11.5	16.5	47	No	0	0	0	0	0	0	0	0	0	0
17	C416	10.8	13.0	58	No	0	0	0	0	0	0	0	0	0	0
17	C417	12.1	19.1	47	No	0	0	0	0	0	0	0	0	0	0
17	C418	12.4	21.7	45	No	0	0	0	0	0	0	0	0	0	0
17	C419	11.5	16.7	67	No	0	0	0	0	0	0	0	0	0	0
17	C420	7.9	5.1	56	No	0	0	0	0	0	0	0	0	0	0
17	C421	11.1	15.5	47	No	0	0	0	0	0	0	0	0	0	0
17	C422	5.9	1.9	-	No	0	0	0	0	0	0	0	0	0	0
17	C423	7.1	3.6	45	No	0	0	0	0	0	0	0	0	0	0
17	C424	11.2	14.5	45	No	0	0	0	0	0	0	0	0	0	0
17	C425	10.6	12.8	44	No	0	0	0	0	0	0	0	0	0	0
17	C426	9.2	7.6	-	No	0	0	0	0	0	0	0	0	0	0
17	C427	11.7	16.5	47	No	0	0	0	0	0	0	0	0	0	0
17	C428	12.2	20.4	50	No	0	0	0	0	0	0	0	0	0	0
17	C429	11.3	15.3	43	No	0	0	0	0	0	0	0	0	0	0
17	C430	9.7	9.5	41	No	0	0	0	0	0	0	0	0	0	0
17	C431	12.2	20.6	44	No	0	0	0	0	0	0	0	0	0	0
17	C432	10.9	14.1	43	No	0	0	0	0	0	0	0	0	0	0
17	C433	11.4	16.1	48	No	0	0	1	0	0	0	0	0	0	0
17	C434	8.7	6.0	44	No	0	0	0	0	0	0	0	0	0	0
17	C435	10.9	14.7	44	No	0	0	0	0	0	0	0	0	0	0
17	C436	12.4	20.1	48	No	0	0	0	0	0	0	0	0	0	0
17	C437	7	3.3	39	No	0	0	0	0	0	0	0	0	0	0
17	C438	7	3.3	55	No	0	0	0	0	0	0	0	0	0	0
17	C439	7.4	4.0	56	No	0	0	0	0	0	0	0	0	0	0
17	C440	11.3	15.5	49	No	0	0	0	0	0	0	0	0	0	0
17	C441	11.4	14.9	48	No	0	0	0	0	0	0	0	0	0	0
17	C442	11.5	16.9	46	No	0	0	0	0	0	0	0	0	0	0
17	C443	8.4	5.5	49	No	0	0	0	0	0	0	1	0	0	0
17	C444	10.5	12.4	49	No	0	0	0	0	0	0	0	0	0	0
17	C445	11.1	13.7	54	No	0	0	0	0	0	0	0	0	0	0
17	C446	11.9	18.3	57	No	0	0	0	0	0	0	0	0	0	0
17	C447	8.9	7.4	44	No	0	0	0	0	0	0	0	0	0	0
17	C448	7.3	3.8	48	No	0	0	0	0	0	0	0	0	0	0
17	C449	8.9	6.5	54	No	0	0	0	0	0	0	0	0	0	0
17	C450	7.9	4.7	38	No	0	0	0	0	0	0	0	0	0	0
17	C451	9.9	9.2	50	No	0	0	0	0	0	0	0	0	0	0
17	C452	8.5	6.2	58	No	0	0	0	0	0	0	0	0	0	0
17	C453	10.9	13.6	62	No	0	0	0	0	0	0	0	0	0	0
17	C454	7	3.0	51	No	0	0	0	0	0	0	0	0	0	0
17	C455	11.3	15.7	-	No	0	0	0	0	0	0	0	0	0	0
17	C456	8.9	7.7	61	No	0	0	0	0	0	0	0	0	0	0
17	C457	10.4	12.5	69	No	0	0	0	0	0	0	0	0	0	0
17	C458	7.6	4.1	51	No	0	0	0	0	0	0	0	0	0	0
17	C459	11	13.9	46	No	0	0	0	0	0	0	0	0	0	0
17	C460	10.5	13.3	46	No	0	0	0	0	0	0	0	0	0	0
18	A711	10.6	12.5	-	No	0	0	0	0	0	0	0	0	0	0
18	A712	10.1	10.9	-	No	0	0	0	0	0	0	0	0	0	0
18	A713	8.9	7.2	-	No	0	0	0	0	0	0	0	0	0	0
18	A714	8.9	7.5	-	No	0	0	0	0	0	0	0	0	0	0
18	A715	7.7	4.9	-	No	0	0	0	0	0	0	0	0	0	0
18	A716	7.9	5.0	-	No	0	0	0	0	0	0	0	0	0	0
18	A717	9.2	7.5	-	No	0	0	0	0	0	0	0	0	0	0
18	A718	10.1	10.6	-	No	0	0	0	0	0	0	0	0	0	0
18	A719	8.6	7.1	-	No	0	0	0	0	0	0	0	0	0	0
18	A720	7.9	5.5	-	No	0	0	0	0	0	0	0	0	0	0
18	A721	8.8	7.5	-	No	0	0	0	0	0	0	0	0	0	0
18	A722	10.5	11.7	-	No	0	0	0	0	0	0	0	0	0	0
18	A723	9.5	9.3	-	No	0	0	0	0	0	0	0	0	0	0
18	A724	9.9	9.9	-	No	0	0	0	0	0	0	0	0	0	0
18	A725	8.9	7.7	-	No	0	0	0	0	0	0	0	0	0	0
18	A726	9.7	10.5	-	No	0	0	0	0	0	0	0	0	0	0
18	A727	10.6	12.6	-	No	0	0	0	0	0	0	0	0	0	0

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
18	A728	8	5.1	-	No	0	0	0	0	0	0	0	0	0	0
18	A729	7.8	4.9	-	No	0	0	0	0	0	0	0	0	0	0
18	A730	7.7	4.8	-	No	0	0	0	0	0	0	0	0	0	0
18	A731	7.7	4.4	-	No	0	0	0	0	0	0	0	0	0	0
18	A732	8.2	5.7	-	No	0	0	0	0	0	0	0	0	0	1
18	A733	10.3	12.4	-	No	0	0	0	0	0	0	0	0	0	0
18	A734	9	7.8	-	No	0	0	0	0	0	0	0	0	0	0
18	A735	9.3	8.7	-	No	0	0	0	0	0	0	0	0	0	0
18	A736	10	10.6	-	No	0	0	0	0	0	0	0	0	0	0
18	A737	8.6	7.1	-	No	0	0	0	0	0	0	0	0	0	0
18	A738	10	10.7	-	No	0	0	0	0	0	0	0	0	0	0
18	A739	9	8.0	-	No	0	0	0	0	0	0	0	0	0	0
18	A740	9.2	8.5	-	No	0	0	0	0	0	0	0	0	0	1
18	A741	7.5	4.4	-	No	0	0	0	0	0	0	0	0	0	1
18	A742	8.3	6.2	-	No	0	0	0	0	0	0	0	0	0	0
18	A743	8.9	7.1	-	No	0	0	0	0	0	0	0	0	0	1
18	A744	8.4	5.9	-	No	0	0	0	0	0	0	0	0	0	0
18	A745	8.6	6.6	-	No	0	0	0	0	0	0	0	0	0	0
18	A746	8.3	5.7	-	No	0	0	0	0	0	0	0	0	0	0
19	B164	13.5	26.8	-	No	0	0	0	0	0	0	0	0	0	0
19	B165	11.5	16.9	-	No	0	0	0	0	0	0	0	0	0	0
19	B166	12	17.1	-	No	0	0	0	0	0	0	0	0	0	0
19	B167	12.6	24.0	-	No	0	0	0	0	0	0	0	0	0	0
19	B168	11.2	15.3	-	No	0	0	0	0	0	0	0	0	0	0
19	B169	10.8	15.0	-	No	0	0	0	0	0	0	0	0	0	0
19	B170	12.7	23.1	-	No	0	0	0	0	0	0	0	0	0	0
19	B171	11.7	19.1	-	No	0	0	0	0	0	0	0	0	0	0
19	B172	13.2	25.9	-	No	0	0	0	0	0	0	0	0	0	0
19	B173	11.9	18.4	-	No	0	0	0	0	0	0	0	0	0	0
19	B174	13.5	27.4	-	No	0	0	0	0	0	0	0	0	0	0
19	B175	12.5	21.9	-	No	0	0	0	0	0	0	0	0	0	0
19	B176	12.3	21.3	-	No	0	0	0	0	0	0	0	0	0	0
19	B177	13.4	27.9	-	No	0	0	0	0	0	0	0	0	0	0
19	B178	12.8	24.3	-	No	0	0	0	0	0	0	0	0	0	1
19	B179	12.2	19.3	-	No	0	0	0	0	0	0	0	0	0	0
19	B180	12	19.9	-	No	0	0	0	0	0	0	0	0	0	1
19	B181	13.5	28.6	-	No	0	0	0	0	0	0	0	0	0	1
19	B182	12.6	21.5	-	No	0	0	0	0	0	0	0	0	0	0
19	B183	11.3	16.2	-	No	0	0	0	0	0	0	0	0	0	0
19	B184	11	15.5	-	No	0	0	0	0	0	0	0	0	0	1
19	B185	12.8	25.4	-	No	0	0	0	0	0	0	0	0	0	0
19	B186	10.9	14.3	-	No	0	0	0	0	0	0	0	0	0	0
19	B187	10.8	14.2	-	No	0	0	0	0	0	0	0	0	0	0
19	B188	12.5	22.3	-	No	0	0	0	0	0	0	0	0	0	0
19	B189	12.3	20.3	-	No	0	0	0	0	0	0	0	0	0	1
19	B190	12.5	22.2	-	No	0	0	0	0	0	0	0	0	0	0
19	B191	11.2	14.8	-	No	0	0	0	0	0	0	0	0	0	0
19	B192	11.9	20.7	-	No	0	0	0	0	0	0	0	0	0	0
19	B193	10.3	11.5	-	No	0	0	0	0	0	0	0	0	0	0
19	B194	12.7	23.2	-	No	0	0	0	0	0	0	0	0	0	1
19	B195	11.2	14.8	-	No	0	0	0	0	0	0	0	0	0	0
19	B196	9.9	10.7	-	No	0	0	0	0	0	0	0	0	0	0
19	B197	11.3	15.9	-	No	0	0	0	0	0	0	0	0	0	0
19	B198	12.7	23.1	-	No	0	0	0	0	0	0	0	0	0	0
19	B199	11.9	18.5	-	No	0	0	0	0	0	0	0	0	0	1
19	B200	10	10.3	-	No	0	0	0	0	0	0	0	0	0	0
19	B201	11.2	16.1	-	No	0	0	0	0	0	0	0	0	0	0
19	B202	10.5	12.9	-	No	0	0	0	0	0	0	0	0	0	0
19	B203	11	15.6	-	No	0	0	0	0	0	0	0	0	0	0
19	B204	12.2	20.2	-	No	0	0	0	0	0	0	0	0	0	0
19	B205	10.5	12.1	-	No	0	0	0	0	0	0	0	0	0	1
19	B206	12.5	23.3	-	No	0	0	0	0	0	0	0	0	0	0
19	B207	13.7	29.1	-	No	0	0	0	0	0	0	0	0	0	1
19	B208	11	14.3	-	No	0	0	0	0	0	0	0	0	0	0
19	B209	14.4	33.1	-	No	0	0	0	0	0	0	0	0	0	0
19	B210	11.4	15.5	-	No	0	0	0	0	0	0	0	0	0	0
19	B211	11	15.3	-	No	0	0	0	0	0	0	0	0	0	0
19	B212	12.4	21.6	-	No	0	0	0	0	0	0	0	0	0	0
19	B213	11.4	15.9	-	No	0	0	0	0	0	0	0	0	0	0
19	B214	13.5	29.2	-	No	0	0	0	0	0	0	0	0	0	0
19	B215	15.4	45.0	-	No	0	0	0	0	0	0	0	0	0	0
19	B216	12.8	26.1	-	No	0	0	0	0	0	0	0	0	0	0
19	B217	11.8	17.1	-	No	0	0	0	0	0	0	0	0	0	1
19	B218	13	22.9	-	No	0	0	0	0	0	0	0	0	0	0
19	B219	13	24.2	-	No	0	0	0	0	0	0	0	0	0	0
19	B220	12.6	21.3	-	No	0	0	0	0	0	0	0	0	0	1
19	B221	11	16.0	-	No	0	0	0	0	0	0	0	0	0	0
19	B222	13.3	26.1	-	No	0	0	0	0	0	0	0	0	0	0
19	B223	12.7	22.0	-	No	0	0	0	0	0	0	0	0	0	1
19	B224	11.3	15.6	-	No	0	0	0	0	0	0	0	0	0	0

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
19	B225	11.3	14.9	-	No	0	0	0	0	0	0	0	0	0	0
19	B226	13.5	26.6	-	No	0	0	0	0	0	0	0	0	0	0
19	B227	11.6	16.6	-	No	0	0	0	0	0	0	0	0	0	1
20	C461	13.3	28.2	50	No	0	0	0	0	0	0	0	0	0	0
20	C462	12.4	20.5	50	No	0	0	0	0	0	0	0	0	0	0
20	C463	13.4	28.6	55	No	0	0	0	0	0	0	0	0	0	0
20	C464	14.1	33.6	50	No	0	0	0	0	0	0	0	0	0	0
20	C465	11.7	17.1	48	No	0	0	0	0	0	0	0	0	0	0
20	C466	14.2	33.0	54	No	0	0	0	0	0	0	0	0	0	0
20	C467	10	9.7	42	No	0	0	0	0	0	0	0	0	0	0
20	C468	12.3	20.5	42	No	0	0	0	0	0	0	0	0	0	0
20	C469	7.4	4.1	53	No	0	0	0	0	0	0	0	0	0	0
20	C470	14.2	31.9	54	No	0	0	0	0	0	0	0	0	0	0
20	C471	11.1	14.9	54	No	0	0	0	0	0	0	0	0	0	0
20	C472	12.5	21.6	49	No	0	0	0	0	0	0	0	0	0	0
20	C473	12.9	23.8	48	No	0	0	0	0	0	0	0	0	0	0
20	C474	13.9	29.7	53	No	0	0	0	0	0	0	0	0	0	0
20	C475	10.8	14.1	47	No	0	0	0	0	0	0	0	0	0	0
20	C476	10.9	14.6	53	No	0	0	0	0	0	0	0	0	0	0
20	C477	11.2	15.1	36	No	0	0	0	0	0	0	0	0	0	0
20	C478	8.8	6.5	42	No	0	0	0	0	0	0	0	0	0	0
20	C479	11.8	19.0	47	No	0	0	0	0	0	0	0	0	0	0
20	C480	10.5	11.8	44	No	0	0	0	0	0	0	0	0	0	0
20	C481	11.3	17.2	50	No	0	0	1	0	0	0	0	0	0	0
20	C482	9.1	7.5	36	No	0	0	0	0	0	0	0	0	0	0
20	C483	12.4	21.3	52	No	0	0	0	0	0	0	0	0	0	0
20	C484	11.6	18.4	51	No	0	0	0	0	0	0	0	0	0	0
20	C485	10.8	13.3	43	No	0	0	0	0	0	0	0	0	0	0
20	C486	14	31.4	48	No	0	0	0	0	0	0	0	0	0	0
20	C487	11.2	15.3	43	No	0	0	0	0	0	0	0	0	0	0
20	C488	13.7	29.9	56	No	0	0	0	0	0	0	0	0	0	0
20	C489	9.3	8.1	50	No	0	0	0	0	0	0	0	0	0	0
20	C490	11.5	17.1	41	No	0	0	0	0	0	0	0	0	0	0
20	C491	13.5	30.5	47	No	0	0	0	0	0	0	0	0	0	0
20	C492	10	10.7	37	No	0	0	0	0	0	0	0	0	0	0
20	C493	13	25.5	47	No	0	0	0	0	0	0	0	0	0	0
20	C494	8.9	6.6	47	No	0	0	0	0	0	0	0	0	0	0
20	C495	14.3	33.8	46	No	0	0	0	0	0	0	0	0	0	0
20	C496	14	30.2	47	No	0	0	0	0	0	0	0	0	0	0
20	C497	12.9	21.6	39	No	0	0	0	0	0	0	0	0	0	0
20	C498	11	14.1	39	No	0	0	0	0	0	0	0	0	0	0
20	C499	13.3	27.3	44	No	0	0	0	0	0	0	0	0	0	0
20	C500	13.1	23.9	46	No	0	0	0	0	0	0	0	0	0	0
20	C501	12	20.2	45	No	0	0	0	0	0	0	0	0	0	0
20	C502	12.9	25.1	47	No	0	0	0	0	0	0	0	0	0	0
20	C503	12.5	21.8	47	No	0	0	0	0	0	0	0	0	0	0
20	C504	12.6	23.1	47	No	0	0	0	0	0	0	0	0	0	0
20	C505	11.5	16.1	39	No	0	0	0	0	0	0	0	0	0	0
20	C506	11.8	16.7	45	No	0	0	0	0	0	0	0	0	0	0
20	C507	11.5	16.0	40	No	0	0	0	0	0	0	0	0	0	0
20	C508	11.3	16.2	46	No	0	0	2	0	0	0	0	0	0	0
20	C509	13.8	30.5	44	No	0	0	0	0	0	0	0	0	0	0
20	C510	9.9	11.1	42	No	0	0	0	0	0	0	0	0	0	0
20	C511	10.5	13.1	40	No	0	0	0	0	0	0	0	0	0	0
20	C512	12.5	21.5	43	No	0	0	0	0	0	0	0	0	0	0
20	C513	13.5	28.4	42	No	0	0	0	0	0	0	0	0	0	0
20	C514	12.9	23.8	46	No	0	0	0	0	0	0	0	0	0	0
20	C515	14.4	34.4	47	No	0	0	0	0	0	0	0	0	0	0
20	C516	12.6	21.7	49	No	0	0	0	0	0	0	0	0	0	0
20	C517	13	24.2	54	No	0	0	0	0	0	0	0	0	0	0
20	C518	8.8	6.7	55	No	0	0	0	0	0	0	0	0	0	0
20	C519	11.9	18.8	46	No	0	0	0	0	0	0	0	0	0	0
20	C520	14	32.0	54	No	0	0	0	0	0	0	0	0	0	0
21	A747	11.5	17.8	-	No	0	0	0	0	0	0	0	0	0	1
21	A748	12.6	22.7	-	No	0	0	0	0	0	0	0	0	0	1
21	A749	11.1	14.8	-	No	0	0	0	0	0	0	0	0	0	1
21	A750	9	7.7	-	No	0	0	0	0	0	0	0	0	0	1
21	A751	7.1	3.5	-	No	0	0	0	0	0	0	0	0	0	1
21	A752	7.75	4.8	-	No	0	0	0	0	0	0	0	0	0	1
21	A753	10.8	13.2	-	No	0	0	0	0	0	0	0	0	0	1
21	A754	8.2	6.0	-	No	0	0	0	0	0	0	0	0	0	1
21	A755	7.8	4.5	-	No	0	0	0	0	0	0	0	0	0	0
21	A756	10.5	13.2	-	No	0	0	0	0	0	0	0	0	0	0
21	A757	10.5	11.9	-	No	0	0	0	0	0	0	0	0	0	1
21	A758	12.3	20.7	-	No	0	0	0	0	0	0	0	0	0	1
21	A759	6.5	2.8	-	No	0	0	0	0	0	0	0	0	0	1
21	A760	5.45	1.6	-	No	0	0	0	0	0	0	0	0	0	0
21	A761	9.6	10.1	-	No	0	0	0	0	0	0	0	0	0	1
21	A762	7.5	4.1	-	No	0	0	0	0	0	0	0	0	0	0
21	A763	9.8	9.9	-	No	0	0	0	0	0	0	0	0	0	0

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
21	A764	9.5	9.3	-	No	0	0	0	0	0	0	0	0	0	0
21	A765	9.5	9.5	-	No	0	0	0	0	0	0	2	0	0	1
21	A766	10	12.0	-	No	0	0	0	0	0	0	1	0	0	1
21	A767	9.8	11.5	-	No	0	0	0	0	0	0	0	0	0	1
21	A768	8.6	6.8	-	No	0	0	0	0	0	0	0	0	0	1
21	A769	9.5	10.0	-	No	0	0	0	0	0	0	0	0	0	1
21	A770	7.6	4.6	-	No	0	0	0	0	0	0	0	0	0	1
21	A771	5.7	1.7	-	No	0	0	0	0	0	0	0	0	0	1
21	A772	11.5	16.3	-	No	0	0	0	0	0	0	0	0	0	1
21	A773	11.3	14.6	-	No	0	0	0	0	0	0	0	0	0	1
21	A774	11.2	15.2	-	No	0	0	0	0	0	0	1	0	0	1
21	A775	10.4	12.9	-	No	0	0	0	0	0	0	0	0	0	1
21	A776	8.4	6.1	-	No	0	0	0	0	0	0	0	0	0	1
21	A777	9.2	8.1	-	No	0	0	0	0	0	0	0	0	0	2
21	A778	9.4	8.8	-	No	0	0	0	0	0	0	0	0	0	1
21	A779	10.1	10.5	-	No	0	0	0	0	0	0	0	0	0	1
21	A780	9	7.1	-	No	0	0	0	0	0	0	0	0	0	1
21	A781	9.8	10.4	-	No	0	0	0	0	0	0	0	0	0	1
21	A782	7.6	4.5	-	No	0	0	0	0	0	0	0	0	0	1
22	B228	12.8	22.4	-	No	0	0	0	0	0	0	0	0	0	0
22	B229	14.1	32.3	-	No	0	0	0	0	0	0	0	0	0	1
22	B230	14	33.1	-	No	0	0	0	0	0	0	1	0	0	1
22	B231	13.2	26.4	-	No	0	0	0	0	0	0	0	0	0	0
22	B232	16	44.9	-	No	0	0	0	0	0	0	0	0	0	1
22	B233	13.4	26.8	-	No	0	0	0	0	0	0	0	0	0	1
22	B234	13.9	29.3	-	No	0	0	0	0	0	0	0	0	0	1
22	B235	11.9	18.2	-	No	0	0	0	0	0	0	0	0	0	1
22	B236	12.2	18.4	-	No	0	0	0	0	0	0	0	0	0	2
22	B237	15	39.0	-	No	0	0	0	0	0	0	0	0	0	1
22	B238	12.3	19.7	-	No	0	0	0	0	0	0	0	0	0	1
22	B239	12	18.9	-	No	0	0	0	0	0	0	0	0	0	1
22	B240	14.3	35.0	-	No	0	0	0	0	0	0	0	0	0	1
22	B241	13.3	25.8	-	No	0	0	0	0	0	0	0	0	0	1
22	B242	13.6	26.6	-	No	0	0	0	0	0	0	0	0	0	1
22	B243	13	23.8	-	No	0	0	0	0	0	0	0	0	0	1
22	B244	11.7	16.8	-	No	0	0	0	0	0	0	0	0	0	1
22	B245	15.9	45.1	-	No	0	0	0	0	0	0	0	0	0	2
22	B246	14.6	36.5	-	No	0	0	0	0	0	0	0	0	0	1
22	B247	13.9	28.9	-	No	0	0	0	0	0	0	0	0	0	2
22	B248	14.7	36.0	-	No	0	0	0	0	0	0	0	0	0	1
22	B249	13.6	28.1	-	No	0	0	0	0	0	0	0	0	0	1
22	B250	13.6	25.2	-	No	0	0	0	0	0	0	0	0	0	1
22	B251	13.5	26.6	-	No	0	0	0	0	0	0	0	0	0	1
22	B252	14.1	32.7	-	No	0	0	0	0	0	0	0	0	0	1
22	B253	14.2	32.0	-	No	0	0	0	0	0	0	1	0	0	1
22	B254	13.3	27.5	-	No	0	0	0	0	0	0	0	0	0	1
22	B255	13.8	28.3	-	No	0	0	0	0	0	0	0	0	0	0
22	B256	12.4	20.7	-	No	0	0	0	0	0	0	0	0	0	0
22	B257	12.3	20.0	-	No	0	0	0	0	0	0	0	0	0	1
22	B258	15	37.3	-	No	0	0	0	0	0	0	0	0	0	1
22	B259	13.7	23.9	-	No	0	0	0	0	0	0	0	0	0	1
22	B260	12.3	20.0	-	No	0	0	0	0	0	0	0	0	0	1
22	B261	15.5	41.0	-	No	0	0	0	0	0	0	0	0	0	1
22	B262	15.5	40.5	-	No	0	0	0	0	1	0	0	0	0	1
22	B263	12.1	19.6	-	No	0	0	0	0	1	0	0	0	0	1
22	B264	12.7	21.9	-	No	0	0	0	0	0	0	0	0	0	2
22	B265	14.8	37.7	-	No	0	0	0	0	0	0	0	0	0	1
22	B266	13.3	25.0	-	No	0	0	0	0	1	0	0	0	0	1
22	B267	13.8	30.2	-	No	0	0	0	0	0	0	0	0	0	1
22	B268	12.6	21.5	-	No	0	0	0	0	0	0	0	0	0	1
22	B269	14.4	32.3	-	No	0	0	0	0	0	0	0	0	0	1
22	B270	13.8	27.6	-	No	0	0	0	0	0	0	1	0	0	1
22	B271	13.5	26.7	-	No	0	0	0	0	0	0	0	0	0	1
22	B272	14	31.6	-	No	0	0	0	0	1	0	0	0	0	1
22	B273	13.6	28.6	-	No	0	0	0	0	0	0	0	0	0	1
22	B274	15.6	43.9	-	No	0	0	0	0	0	0	1	0	0	1
22	B275	14.3	33.7	-	No	0	0	0	0	0	0	0	0	0	0
22	B276	14.3	29.4	-	No	0	0	0	0	1	0	0	0	0	1
22	B277	14.4	32.4	-	No	0	0	0	0	0	0	0	0	0	1
22	B278	13.3	27.1	-	No	0	0	0	0	0	0	0	0	0	1
22	B279	15.6	43.8	-	No	0	0	0	0	0	0	0	0	0	1
22	B280	13.7	28.3	-	No	0	0	0	0	0	0	0	0	0	1
22	B281	13.7	27.2	-	No	0	0	0	0	0	0	0	0	0	0
22	B282	14.1	31.0	-	No	0	0	0	0	0	0	0	0	0	1
22	B283	12.5	20.7	-	No	0	0	0	0	0	0	0	0	0	0
22	B284	11.8	17.6	-	No	0	0	0	0	1	0	0	0	0	1
22	B285	13.1	25.1	-	No	0	0	0	0	0	0	0	0	0	1
22	B286	14.4	33.5	-	No	0	0	0	0	0	0	0	0	0	1
22	B287	14.8	36.8	-	No	0	0	0	0	1	0	0	0	0	1
22	B288	14.8	38.9	-	No	0	0	0	0	0	0	0	0	0	1

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
22	B289	14.7	34.4	-	No	0	0	0	0	1	0	0	0	0	1
22	B290	12.3	20.0	-	No	0	0	0	0	0	0	0	0	0	1
22	B291	15.6	38.7	-	No	0	0	0	0	0	0	0	0	0	1
23	C521	14	29.5	50	No	0	0	0	0	0	0	0	0	0	0
23	C522	16.4	53.6	46	No	0	0	0	0	0	0	0	0	0	0
23	C523	15.2	37.9	48	No	0	0	0	0	0	0	0	0	0	0
23	C524	15.3	43.6	46	No	0	0	0	0	0	0	0	0	0	0
23	C525	15.1	39.0	48	No	0	0	1	0	0	0	0	0	0	0
23	C526	15.4	43.4	51	No	0	0	1	0	0	0	0	0	0	0
23	C527	14.7	38.1	57	No	0	0	1	0	0	0	0	0	0	0
23	C528	16.1	49.4	48	No	0	0	0	0	0	0	0	0	0	0
23	C529	15.5	45.7	52	No	0	0	0	0	0	0	0	0	0	0
23	C530	16.3	53.0	51	No	0	0	0	0	0	0	0	0	0	0
23	C531	16.4	49.4	-	No	0	0	0	0	0	0	0	0	0	0
23	C532	16.6	53.5	52	No	0	0	0	0	0	0	0	0	0	0
23	C533	17	56.6	50	No	0	0	0	0	0	0	0	0	0	0
23	C534	14.3	32.4	54	No	0	0	0	0	0	0	0	0	0	0
23	C535	14.2	33.6	53	No	0	0	0	0	0	0	0	0	0	0
23	C536	16.1	49.2	52	No	0	0	0	0	0	0	0	0	0	0
23	C537	15.9	47.3	-	No	0	0	0	0	0	0	0	0	0	0
23	C538	16.2	52.9	62	No	0	0	0	0	0	0	0	0	0	0
23	C539	15	41.3	62	No	0	0	0	0	0	0	0	0	0	0
23	C540	15.7	47.6	61	No	0	0	0	0	0	0	0	0	0	0
23	C541	15.3	43.0	55	No	0	0	0	0	0	0	0	0	0	0
23	C542	16.8	56.5	-	No	0	0	0	0	0	0	0	0	0	0
23	C543	14.2	32.5	-	No	0	0	0	0	0	0	0	0	0	0
23	C544	16	50.6	-	No	0	0	0	0	0	0	0	0	0	0
23	C545	15.9	48.9	60	No	0	0	1	0	0	0	0	0	0	0
23	C546	15.6	44.4	50	No	0	0	0	0	0	0	0	0	0	0
23	C547	13.3	27.7	54	No	0	0	1	0	0	0	0	0	0	0
23	C548	15.8	47.7	-	No	0	0	0	0	0	0	0	0	0	0
23	C549	14.2	34.7	48	No	0	0	0	0	0	0	0	0	0	0
23	C550	15.1	40.4	50	No	0	0	0	0	0	0	0	0	0	0
23	C551	14	31.0	37	No	0	0	0	0	0	0	0	0	0	0
23	C552	15.9	47.2	53	No	0	0	0	0	0	0	0	0	0	0
23	C553	14.5	37.8	58	No	0	0	1	0	0	0	0	0	0	0
23	C554	14.4	34.5	55	No	0	0	0	0	0	0	0	0	0	0
24	A783	10	10.7	48	No	0	0	0	0	1	0	0	0	0	1
24	A784	12.6	23.1	49	No	0	0	0	0	1	0	0	0	0	2
24	A785	10.3	11.3	43	No	0	0	0	0	1	0	0	0	0	2
24	A786	12.4	22.3	52	No	0	0	0	0	1	0	0	0	0	2
24	A787	12.4	22.0	47	No	0	0	0	0	3	1	1	0	0	2
24	A788	13	24.6	50	No	0	0	0	0	1	1	1	0	0	1
24	A789	13.7	31.1	52	No	0	0	0	0	1	1	0	0	0	2
24	A790	12.2	20.1	53	No	0	0	0	0	1	0	1	0	0	3
24	A791	10.4	13.4	54	No	0	0	0	0	1	0	0	0	0	2
24	A792	14.4	37.1	49	No	0	0	0	0	1	0	0	0	0	2
24	A793	10.6	13.0	50	No	0	0	0	0	0	0	1	0	0	1
24	A794	12.5	19.5	35	No	0	0	0	0	2	0	0	0	0	1
24	A795	14.4	35.6	44	No	0	0	0	0	0	0	1	0	0	1
24	A796	12.3	19.7	47	No	0	0	0	0	0	1	0	0	0	1
24	A797	10.7	13.6	-	No	0	0	0	0	1	0	1	0	0	1
24	A798	11.5	17.3	-	No	0	0	0	0	1	0	1	0	0	1
24	A799	14	33.0	64	No	0	0	0	0	1	0	0	0	0	2
24	A800	13.9	31.6	44	No	0	0	0	0	1	0	0	0	0	1
24	A801	14.5	35.5	51	No	0	0	0	0	1	0	0	0	1	2
24	A802	13.2	24.9	52	No	0	0	0	0	0	0	1	0	0	1
24	A803	13.6	29.2	55	No	0	0	0	0	1	0	1	0	0	2
24	A804	12.7	23.4	51	No	0	0	0	0	1	0	1	0	0	1
24	A805	13	25.1	51	No	0	0	0	0	1	0	1	0	0	1
24	A806	8.5	6.2	47	No	0	0	0	0	1	1	1	0	0	1
24	A807	15.1	40.7	54	No	0	0	0	0	1	0	0	0	0	2
24	A808	13.6	30.8	53	No	0	0	0	0	0	0	0	0	0	1
24	A809	11.4	17.3	44	No	0	0	0	0	1	0	1	0	0	1
24	A810	13.7	28.7	50	No	0	0	0	0	0	1	0	0	0	1
24	A811	9.8	10.2	43	No	0	0	0	0	1	0	1	0	0	1
24	A812	13.9	30.1	51	No	0	0	0	0	2	1	1	0	0	1
25	B292	14.1	30.3	41	No	0	0	0	0	2	0	1	0	0	3
25	B293	15.9	47.1	43	No	0	0	0	0	1	0	0	0	0	3
25	B294	12.3	22.6	45	No	0	0	0	0	2	0	0	0	0	2
25	B295	15.4	41.8	45	No	0	0	0	0	2	0	3	0	0	3
25	B296	15.7	45.7	45	No	0	0	0	0	1	0	0	0	0	3
25	B297	15.2	40.5	44	No	0	0	0	0	2	0	1	0	0	3
25	B298	14.7	35.5	40	No	0	0	0	0	2	0	1	0	0	3
25	B299	13.4	28.8	48	No	0	0	0	0	1	0	1	0	0	3
25	B300	17.3	58.5	41	No	0	0	0	0	2	0	3	0	0	3
25	B301	16.4	50.4	42	No	0	0	0	0	1	0	0	0	0	3
25	B302	14.4	32.3	45	No	0	0	0	0	1	0	0	0	0	3
25	B303	15.2	38.3	47	No	0	0	0	0	1	0	0	0	0	3
25	B304	15.6	44.6	52	No	0	0	0	0	2	0	1	0	0	3

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
25	B305	15.3	41.3	48	No	0	0	0	0	1	0	0	0	0	3
25	B306	14.9	39.9	49	No	0	0	0	0	2	0	1	0	0	3
25	B307	15.3	40.7	49	No	0	0	0	0	1	0	1	0	0	3
25	B308	13.4	26.1	47	No	0	0	0	0	1	0	1	0	0	3
25	B309	16.2	44.2	49	No	0	0	0	0	2	0	1	0	0	3
25	B310	16.7	56.1	49	No	0	0	0	0	1	0	0	0	0	3
25	B311	15.6	45.0	48	No	0	0	0	0	2	0	1	0	0	3
25	B312	15.5	43.7	48	No	0	0	0	0	1	0	0	0	0	3
25	B313	17.5	63.5	47	No	0	0	0	0	1	0	0	0	0	3
25	B314	17.3	57.0	49	No	0	0	0	0	1	0	0	0	0	3
25	B315	15.8	46.5	47	No	0	0	0	0	1	0	0	0	0	3
25	B316	16.5	52.5	46	No	0	0	0	0	0	0	3	0	0	3
25	B317	17.3	63.0	39	No	0	0	0	0	1	0	2	0	0	3
25	B318	15.5	41.3	49	No	0	0	0	0	1	0	1	0	1	3
25	B319	16	49.8	-	No	0	0	0	0	0	0	1	0	0	3
25	B320	15.2	41.2	52	No	0	0	0	0	0	0	1	0	0	3
25	B321	16.2	50.0	48	No	0	0	0	0	1	0	1	0	0	3
25	B322	15.5	41.2	49	No	0	0	0	0	1	0	2	0	0	3
26	C555	10.45	12.2	44	No	0	0	0	0	1	0	0	0	0	2
26	C556	9	8.3	45	No	0	0	0	0	1	0	1	0	0	1
26	C557	10	10.4	45	No	0	0	0	0	2	0	1	0	0	2
26	C558	14	34.2	47	No	0	0	0	0	0	0	0	0	0	2
26	C559	16.5	51.0	46	No	0	0	0	0	1	0	1	0	0	3
26	C560	15.9	45.6	44	No	0	0	0	0	1	0	3	0	0	3
26	C561	16.9	56.0	44	No	0	0	0	0	1	0	1	0	0	3
26	C562	12.3	20.7	43	No	0	0	0	0	1	0	2	0	0	2
26	C563	11.4	16.5	-	No	0	0	0	0	2	0	1	0	0	1
26	C564	9.2	8.5	50	No	0	0	0	0	1	0	0	0	0	2
26	C565	12.7	22.1	50	No	0	0	0	0	1	0	1	0	0	3
26	C566	9.5	11.0	48	No	0	0	0	0	1	0	0	0	1	2
26	C567	12.4	21.3	39	No	0	0	0	0	1	0	1	0	0	3
26	C568	12.5	22.8	46	No	0	0	0	0	1	0	0	0	0	3
26	C569	11.4	16.8	53	No	0	0	0	0	1	0	1	0	0	2
26	C570	7.1	3.6	50	No	0	0	0	0	1	0	0	0	0	1
26	C571	15	39.2	48	No	0	0	0	0	1	0	1	0	0	2
26	C572	11.1	15.1	42	No	0	0	0	0	0	0	1	0	0	2
26	C573	15.9	45.3	50	No	0	0	0	0	1	0	1	0	0	3
26	C574	14	32.6	37	No	0	0	0	0	1	0	1	0	0	2
26	C575	12.2	20.3	40	No	0	0	0	0	2	0	2	0	0	2
26	C576	11.5	16.9	43	No	0	0	0	0	1	0	1	0	0	1
26	C577	13.8	30.2	45	No	0	0	0	0	0	0	2	0	0	3
26	C578	13.4	26.7	40	No	0	0	0	0	1	0	0	0	0	1
26	C579	10.2	11.6	48	No	0	0	0	0	2	0	0	0	0	1
26	C580	15.3	38.0	56	No	0	0	0	0	1	0	0	0	0	3
26	C581	15.5	42.8	45	No	0	0	0	0	2	0	1	0	1	3
26	C582	12.8	24.9	46	No	0	0	0	0	2	0	1	0	0	3
26	C583	13.7	30.4	42	No	0	0	0	0	2	0	1	0	1	3
26	C584	16.9	57.3	48	No	0	0	0	0	2	0	1	0	0	3
27	A813	13.5	28.2	42	No	0	0	0	0	1	0	1	0	0	0
27	A814	10.4	12.0	39	No	0	0	0	0	0	0	1	0	0	0
27	A815	7.1	3.5	50	No	0	0	0	0	1	0	1	0	0	0
27	A816	13.3	26.4	46	No	0	0	0	0	0	0	1	0	0	0
27	A817	12.8	23.3	52	No	0	0	0	0	0	0	1	0	0	0
27	A818	14	31.4	51	No	0	0	0	0	0	0	2	0	0	0
27	A819	14	31.4	50	No	0	0	0	0	0	0	0	0	0	0
27	A820	14.5	34.8	49	No	0	0	0	0	0	0	1	0	0	0
27	A821	15.7	45.0	48	No	0	0	0	0	0	1	1	0	0	0
27	A822	12.2	19.3	49	No	0	0	0	0	0	0	1	0	0	0
27	A823	13.2	27.0	46	No	0	0	0	0	0	0	1	0	0	0
27	A824	9.8	11.3	48	No	0	0	0	0	0	0	2	0	0	0
27	A825	14.7	38.6	44	No	0	0	0	0	0	0	1	0	0	0
27	A826	14	32.2	47	No	0	0	0	0	1	0	2	0	0	0
27	A827	14.7	35.8	38	No	0	0	0	0	0	0	1	0	0	0
27	A828	14.9	37.4	50	No	0	0	0	0	1	0	1	0	0	0
27	A829	12	19.2	-	No	0	0	0	0	0	0	0	0	0	0
27	A830	12.5	21.4	45	No	0	0	0	0	0	1	0	0	0	0
27	A831	13	25.5	48	No	0	0	0	0	0	0	1	0	0	0
27	A832	16.3	47.3	50	No	0	0	0	0	1	0	3	0	0	0
27	A833	13.9	29.0	57	No	0	0	0	0	0	0	3	0	0	0
27	A834	11.1	16.3	33	No	0	0	0	0	0	0	1	0	0	0
27	A835	8.3	4.8	40	No	2	0	0	0	0	0	3	0	0	0
27	A836	13.1	23.9	46	No	0	0	0	0	0	0	1	0	0	0
27	A837	10.2	11.0	42	No	0	0	0	0	0	0	1	0	0	0
27	A838	13	24.8	47	No	0	0	0	0	0	0	1	0	0	0
27	A839	11.4	21.5	43	No	0	0	0	0	0	0	2	0	0	0
27	A840	11.4	16.7	47	No	0	0	0	0	1	0	1	0	0	0
27	A841	10.6	13.2	42	No	0	0	0	0	1	0	1	0	0	0
27	A842	16.3	48.0	59	No	0	0	0	0	0	0	3	0	0	0
27	A843	15.2	39.8	39	No	0	0	0	0	0	0	0	0	0	0
27	A844	13	23.4	46	No	0	0	0	0	1	0	2	0	0	0

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
27	A845	10.5	13.5	51	No	0	0	0	0	0	0	2	0	0	0
27	A846	14.5	33.4	50	No	0	0	0	0	0	0	1	0	0	0
27	A847	9.3	8.7	40	No	0	0	0	0	1	0	0	0	0	0
27	A848	12.8	24.0	42	No	0	0	0	0	0	0	1	0	0	0
28	B323	16.8	56.9	51	No	0	0	0	0	1	1	1	0	0	0
28	B324	15.7	44.7	45	No	0	0	0	0	1	1	3	0	0	0
28	B325	16.8	61.2	49	No	0	0	0	0	1	0	1	0	0	0
28	B326	17	60.6	46	No	0	0	0	0	1	0	1	0	0	0
28	B327	20.1	98.9	52	No	0	0	0	0	0	0	1	0	0	0
28	B328	17.6	68.4	51	No	0	0	0	0	1	1	0	0	0	0
28	B329	15.3	41.4	50	No	0	0	0	0	0	0	1	0	0	0
28	B330	17.4	66.9	49	No	0	0	0	0	1	0	1	0	0	0
28	B331	14.7	37.3	48	No	0	0	0	0	0	0	1	0	0	0
28	B332	15.2	40.2	46	No	0	0	0	0	0	0	1	0	0	0
28	B333	16.2	49.4	47	No	0	0	0	0	0	0	1	0	0	0
28	B334	16.3	48.6	45	No	0	0	0	0	0	1	2	0	0	0
28	B335	16.1	51.8	53	No	0	0	0	0	0	0	1	0	0	0
28	B336	15.1	39.9	50	No	0	0	0	0	1	0	1	0	0	0
28	B337	16.2	47.8	54	No	0	0	0	0	0	0	1	0	0	0
28	B338	15.8	41.4	52	No	0	0	0	0	0	0	1	0	0	0
28	B339	16	47.4	48	No	0	0	0	0	1	1	1	0	0	0
28	B340	17	59.0	48	No	0	0	0	0	1	0	1	0	0	0
28	B341	18.8	80.2	49	No	0	0	0	0	2	1	1	0	0	0
28	B342	18	69.8	-	No	0	0	0	0	2	0	1	0	0	0
28	B343	14	31.1	47	No	0	0	0	0	3	0	2	0	0	0
28	B344	15.9	46.3	49	No	0	0	0	0	1	0	1	0	0	0
28	B345	15.3	41.5	46	No	0	0	0	0	0	0	1	0	0	0
28	B346	16.8	57.1	52	No	0	0	0	0	1	0	1	0	0	0
28	B347	16.3	49.4	48	No	0	0	0	0	0	0	1	0	0	1
28	B348	17.2	63.0	50	No	0	0	0	0	0	0	1	0	0	0
28	B349	17.8	67.9	44	No	0	0	0	0	0	0	1	0	0	0
28	B350	16.3	48.9	55	No	0	0	0	0	0	0	1	0	0	0
28	B351	16.4	55.1	54	No	0	0	0	0	0	0	1	0	0	0
28	B352	16.5	52.6	51	No	0	0	0	0	0	0	1	0	0	0
29	C585	16.3	58.2	45	No	0	0	0	0	3	0	1	0	0	1
29	C586	12.2	25.7	46	No	0	0	0	0	2	0	1	0	0	1
29	C587	11.8	20.1	46	No	0	0	0	0	1	1	1	0	0	0
29	C588	15	43.1	47	No	0	0	0	0	1	1	1	0	0	0
29	C589	14.7	40.3	47	No	0	0	0	0	1	1	1	0	0	0
29	C590	12.8	27.9	50	No	0	0	0	0	1	0	1	0	0	0
29	C591	10.1	11.3	42	No	0	0	0	0	2	1	1	0	0	1
29	C592	17.5	65.4	52	No	0	0	0	0	2	0	1	0	0	1
29	C593	13	24.4	41	No	0	0	0	0	2	0	1	0	0	1
29	C594	15.5	42.2	45	No	0	0	0	0	1	1	1	0	0	1
29	C595	15.1	42.6	44	No	0	0	0	0	3	0	3	0	0	0
29	C596	15.6	46.9	45	No	0	0	0	0	1	0	2	0	0	1
29	C597	15.8	47.4	-	No	0	0	0	0	0	0	3	0	0	1
29	C598	18.6	80.3	49	No	0	0	0	0	0	0	3	0	0	1
29	C599	11.9	19.8	45	No	0	0	0	0	0	0	1	0	0	0
29	C600	13.2	31.6	52	No	0	0	0	0	1	0	1	0	0	0
29	C601	8.5	6.0	51	No	0	0	0	0	1	0	1	0	0	0
29	C602	17.2	62.7	49	No	0	0	0	0	1	0	2	0	0	0
29	C603	10.3	12.1	39	No	0	0	0	0	1	0	1	0	0	0
29	C604	10	11.6	44	No	0	0	0	0	1	0	0	0	0	0
29	C605	16	50.6	-	No	0	0	0	0	1	0	0	0	0	0
29	C606	15.7	48.3	-	No	0	0	0	0	1	0	2	0	0	0
29	C607	16.1	52.3	48	No	0	0	0	0	1	0	2	0	0	0
29	C608	15	42.4	49	No	0	0	0	0	0	0	1	0	0	1
29	C609	17.2	63.4	50	No	0	0	0	0	1	0	3	0	0	0
29	C610	6.8	3.1	39	No	0	0	0	0	1	0	1	0	0	1
29	C611	18.5	54.3	47	No	0	0	0	0	1	0	0	0	0	0
29	C612	13.1	26.3	44	No	0	0	0	0	0	0	1	0	0	0
29	C613	13.3	25.3	52	No	0	0	0	0	1	1	0	0	0	0
29	C614	17.7	66.6	49	No	0	0	0	0	2	0	1	0	0	1
30	A849	13.5	26.6	-	No	0	0	0	0	0	0	1	0	0	0
30	A850	15.8	44.7	-	No	0	0	0	0	1	0	2	0	0	1
30	A851	10.1	11.9	-	No	0	0	0	0	0	0	3	0	0	0
30	A852	13.3	28.8	-	No	0	0	0	0	0	0	2	0	0	0
30	A853	9.7	10.3	-	No	0	0	0	0	0	0	2	0	0	1
30	A854	9.3	7.4	-	No	0	0	0	0	0	0	3	0	0	0
30	A855	11.9	19.7	-	No	0	0	0	0	0	0	1	0	0	1
30	A856	11.7	19.8	-	No	0	0	0	0	0	1	2	0	0	0
30	A857	14.2	32.9	-	No	0	0	0	0	0	0	1	0	0	0
30	A858	12.6	24.5	-	No	0	0	0	0	0	0	1	0	0	0
30	A859	13.1	23.1	53	Yes	3	0	0	0	0	0	1	0	0	1
30	A860	8.4	6.2	45	No	0	0	0	0	0	0	1	0	0	0
30	A861	15.4	40.0	56	No	0	0	0	0	0	0	2	0	0	1
30	A862	16.3	47.4	51	No	0	0	0	0	0	0	1	0	0	0
30	A863	14.4	32.1	46	No	0	0	0	0	0	0	3	0	0	0
30	A864	13.8	30.0	51	No	0	0	0	0	0	0	1	0	0	0

Host						*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
30	A865	17	55.1	56	No	0	0	0	0	0	0	0	0	0	1
30	A866	13.1	26.2	55	No	0	0	0	0	0	0	0	0	0	1
30	A867	12.6	22.1	-	No	0	0	0	0	0	0	1	0	0	1
30	A868	16.5	53.1	-	No	0	0	0	0	0	0	1	0	0	1
30	A869	12.6	21.1	-	No	0	0	0	0	0	0	1	0	0	1
30	A870	13.5	30.7	-	No	0	0	0	0	0	0	1	0	0	0
30	A871	17.1	55.3	37	No	0	0	0	0	0	0	3	0	0	0
30	A872	12.2	15.3	10	Yes	3	2	0	0	0	0	0	0	0	0
30	A873	15.9	47.3	49	No	0	0	0	0	0	0	3	0	0	0
30	A874	14.1	27.9	44	No	3	0	0	0	0	0	3	0	0	1
30	A875	16.2	48.8	58	No	0	0	0	0	0	0	3	0	0	1
30	A876	16.2	47.1	50	No	0	0	0	0	1	0	3	0	0	0
30	A877	9.9	9.2	42	No	0	0	0	0	0	0	3	0	0	1
30	A878	13.7	26.0	51	Yes	1	0	0	0	0	0	2	0	0	1
30	A879	11.4	16.2	54	Yes	3	0	0	0	0	0	1	0	0	1
30	A880	13.2	24.3	57	Yes	3	0	0	0	0	0	2	0	0	1
30	A881	15.4	39.6	48	No	0	0	0	0	0	0	1	0	0	1
30	A882	15.1	39.1	52	No	0	0	0	0	0	0	3	1	0	0
30	A883	16.5	48.7	57	No	0	0	0	0	0	0	3	0	0	0
30	A884	10.7	10.6	10	Yes	3	3	0	0	0	0	3	1	0	0
30	A885	13.4	27.3	26	Yes	3	0	0	0	0	0	3	0	0	1
30	A886	13.5	24.2	45	No	3	0	0	0	0	0	0	0	0	1
30	A887	12.4	21.0	-	No	0	0	0	0	0	0	1	0	0	0
30	A888	13.9	30.2	-	No	0	0	0	0	0	0	3	1	0	1
30	A889	16.6	45.7	58	No	0	0	0	0	0	0	3	1	0	0
30	A890	13.1	25.4	50	No	0	0	0	0	0	0	3	1	0	0
30	A891	12.2	16.9	32	No	3	3	0	0	0	0	1	0	0	0
30	A892	13.9	31.6	49	No	1	0	0	0	0	0	3	0	0	1
30	A893	14.1	29.5	49	No	0	0	0	0	0	0	3	1	0	1
30	A894	13.2	22.9	53	No	0	0	0	0	0	0	1	0	0	1
30	A895	16.3	47.9	49	No	0	0	0	0	0	0	1	0	0	1
30	A896	16.1	44.7	55	No	0	0	0	0	0	0	3	0	0	0
30	A897	15.1	38.6	-	No	0	0	0	0	0	0	3	0	0	1
30	A898	14.7	32.2	-	No	0	0	0	0	0	0	2	0	0	1
30	A899	15.2	35.0	-	No	0	0	0	0	0	0	1	0	0	1
30	A900	14	29.4	-	No	0	0	0	0	0	0	1	0	0	1
30	A901	8.1	5.6	41	No	0	0	0	0	0	0	3	0	0	1
30	A902	10.7	12.0	20	Yes	3	2	0	0	0	0	3	1	0	0
30	A903	10.1	8.9	5	Yes	3	3	0	0	0	0	3	1	0	1
30	A904	17.6	59.4	52	No	0	0	0	0	0	0	1	0	0	1
31	B353	18.4	68.5	-	No	0	0	0	0	0	0	0	0	0	1
31	B354	15.5	41.4	-	No	0	0	0	0	0	0	0	0	0	1
31	B355	16.8	56.9	-	No	0	0	0	0	0	0	0	0	0	1
31	B356	18.2	72.3	-	No	0	0	0	0	0	0	0	0	0	1
31	B357	15	37.3	-	No	0	0	0	0	0	0	0	0	0	1
31	B358	15.7	46.6	-	No	0	0	0	0	0	0	0	0	0	1
31	B359	13.9	32.1	-	No	0	0	0	0	0	0	0	0	0	0
31	B360	18.7	67.7	-	No	0	0	0	0	0	0	0	0	0	1
31	B361	15.5	39.4	-	No	0	0	0	0	0	0	0	0	0	0
31	B362	17.3	54.7	-	No	0	0	0	0	0	0	0	0	0	1
31	B363	15.8	42.5	-	No	0	0	0	0	0	0	0	0	0	0
31	B364	17.4	58.9	-	No	0	0	0	0	0	0	0	0	0	1
31	B365	18.5	73.6	-	No	0	0	0	0	0	0	0	0	0	0
31	B366	17.2	55.2	-	No	0	0	0	0	0	0	0	0	0	0
31	B367	18.8	72.2	-	No	0	0	0	0	0	0	0	0	0	1
31	B368	18.6	69.0	-	No	0	0	0	0	0	0	0	0	0	1
31	B369	17.9	63.4	-	No	0	0	0	0	0	0	0	0	0	0
32	C615	15.7	42.4	-	No	0	0	0	0	0	0	3	0	0	1
32	C616	14.5	33.4	-	No	0	0	0	0	0	0	3	0	0	0
32	C617	19.3	79.9	-	No	0	0	0	0	0	0	3	0	0	1
32	C618	16.9	52.0	-	No	0	0	0	0	0	0	3	0	0	1
32	C619	15.6	39.9	-	No	0	0	0	0	0	0	3	0	0	1
32	C620	17.3	55.5	-	No	0	1	0	0	0	0	3	1	0	1
32	C621	15.5	40.7	-	No	0	0	0	0	0	0	3	0	0	1
32	C622	17.3	57.5	-	No	0	0	0	0	0	0	3	0	0	1
32	C623	17.5	60.0	-	No	0	0	0	0	0	0	3	0	0	1
32	C624	14.7	36.3	-	No	0	0	0	0	0	0	3	1	0	1
32	C625	17.3	60.3	-	No	0	0	0	0	1	0	3	0	0	1
32	C626	16.2	45.8	-	No	0	0	0	0	1	0	3	0	0	0
32	C627	17	51.1	-	No	0	0	0	0	0	0	1	0	0	0
32	C628	13.3	29.7	-	No	0	0	0	0	0	0	2	0	0	1
32	C629	17.4	58.6	-	No	0	0	0	0	0	0	3	0	0	1
32	C630	17.3	58.6	-	No	0	0	0	0	0	0	3	1	0	0
32	C631	17.7	61.2	-	No	0	0	0	0	1	0	1	0	0	0
32	C632	17.2	58.0	-	No	0	0	0	0	1	0	3	0	0	0
32	C633	10.9	14.1	-	No	0	0	0	0	0	0	2	0	0	1
32	C634	14.5	38.4	-	No	0	0	0	0	0	0	2	0	0	1
32	C635	12.9	28.2	-	No	0	0	0	0	0	0	1	0	0	1
32	C636	16.6	51.3	-	No	0	0	0	0	0	0	1	0	0	0
32	C637	9.4	9.2	-	No	0	0	0	0	1	0	1	1	0	0

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
32	C638	19.5	84.2	-	No	0	0	0	0	1	0	3	0	0	1
32	C639	15	35.3	-	No	0	0	0	0	1	0	1	0	0	1
32	C640	18.5	82.1	-	No	0	0	0	0	0	0	2	1	0	1
32	C641	19.2	79.3	-	No	0	0	0	0	0	0	3	0	0	0
32	C642	20.3	91.7	-	No	0	0	0	0	0	0	3	0	0	1
32	C643	18.4	71.0	-	No	0	0	0	0	0	0	3	0	0	0
32	C644	19.8	90.9	-	No	0	0	0	0	0	0	3	0	0	1
32	C645	16.5	49.2	-	No	0	0	0	0	0	0	1	0	0	0
32	C646	18	65.3	-	No	0	0	0	0	0	0	1	0	0	1
32	C647	18.4	68.1	60	No	0	0	0	0	0	0	1	0	0	1
32	C648	16.3	49.4	55	Yes	3	0	0	0	0	0	1	0	0	0
32	C649	18.3	71.7	57	Yes	0	0	0	0	1	0	1	0	0	1
32	C650	15.6	41.4	53	No	0	0	0	0	0	0	1	0	0	0
32	C651	17	52.8	51	No	0	0	0	0	0	0	1	0	0	0
32	C652	12	17.5	52	No	0	0	0	0	0	0	1	0	0	0
32	C653	20.4	94.4	51	No	0	0	0	0	0	0	1	0	0	0
33	P001	16.4	50.9	51	No	0	0	0	0	0	0	2	0	0	1
33	P002	12.1	13.4	47	Yes	3	0	0	0	0	0	3	0	0	0
33	P003	19.1	84.1	50	No	0	0	0	0	0	0	3	0	0	0
33	P004	16.9	48.0	49	No	1	0	0	0	0	0	2	0	0	0
33	P005	17	53.7	50	No	0	0	0	0	0	0	3	0	0	1
33	P006	9.2	11.0	42	No	0	0	0	0	0	0	1	0	0	1
33	P007	17	55.1	53	No	0	0	0	0	0	0	1	0	0	1
33	P008	17.1	55.0	-	No	0	0	0	0	0	0	1	0	0	1
33	P009	19.6	87.6	48	No	0	0	0	0	0	0	2	0	0	1
33	P010	17.1	59.9	39	No	0	0	0	0	0	0	3	0	0	0
33	P011	20.3	92.8	50	No	0	0	0	0	0	0	3	0	0	1
33	P012	16.3	51.0	46	Yes	1	0	0	0	0	0	3	0	0	0
33	P013	20.5	99.5	50	No	0	0	0	0	0	0	3	0	0	1
33	P014	21.8	126.0	51	No	0	0	0	0	0	0	1	0	0	1
33	P015	16.2	43.3	53	Yes	1	0	0	0	0	0	1	0	0	0
33	P016	20.9	103.1	48	No	0	0	0	0	0	0	1	0	0	0
33	P017	18	55.9	50	No	0	0	0	0	0	0	1	1	0	0
33	P018	16.4	46.1	50	Yes	0	0	0	0	0	0	3	0	0	1
33	P019	17.4	57.9	55	No	0	0	0	0	0	0	1	0	0	0
33	P020	16.3	44.4	49	Yes	2	0	0	0	0	0	2	0	0	0
33	P021	18	64.8	51	No	0	0	0	0	0	0	1	0	0	0
33	P022	18.7	75.3	51	No	0	0	0	0	0	0	3	0	0	0
33	P023	18	65.5	53	No	0	0	1	0	0	0	2	0	0	0
33	P024	17	56.0	49	Yes	1	0	0	0	0	0	1	0	0	0
33	P025	17.9	57.1	52	Yes	0	0	0	0	0	0	1	0	0	1
33	P026	13.2	21.0	49	No	0	0	1	0	0	0	2	0	0	1
33	P027	16.5	50.9	50	Yes	1	0	0	0	0	0	1	0	0	0
33	P028	12.3	21.2	53	No	0	0	0	0	0	0	1	0	0	0
33	P029	19.4	84.9	48	Yes	1	0	0	0	0	0	1	0	0	1
33	P030	12.3	17.2	53	Yes	0	0	0	0	0	0	1	0	0	1
33	P031	17.5	62.4	53	No	0	0	0	0	0	0	0	0	0	0
33	P032	18.6	70.0	53	No	0	0	0	0	0	0	1	0	0	1
33	P033	15.8	40.4	-	No	0	0	0	0	0	0	0	0	0	0
33	P034	11.3	18.1	-	No	0	0	0	0	0	0	0	0	0	0
33	P035	15.9	40.5	-	No	0	0	0	0	0	0	1	0	0	0
33	P036	19.2	68.2	-	No	0	0	0	0	0	0	3	0	0	0
33	P037	17.6	60.8	-	No	0	0	0	0	0	0	3	0	0	0
33	P038	13.7	21.6	-	No	0	0	0	0	0	0	3	0	0	0
33	P039	19.8	84.8	-	No	0	0	0	0	0	0	1	0	0	0
33	P040	11.1	13.6	-	No	3	0	0	0	0	0	2	0	0	1
33	P041	16.2	50.6	-	No	0	0	0	0	0	0	3	0	0	0
33	P042	16.1	43.7	-	Yes	2	0	0	0	0	0	1	0	0	0
33	P043	18	64.6	-	Yes	0	0	0	0	0	0	1	0	0	0
33	P044	18.7	77.9	-	Yes	1	0	0	0	0	0	3	0	0	0
33	P045	22.5	132.2	-	Yes	0	0	0	0	0	0	1	0	0	1
33	P046	21.6	115.0	-	Yes	0	0	0	0	0	0	1	0	0	0
34	P047	13.1	21.2	47	No	0	0	0	0	1	0	2	0	0	0
34	P048	14.8	40.8	58	No	0	0	0	0	0	0	1	0	0	1
34	P049	20.3	84.3	48	Yes	3	0	0	0	0	0	2	1	0	0
34	P050	20.5	101.9	58	No	0	0	0	0	0	0	1	0	0	1
34	P051	20.5	98.0	58	No	0	0	0	0	0	0	2	0	0	1
34	P052	23.8	161.9	52	No	0	0	0	0	0	0	2	0	0	1
34	P053	20.2	91.3	68	No	2	0	0	0	0	0	1	0	0	0
34	P054	19.3	77.7	58	No	0	0	0	0	0	0	1	0	0	1
34	P055	19.6	78.7	57	No	0	0	0	0	0	0	2	0	0	0
34	P056	22.6	129.5	56	No	1	0	0	0	0	0	1	0	0	0
34	P057	22.4	130.7	64	Yes	0	0	0	0	0	0	3	0	0	0
34	P058	18.7	75.1	54	Yes	3	0	0	0	0	0	2	0	0	0
34	P059	20.8	91.7	69	No	1	0	0	0	0	0	3	0	0	1
34	P060	21.7	111.0	58	No	0	0	0	0	0	0	3	0	0	1
34	P061	22.8	128.6	73	Yes	2	0	0	0	0	0	2	0	0	1
34	P062	18.8	77.5	-	Yes	1	0	0	0	0	0	2	1	0	0
34	P063	19	71.6	52	No	0	0	0	0	0	0	2	0	0	0
34	P064	22	120.9	70	Yes	3	0	0	0	0	0	3	0	0	1

		Host				*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*	
Sampling no.	**Sample**	Length (cm)	Weight (g)	Hct	Skin damage	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
34	P065	22.5	131.5	67	Yes	3	0	0	0	0	0	3	0	0	1
34	P066	22.9	126.0	55	No	0	0	0	0	0	0	1	0	0	1
34	P067	21.5	106.2	57	Yes	3	0	0	0	0	0	2	0	0	0
34	P068	22.5	115.7	69	No	0	0	0	0	0	0	1	0	0	0
34	P069	19.1	86.2	41	Yes	2	0	0	0	0	0	1	0	0	0
34	P070	20.5	103.1	58	Yes	0	0	0	0	0	0	1	0	0	0
34	P071	20.2	92.5	75	Yes	3	0	0	0	0	0	2	0	0	0
34	P072	15.4	40.4	29	Yes	1	0	0	0	0	0	1	0	0	0
34	P073	20.6	100.0	67	Yes	1	0	0	0	0	0	1	0	0	0
34	P074	16.5	55.9	67	Yes	2	0	0	0	0	0	1	0	0	0
34	P075	21.6	117.2	67	Yes	2	0	0	0	0	0	3	0	0	0
34	P076	19.9	88.4	73	Yes	1	0	0	0	0	0	3	0	0	1
34	P077	20.7	88.9	61	Yes	1	0	0	0	0	0	3	0	0	0
34	P078	18.2	67.3	62	No	0	0	0	0	0	0	1	0	0	1
34	P079	21.8	109.9	73	No	0	0	0	0	0	0	2	0	0	0
34	P080	16.4	46.1	49	No	1	0	0	0	0	0	2	0	0	1
34	P081	19.9	78.7	71	Yes	0	0	0	0	0	0	2	0	0	1
34	P082	19.8	86.7	63	No	0	0	0	0	0	0	3	0	0	0
34	P083	18.7	79.2	66	Yes	1	0	0	0	0	0	2	0	0	0
34	P084	14	28.0	62	Yes	1	0	0	0	0	0	2	0	0	0
34	P085	18.5	63.3	65	No	0	0	0	0	0	0	3	0	0	0
34	P086	20	89.6	59	No	0	0	0	0	0	0	1	0	0	0
34	P087	21.2	100.8	61	Yes	1	0	0	0	0	0	3	0	0	1
35	P088	25.2	169.0	41	No	0	0	0	0	0	0	1	0	0	0
35	P089	22.9	113.0	50	No	0	0	0	0	0	0	3	0	0	0
35	P090	23.1	118.0	49	No	0	0	0	0	0	0	2	0	0	0
35	P091	22	102.0	43	Yes	0	0	0	0	0	0	3	0	0	1
35	P092	27.2	193.0	35	Yes	0	0	0	0	0	0	1	0	0	0
35	P093	21.9	97.0	36	No	0	0	0	0	0	0	1	0	0	0
35	P094	21.7	97.0	45	No	0	0	0	0	0	0	1	0	0	0
35	P095	21.7	94.0	43	No	0	0	0	0	0	0	1	0	0	0
35	P096	24.4	144.0	43	No	0	0	0	0	0	0	0	0	0	0
35	P097	21.6	99.0	46	No	0	0	0	0	0	0	3	0	0	1
35	P098	23.8	140.0	44	No	0	0	0	0	0	0	1	0	0	1
35	P099	23.3	125.0	38	No	0	0	0	0	0	0	1	0	0	0
35	P100	22.8	112.0	44	No	0	0	0	0	0	0	1	0	0	0
35	P101	25.3	158.0	45	No	0	0	0	0	0	0	1	0	0	0
35	P102	23.5	128.0	43	No	0	0	0	0	0	0	1	0	0	0
35	P103	21.3	89.0	46	No	0	0	0	0	0	0	1	0	0	0
35	P104	25.5	160.0	45	No	0	0	0	0	0	0	1	0	0	0
35	P105	23.1	126.0	42	No	0	0	0	0	0	0	3	0	0	0
35	P106	21	81.0	40	No	0	0	0	0	0	0	1	0	0	0
35	P107	23.3	115.0	44	No	0	0	0	0	0	0	1	0	0	0
35	P108	21.9	97.0	42	No	0	0	0	0	0	0	2	0	0	0
35	P109	22.1	104.0	40	Yes	0	0	0	0	0	0	1	1	0	0
35	P110	23	128.0	39	No	0	0	0	0	0	0	1	0	0	0
35	P111	25.2	159.0	36	No	0	0	0	0	0	0	1	0	0	0
35	P112	21.2	85.0	35	No	0	0	0	0	0	0	3	0	0	1
35	P113	22.4	110.0	35	No	0	0	0	0	0	0	3	0	0	1
35	P114	22.9	128.0	44	No	0	0	0	0	0	0	2	0	0	0
35	P115	22.8	130.0	45	No	0	0	0	0	0	0	2	0	0	1
35	P116	23.4	114.0	49	No	0	0	0	0	0	0	1	0	0	0
35	P117	22.2	114.0	35	No	0	0	0	0	0	0	1	0	0	0
35	P118	21.7	99.0	40	No	0	0	0	0	0	0	1	0	0	0
35	P119	22.1	110.0	41	Yes	0	0	0	0	0	0	1	0	0	1
35	P120	20.9	89.0	-	No	0	0	0	0	0	0	1	0	0	0
35	P121	21	94.0	-	No	0	0	0	0	0	0	1	0	0	0
35	P122	20.1	79.0	-	No	0	0	0	0	0	0	1	0	0	0
35	P123	23.1	124.0	-	No	0	0	0	0	0	0	1	0	0	1
35	P124	23.2	132.0	-	No	0	0	0	0	0	0	1	0	0	0
35	P125	27.1	206.0	-	No	0	0	0	0	0	0	1	0	0	0
35	P126	23.2	130.0	-	Yes	0	0	0	0	0	0	1	0	0	0
35	P127	23.5	137.0	-	No	0	0	1	0	0	0	2	0	0	0

APPENDIX C. Morphology

Ichthyobodo

Morphological measurements of *Ichthyobodo* (free-swimming form and trophozoites*) from skin and gills** of salmon (SS), and from the skin of rainbow trout (OM) and three-spined sticklebacks (GA). All measurements are of 2D images from stained smears. Lengths are given in µm, area in µm^2. **L1 and L2:** Diameters (length and width respectively) of the cell. **L3**: Distance from the centre of the longitudinal axis to the end of the cell at the flagellar pocket. **L4 and L5**: Position of the nucleus as the distance from the centre to margin of the cell at the flagellar pocket and the anterior part respectively. Positions calculated in a cell-size ratio (L4/L2 and L5/L1). **L6 and L7**: Diameter of the nucleus with L6 and L7 parallels to L1 and L2 respectively. **A 1**: Area of the cell. **A 2**: Area of the nucleus.

Ichthyobodo cells	Dimensions of *Ichthyobodo*								
	L1	L2	L3	L4	L5	L6	L7	A1	A2
SS1 - 1	12.5	6.4	13.7	8.7	6.4	4.6	4.3	143.1	17.5
SS1 - 2	10.0	6.3	13.2	8.5	5.2	4.2	3.7	106.5	13.2
SS1 - 3	10.7	6.1	13.0	8.3	6.1	4.4	4.0	106.1	15.8
SS1 - 4	12.3	5.3	13.2	8.0	5.3	4.6	3.7	131.2	15.7
SS1 - 5	13.4	5.6	13.6	8.5	6.8	4.9	4.3	150.4	19.7
SS1 - 6	13.5	6.5	14.7	8.5	7.9	5.1	4.5	161.7	20.6
SS1 - 7	11.5	7.5	14.4	9.8	5.8	4.9	3.9	136.9	17.4
SS1 - 8	13.7	7.5	15.3	9.7	7.0	5.0	4.7	166.7	19.7
SS1 - 9	13.2	6.7	14.2	8.2	6.7	4.7	4.4	147.8	18.8
SS1 - 10	12.3	7.0	13.3	8.3	5.2	4.5	3.7	127.8	15.9
SS1 - 11	11.4	6.3	12.9	7.6	5.6	4.5	4.1	115.8	17.0
SS1 - 12	10.9	6.3	11.9	7.3	4.7	4.3	3.4	107.9	13.6
SS1 - 13	12.4	6.2	14.9	9.5	6.2	4.9	4.6	149.4	20.6
SS1 - 14	10.4	5.3	11.5	6.2	5.7	4.1	3.4	90.1	13.4
SS1 - 15	12.0	5.9	12.0	8.3	6.2	4.4	3.4	111.9	14.9
SS1 - 16	12.5	6.5	13.6	8.3	6.5	4.9	4.1	131.2	17.8
SS1 - 17	10.1	6.0	13.1	8.8	5.0	4.2	4.3	108.9	16.0
SS1 - 18	12.2	6.2	13.5	8.7	6.0	5.2	3.8	132.3	17.7
SS1 - 19	13.0	8.2	14.7	8.6	6.6	5.1	4.6	152.8	20.1
SS1 - 20	16.5	8.0	18.0	9.6	9.2	6.0	5.2	226.2	27.7
SS1 - 21	12.1	6.1	12.7	8.3	6.6	4.0	3.6	123.4	13.3
SS1 - 22	11.7	7.5	12.9	9.3	6.0	4.7	3.6	119.0	14.9
SS1 - 23	11.2	6.4	12.3	7.7	4.7	4.0	3.9	112.6	14.4
SS1 - 24	15.0	7.2	14.7	8.9	8.2	5.1	4.2	161.4	21.4
SS1 - 25	13.6	7.8	14.2	7.7	7.4	5.2	4.3	148.5	19.7
SS1 - 26	12.9	5.6	13.6	8.1	5.7	4.7	4.1	140.3	16.9
SS1 - 27	12.2	5.4	13.0	7.7	5.7	4.7	3.9	123.5	17.5
SS1 - 28	12.3	6.9	13.6	9.2	6.9	4.4	4.3	132.5	17.0
SS1 - 29	10.2	4.9	12.9	8.0	5.2	4.2	3.2	107.5	11.2
SS1 - 30	13.9	6.8	14.6	8.9	6.8	4.7	4.5	165.7	19.3
SS2 - 1	12.5	7.7	14.0	8.2	7.4	4.3	4.3	132.0	16.9
SS2 - 2	12.3	6.1	14.2	7.6	6.1	4.5	5.3	131.4	18.6
SS2 - 3	13.1	6.8	15.9	8.9	7.9	4.8	4.7	149.4	18.8
SS2 - 4	12.2	8.5	15.2	8.5	6.8	4.6	4.7	142.2	19.3
SS2 - 5	10.3	6.6	12.4	8.1	5.5	4.0	3.7	99.3	12.4
SS2 - 6	12.8	7.0	14.7	7.9	6.0	4.9	4.6	143.2	18.5
SS2 - 7	15.6	7.1	14.3	7.1	7.9	5.6	4.6	167.3	24.3
SS2 - 8	10.1	5.4	12.0	8.5	5.1	3.7	3.8	92.8	12.0
SS2 - 9	9.9	6.0	11.9	6.2	5.2	4.2	3.3	89.9	12.0
SS2 - 10	11.1	7.4	12.9	7.4	5.4	4.5	3.8	106.8	13.5
SS2 - 11	10.2	5.7	12.0	6.6	4.3	3.9	3.4	92.3	11.0
SS2 - 12	13.5	5.7	14.3	8.4	6.3	4.7	4.4	147.3	18.4
SS2 - 13	11.3	6.5	13.2	5.8	5.6	4.3	3.7	116.6	13.3
SS2 - 14	11.1	5.9	11.9	7.8	5.9	3.8	3.7	101.6	12.7
SS2 - 15	9.9	5.6	12.0	6.7	4.2	3.9	3.3	92.9	12.0
SS2 - 16	11.0	6.8	12.7	7.4	5.0	4.2	3.7	108.1	13.8
SS2 - 17	9.9	5.8	11.8	6.2	5.3	4.0	3.2	91.1	12.7
SS2 - 18	10.9	5.8	12.9	7.9	4.9	4.3	3.7	102.2	11.9
SS2 - 19	11.8	7.0	13.5	5.5	7.2	4.1	3.5	119.3	13.5
SS2 - 20	11.7	6.9	13.0	6.9	5.8	3.7	4.4	117.2	14.9
SS2 - 21	10.9	5.3	13.0	7.8	5.4	3.9	3.7	114.6	11.6
SS2 - 22	11.0	6.2	12.7	7.4	5.7	4.3	3.7	107.4	13.9
SS2 - 23	12.8	6.7	14.8	8.7	7.2	4.8	4.4	137.1	18.7
SS2 - 24	11.1	6.2	13.4	7.6	5.6	4.2	3.9	116.1	15.6
SS2 - 25	12.3	7.9	15.2	8.2	6.2	4.3	4.4	142.5	16.7
SS2 - 26	9.3	5.8	10.9	7.2	4.6	3.9	3.0	77.9	10.1
SS2 - 27	13.8	6.9	15.6	9.9	7.2	4.2	4.8	159.5	17.8
SS2 - 28	13.2	7.1	15.8	8.3	6.6	4.6	4.5	156.3	18.2
SS2 - 29	11.5	7.3	14.2	7.9	6.3	4.3	4.4	127.3	16.3
SS2 - 30	11.7	6.1	14.2	8.0	6.1	4.1	4.4	130.2	15.7
SS2 - 31	11.3	6.4	12.9	7.8	5.3	4.3	3.6	112.6	14.9
SS3** - 1	12.1	5.8	12.4	7.4	6.7	3.8	3.5	121.1	13.1
SS3** - 2	10.1	6.3	12.4	8.5	6.0	3.7	3.5	96.1	11.3
SS3** - 3	10.6	6.3	13.1	7.9	5.9	4.0	3.9	99.4	13.1

Ichthyobodo	Dimensions of *Ichthyobodo*								
	L1	L2	L3	L4	L5	L6	L7	A1	A2
SS3** - 4	9.7	6.3	11.5	6.8	5.7	3.8	4.0	91.1	10.8
SS3** - 5	11.7	6.0	12.9	7.9	8.0	3.9	3.9	121.8	12.0
SS3** - 6	9.3	4.4	9.8	7.0	5.0	3.1	3.1	69.6	9.6
SS3** - 7	10.6	5.6	12.5	7.2	6.1	4.4	3.8	97.9	14.0
SS3** - 8	10.4	5.0	11.7	7.2	5.2	3.6	3.4	94.9	12.2
SS3** - 9	11.8	4.9	12.9	7.7	7.7	3.4	3.9	129.6	13.1
SS3** - 10	10.9	5.3	11.3	7.4	5.2	4.0	3.1	96.5	10.7
SS3** - 11	11.2	5.3	12.2	8.5	6.4	3.9	3.7	104.8	13.8
SS3** - 12	9.2	4.3	9.7	6.8	5.0	3.3	3.1	70.7	9.9
SS3** - 13	12.2	4.7	11.2	7.4	5.6	3.9	3.8	106.6	13.4
SS3** - 14	9.1	6.4	10.2	5.6	5.4	3.3	3.2	75.6	9.6
SS3** - 15	8.3	5.1	11.0	6.3	4.4	3.1	3.3	75.5	10.4
SS3** - 16	9.3	4.4	10.2	6.4	5.8	3.1	3.4	75.1	9.9
SS3** - 17	9.4	5.2	11.5	7.4	5.0	3.1	3.0	85.5	10.0
SS3** - 18	10.1	5.4	11.7	7.6	6.7	3.3	3.3	93.4	11.6
SS3** - 19	9.3	4.1	11.4	6.7	4.4	3.3	3.4	84.0	11.0
SS3** - 20	13.2	6.4	13.9	9.7	7.1	5.1	4.9	139.1	20.3
SS3** - 21	12.8	6.0	13.3	8.3	6.6	4.7	3.8	130.4	15.0
SS3** - 22	10.5	4.2	12.3	7.7	4.8	4.8	4.0	100.0	15.0
SS3** - 23	9.9	4.3	11.1	6.9	5.3	3.0	3.2	90.6	10.0
SS3** - 24	10.1	4.4	11.2	7.0	5.6	3.5	3.2	87.3	10.7
SS3** - 25	9.3	6.1	10.6	6.0	5.8	3.4	3.3	79.5	11.8
SS3** - 26	9.8	4.8	11.1	7.2	5.5	3.5	3.5	87.7	11.2
SS3** - 27	10.2	6.7	11.9	8.3	6.2	3.7	3.1	91.2	10.1
SS3** - 28	9.4	4.8	11.1	6.7	5.1	3.1	2.8	78.4	7.6
SS3** - 29	10.3	4.1	12.0	6.9	6.3	3.3	3.7	91.0	10.8
SS3** - 30	10.1	4.9	12.2	7.3	5.6	3.9	3.4	96.6	12.7
SS3** - 31	11.4	4.1	11.5	7.3	6.7	4.0	3.7	101.1	13.0
SS3** - 32	9.3	4.5	10.9	6.0	4.7	3.8	3.2	80.9	11.9
SS3** - 33	9.5	4.4	12.6	7.4	4.6	3.3	3.6	97.2	11.2
SS3** - 34	11.9	5.4	12.4	7.4	6.6	4.0	3.5	104.9	12.2
SS4 - 1	11.0	3.7	12.1	7.7	5.8	-	-	113.6	-
SS4 - 2	10.3	6.6	13.5	8.2	5.5	4.9	4.3	115.5	18.1
SS4 - 3	13.4	6.7	13.8	8.7	7.1	4.4	4.5	144.5	19.0
SS4 - 4	10.0	4.2	12.7	6.7	4.7	3.9	3.9	102.2	13.4
SS4 - 5	10.8	5.8	11.5	6.9	5.4	4.2	4.0	101.0	14.6
SS4 - 6	14.0	7.5	14.3	8.5	7.2	4.8	4.8	163.1	20.2
SS4 - 7	11.4	5.7	13.6	8.7	6.5	5.2	4.3	121.7	19.0
SS4 - 8	11.9	5.1	14.7	8.0	6.9	4.7	4.3	139.3	20.0
SS4 - 9	13.5	7.4	15.2	9.5	7.4	5.4	5.1	166.8	22.9
SS4 - 10	11.3	5.3	13.9	9.6	7.4	4.7	4.4	128.0	16.6
SS4 - 11	12.5	6.2	13.0	9.1	6.4	5.8	4.1	133.0	19.8
SS4 - 12	12.1	6.2	14.6	9.5	5.8	4.8	4.0	140.9	18.3
SS4 - 13	11.5	5.5	11.7	7.8	5.8	4.4	3.8	104.1	14.6
SS4 - 14	10.9	5.0	12.7	8.9	6.2	4.2	3.9	112.3	14.5
SS4 - 15	12.9	7.6	15.1	9.7	6.7	4.9	4.4	159.7	19.7
SS4 - 16	11.9	5.3	13.3	7.4	6.2	4.6	4.0	129.6	15.1
SS4 - 17	9.9	5.2	11.3	7.2	5.7	4.8	3.4	92.8	14.0
SS4 - 18	12.5	5.6	13.7	8.9	6.8	4.7	4.0	143.0	18.0
SS4 - 19	13.1	6.0	12.9	8.1	7.0	5.1	3.6	131.9	18.3
SS4 - 20	12.2	5.5	13.8	9.0	6.6	4.8	4.0	139.4	17.4
SS4 - 21	11.9	4.8	11.6	7.4	5.7	4.1	4.4	106.9	16.4
SS4 - 22	11.8	5.1	12.9	8.3	6.3	4.7	4.0	130.1	15.8
SS4 - 23	12.1	6.4	12.7	7.3	6.6	4.3	4.2	122.9	17.3
SS4 - 24	11.2	6.0	11.7	7.2	6.3	4.1	3.9	109.6	15.7
SS4 - 25	13.6	7.3	15.1	8.6	5.8	4.8	4.7	168.1	19.7
SS4 - 26	11.8	6.2	13.8	9.1	4.6	4.6	4.0	134.0	16.0
SS4 - 27	9.6	4.8	11.7	7.2	5.2	4.4	3.9	93.4	14.9
SS4 - 28	8.7	4.3	11.2	7.6	5.0	3.2	3.4	81.4	10.3
SS4 - 29	10.9	5.4	11.7	8.2	5.8	4.1	4.4	98.5	16.1
SS4 - 30	11.3	5.9	13.4	9.1	5.6	4.6	4.5	127.1	18.5
SS5*-1	16.8	7.5	10.2	9.1	3.5	3.9	5.0	124.7	12.2
SS5*-2	13.8	5.5	8.6	5.8	4.9	4.3	4.5	91.4	16.8
SS5*-3	18.9	4.9	9.2	9.4	4.5	6.9	4.6	112.6	24.1

Ichthyobodo cells	L1	L2	L3	L4	L5	L6	L7	A1	A2
	Dimensions of *Ichthyobodo*								
SS5*-4	15.1	4.5	8.6	8.5	5.1	3.6	2.9	86.7	11.9
SS5*-5	17.2	4.5	9.6	7.6	5.8	5.7	5.8	123.3	27.6
SS5*-6	16.7	4.8	9.9	9.0	3.5	5.3	4.5	112.8	18.5
SS5*-7	15.1	4.0	7.9	8.6	4.2	3.9	4.5	79.8	15.3
SS5*-8	17.3	4.9	10.0	7.2	5.3	4.9	4.4	123.7	18.1
SS5*-9	19.0	4.4	9.4	9.8	5.2	5.8	4.1	123.0	19.4
SS5*-10	15.8	6.0	10.4	7.3	6.2	5.5	5.0	121.5	20.8
SS5*-11	13.2	3.9	8.4	5.7	3.8	3.3	3.4	81.5	9.7
SS5*-12	14.0	5.1	9.1	6.2	4.8	4.5	4.9	97.6	17.7
SS5*-13	15.5	5.3	10.3	6.2	5.7	4.4	4.8	116.7	18.5
SS5*-14	13.2	4.7	8.7	6.5	5.5	5.0	4.8	89.1	19.5
SS5*-15	12.9	4.3	7.7	3.7	4.0	4.0	4.6	73.0	15.4
SS5*-16	16.0	3.7	6.9	7.5	4.3	5.0	4.3	87.7	18.1
SS5*-17	15.5	4.0	8.1	9.3	3.8	4.9	4.5	85.2	19.2
SS5*-18	12.6	3.1	7.0	6.0	3.9	3.7	4.1	59.4	12.4
SS5*-19	12.5	3.3	6.3	5.4	3.6	4.0	3.9	64.2	14.3
SS5*-20	16.7	4.5	8.5	9.9	4.3	4.8	4.0	94.7	15.9
SS5*-21	13.1	4.2	8.3	7.5	4.7	4.6	4.0	75.5	14.9
SS5*-22	14.7	3.0	8.7	7.9	5.4	4.9	4.0	87.0	14.6
SS5*-23	12.8	2.9	6.8	6.6	3.4	3.7	3.0	64.2	9.0
SS5*-24	11.6	3.2	6.3	6.1	3.8	3.9	3.4	55.7	10.6
SS5*-25	14.5	4.4	8.9	9.3	4.9	4.5	4.8	93.4	19.2
SS5*-26	13.1	4.9	10.0	7.0	5.3	2.7	4.3	94.8	10.9
SS5*-27	15.8	6.0	10.7	8.1	7.2	4.6	4.8	124.9	18.0
SS5*-28	16.1	4.8	9.3	8.6	5.6	3.8	3.2	109.9	10.5
SS5*-29	12.7	4.2	7.5	6.0	4.5	3.8	3.1	70.1	10.2
SS5*-30	14.5	4.1	7.4	9.2	4.7	4.8	3.9	77.7	15.1
OM - 1	12.2	7.4	14.4	7.7	6.7	4.4	3.9	137.4	17.3
OM - 2	11.2	7.5	13.5	8.2	5.9	4.3	3.9	119.7	15.1
OM - 3	13.1	5.4	14.2	8.4	6.4	4.7	4.7	149.2	19.3
OM - 4	13.2	7.4	15.1	9.2	8.0	4.8	4.4	161.3	18.3
OM - 5	10.7	5.6	11.6	6.6	4.3	4.4	3.4	101.4	12.8
OM - 6	15.2	6.0	15.0	9.9	7.4	5.0	5.0	174.8	24.0
OM - 7	10.5	4.0	12.2	8.3	4.9	3.9	3.8	103.7	12.9
OM - 8	12.6	4.0	16.0	9.1	6.5	5.1	4.5	167.0	19.4
OM - 9	12.0	8.0	15.1	7.6	6.9	4.2	4.2	143.4	15.5
OM - 10	10.2	5.8	12.2	8.3	5.5	4.4	3.6	98.7	13.0
OM - 11	12.9	7.9	14.3	7.7	7.2	4.8	4.5	140.5	18.0
OM - 12	12.4	8.2	14.3	8.0	6.7	4.2	3.8	136.1	16.3
OM - 13	11.8	6.5	14.2	8.9	6.8	5.1	4.5	140.2	19.9
OM - 14	13.8	5.8	14.4	8.2	7.6	4.6	4.0	150.3	18.6
OM - 15	10.6	7.8	13.8	7.4	5.8	4.0	4.2	119.2	17.2
OM - 16	10.1	7.8	13.4	7.6	5.6	4.8	3.7	110.5	17.3
OM - 17	12.4	8.1	14.2	6.9	6.7	4.3	4.9	137.6	19.2
OM - 18	10.7	8.2	14.0	7.5	5.6	4.1	4.8	118.3	16.4

Ichthyobodo	L1	L2	L3	L4	L5	L6	L7	A1	A2
	Dimensions of *Ichthyobodo*								
OM - 19	12.0	6.3	11.9	6.7	5.6	4.6	4.2	117.3	15.6
OM - 20	11.3	5.3	13.3	7.2	5.3	4.0	4.3	118.7	15.1
OM - 21	11.7	6.5	12.7	8.2	5.8	4.4	4.0	114.4	15.6
OM - 22	11.1	5.4	12.1	6.3	5.4	3.8	3.9	89.3	13.3
OM - 23	11.6	6.5	12.1	6.6	6.2	3.6	3.6	106.6	14.1
OM - 24	11.3	6.3	14.6	6.8	6.3	4.5	3.9	133.0	16.8
OM - 25	11.8	5.7	13.4	7.5	6.1	4.4	4.4	134.6	18.0
OM - 26	10.2	7.0	13.7	9.4	5.6	4.3	3.3	113.4	13.6
OM - 27	10.3	6.8	11.0	5.8	5.9	3.2	3.6	85.5	12.0
OM - 28	11.4	5.8	13.4	7.1	5.3	3.7	4.3	118.9	14.1
OM - 29	11.2	5.3	11.3	5.8	6.1	3.5	3.1	92.7	11.1
OM - 30	13.6	7.0	13.0	7.3	6.9	4.5	4.0	135.3	18.0
OM - 31	12.5	8.1	14.9	9.2	6.4	4.6	5.1	144.6	18.8
OM - 32	12.1	6.9	13.3	7.7	6.1	4.7	3.8	126.9	17.5
GA - 1	12.3	6.0	14.3	8.0	5.9	5.0	4.2	142.4	20.6
GA - 2	13.0	7.0	14.6	10.0	6.2	5.1	5.7	150.5	22.8
GA - 3	13.3	4.9	12.5	7.7	6.2	4.6	4.8	135.8	18.8
GA - 4	10.8	5.8	12.2	7.3	4.4	4.0	3.4	116.2	13.8
GA - 5	11.7	6.1	12.2	7.4	5.7	3.3	4.1	116.8	12.7
GA - 6	11.4	4.7	11.4	8.1	4.9	3.6	4.0	105.6	14.0
GA - 7	11.0	6.1	11.5	7.2	4.1	3.2	3.5	98.2	10.8
GA - 8	12.1	5.0	13.8	8.7	5.6	5.2	5.3	142.1	23.5
GA - 9	12.9	6.7	13.3	9.2	5.6	5.8	4.8	150.7	22.7
GA - 10	11.8	4.9	13.7	8.0	4.4	4.2	3.7	129.2	14.9
GA - 11	12.4	7.0	14.1	8.4	7.0	5.2	4.8	143.2	23.7
GA - 12	10.4	5.8	11.4	7.2	5.5	3.7	3.8	97.1	13.4
GA - 13	11.4	6.0	12.0	7.7	5.7	3.7	3.5	110.9	12.5
GA - 14	11.0	5.9	11.8	7.4	6.2	4.5	4.0	103.3	18.3
GA - 15	10.9	5.9	12.0	7.9	4.4	3.7	3.6	104.0	11.7
GA - 16	12.9	6.0	13.5	8.1	4.6	4.4	4.0	142.5	16.4
GA - 17	12.1	7.8	13.6	8.4	6.2	4.9	3.9	127.1	17.9
GA - 18	11.2	5.2	12.5	7.6	6.2	4.0	4.6	116.2	17.3
GA - 19	12.3	6.9	12.6	8.6	6.4	-	-	124.3	-
GA - 20	13.3	5.6	13.6	8.5	6.0	5.4	4.8	148.7	24.9
GA - 21	12.1	8.2	13.6	8.6	5.5	4.4	3.8	129.7	18.4
GA - 22	11.9	4.4	12.5	7.9	5.8	5.0	4.3	121.8	18.9
GA - 23	9.9	5.5	11.4	5.1	6.0	3.4	3.6	92.2	13.8
GA - 24	9.5	4.6	10.0	6.6	5.3	-	-	73.5	-
GA - 25	10.5	3.9	11.6	7.3	5.5	4.1	3.4	100.6	12.7
GA - 26	12.8	6.8	14.0	9.9	6.0	4.2	4.0	147.0	24.1
GA - 27	11.3	4.8	11.2	6.2	5.3	4.0	4.2	98.9	16.5
GA - 28	13.9	5.6	13.7	7.8	5.4	-	-	141.3	-
GA - 29	11.7	6.0	14.4	9.2	6.7	4.7	4.6	133.5	20.2
GA - 30	12.9	4.6	11.9	7.9	5.3	5.0	3.7	118.8	19.0
GA - 31	12.5	5.1	13.2	8.0	5.3	4.2	4.4	130.6	16.2

Live measurements. *Ichthyobodo* cells (free-swimming form) from the skin of hatchery reared salmon fry and three-spined stickleback. The flagellates were measured under a light microscope equipped with an ocular scale. Cell dimensions (L1 = length, L2 = width) are given in µm.

Date	Salmon (fry)		*Ichthyobodo* dimensions	
	Length (cm)	Weight (g)	L1	L2
09 March 2000	3.4	0.3	12.5	-
09 March 2000	3.2	0.3	12.5	-
09 March 2000	3.6	0.4	15.0	-
n	3	3	3	0
Min	3.2	0.3	12.5	
Max	3.6	0.4	15.0	
Mean	3.4	0.3	13.3	
SD	0.2	0.0	1.4	

Date	Stickleback		*Ichthyobodo* dimensions	
	Length (cm)	Weight (g)	L1	L2
01 June 2001	4.6	-	13.0	-
01 June 2001	4.6	-	13.0	-
01 June 2001	4.6	-	14.3	-
01 June 2001	4.6	-	10.4	-
01 June 2001	4.6	-	10.4	-
01 June 2001	4.6	-	10.4	-
01 June 2001	4.6	-	10.4	-
01 June 2001	4.6	-	10.4	-
02 June 2001	4.7	-	14.3	9.1
02 June 2001	4.7	-	12.7	9.1
02 June 2001	4.7	-	14.3	13.0
02 June 2001	4.1	-	15.6	13.0
02 June 2001	4.1	-	11.7	9.1
02 June 2001	4.1	-	13.0	7.8
02 June 2001	4.6	-	12.7	7.8
n	15	0	15	7
Min	4.5		12.4	9.8
Max	4.1		10.4	7.8
Mean	4.7		15.6	13.0
SD	0.2		1.7	2.2

Vacuoles. Occurrence of vacuoles in free-swimming forms of *Ichthyobodo* in Diff-Quick® stained smears from skin or gills of different hosts (SS = *Salmo salar,* OM = *Oncorhynchus mykiss,* GA = *Gasterosteus aculeatus*). Vacuole no.1 (V1) is situated at the posterior end of the axostyle, while no.2 (V2) and no.3 (V3) are located in the area by the flagellar pocket and longitudinal groove respectively.

Ichthyobodo cell	No. of vacuoles observed	Position V1	V2	V3
SS skin - 1	2	x	x	-
SS skin - 2	1	x	-	-
SS skin - 3	2	x	x	-
SS skin - 4	1	x	-	-
SS skin - 5	3	x	x	x
SS skin - 6	1	x	-	-
SS skin - 7	2	x	x	-
SS skin - 8	2	x	x	-
SS skin - 9	2	x	x	-
SS skin - 10	2	x	x	-
SS skin - 11	1	x	-	-
SS skin - 12	1	x	-	-
SS skin - 13	1	x	-	-
SS skin - 14	2	x	x	-
SS skin - 15	2	x	x	-
SS skin - 16	1	x	-	-
SS skin - 17	2	x	x	-
SS skin - 18	1	x	-	-
SS skin - 19	2	x	x	-
SS skin - 20	2	x	x	-
SS skin - 21	2	x	x	-
SS skin - 22	1	x	-	-
SS skin - 23	2	x	x	-
SS skin - 24	2	x	x	-
SS skin - 25	2	x	x	-
SS skin - 26	1	x	-	-
SS skin - 27	1	x	-	-
SS skin - 28	1	x	-	-
SS skin - 29	1	x	-	-
SS skin - 30	1	x	-	-
SS skin - 31	1	x	-	-
SS skin - 32	1	-	x	-
SS skin - 33	1	x	-	-
SS skin - 34	1	x	-	-
SS skin - 35	2	x	x	-
SS skin - 36	2	x	x	-
SS skin - 37	3	x	x	x
SS skin - 38	3	x	x	x
SS skin - 39	3	x	x	x
SS skin - 40	2	x	x	-
SS skin - 41	1	x	-	-
SS skin - 42	2	x	x	-
SS skin - 43	1	x	-	-
SS skin - 44	1	x	-	-
SS skin - 45	2	x	x	-
SS skin - 46	1	x	-	-
SS skin - 47	2	x	x	-
SS skin - 48	2	x	-	x
SS skin - 49	1	x	-	-
SS skin - 50	1	x	-	-
SS skin - 51	2	x	x	-
SS skin - 52	2	x	-	x
SS skin - 53	2	x	x	-
SS skin - 54	1	x	-	-
SS skin - 55	3	x	-	x
SS skin - 56	2	x	x	-
SS skin - 57	2	x	x	-

Ichthyobodo	No. of vacuoles	Position V1	V2	V3
SS skin - 58	2	x	x	-
SS skin - 59	3	x	x	-
SS skin - 60	1	x	-	-
SS skin - 61	2	x	-	x
SS skin - 62	3	x	x	x
SS skin - 63	1	x	-	-
SS skin - 64	2	x	-	x
SS skin - 65	1	x	-	-
SS skin - 66	2	x	x	-
SS skin - 67	3	x	x	x
SS skin - 68	1	x	-	-
SS gill - 1	3	x	x	x
SS gill - 2	2	x	x	-
SS gill - 3	1	x	-	-
SS gill - 4	1	x	-	-
SS gill - 5	2	x	x	-
SS gill - 6	3	x	x	x
SS gill - 7	2	x	x	-
SS gill - 8	2	x	x	-
SS gill - 9	1	x	-	-
SS gill - 10	2	x	x	-
SS gill - 11	2	x	x	-
SS gill - 12	1	x	-	-
SS gill - 13	2	x	x	-
SS gill - 14	2	x	x	-
SS gill - 15	2	x	x	-
SS gill - 16	1	x	-	-
SS gill - 17	2	x	x	-
SS gill - 18	2	x	x	-
SS gill - 19	2	x	x	-
OM skin - 1	1	x	-	-
OM skin - 2	1	x	-	-
OM skin - 3	2	x	x	-
OM skin - 4	1	x	-	-
OM skin - 5	1	x	-	-
OM skin - 6	2	x	x	-
OM skin - 7	1	x	-	-
OM skin - 8	2	x	x	-
OM skin - 9	2	x	x	-
OM skin - 10	1	x	-	-
OM skin - 11	1	x	-	-
OM skin - 12	1	x	-	-
OM skin - 13	2	x	x	-
OM skin - 14	2	x	x	-
OM skin - 15	2	x	x	-
OM skin - 16	1	x	-	-
OM skin - 17	1	x	-	-
OM skin - 18	1	x	-	-
OM skin - 19	1	x	-	-
OM skin - 20	2	x	x	-
GA skin - 1	2	x	x	-
GA skin - 2	2	x	x	-
GA skin - 3	2	x	x	-
GA skin - 4	2	x	x	-
GA skin - 5	2	x	x	-
GA skin - 6	2	x	x	-

Kinetoplasts. Counts of kinetoplasts in free-swimming forms of *Ichthyobodo* in Diff-Quick® stained smears from skin or gills of different hosts (SS = *Salmo salar,* OM = *Oncorhynchus mykiss,* GA = *Gasterosteus aculeatus*).

Ichthyobodo cells	Numbers of kinetoplasts	*Ichthyobodo* cells	Numbers of kinetoplasts	*Ichthyobodo* cells	Numbers of kinetoplasts
SS skin - 1	84	SS skin - 53	62	OM skin - 8	49
SS skin - 2	65	SS skin - 54	43	OM skin - 9	60
SS skin - 3	86	SS skin - 55	54	OM skin - 10	51
SS skin - 4	81	SS skin - 56	43	OM skin - 11	39
SS skin - 5	88	SS skin - 57	52	OM skin - 12	51
SS skin - 6	60	SS skin - 58	97	OM skin - 13	62
SS skin - 7	59	SS skin - 59	72	OM skin - 14	66
SS skin - 8	84	SS skin - 60	54	OM skin - 15	40
SS skin - 9	59	SS skin - 61	47	OM skin - 16	59
SS skin - 10	54	SS skin - 62	61	OM skin - 17	57
SS skin - 11	54	SS skin - 63	54	OM skin - 18	72
SS skin - 12	54	SS skin - 64	90	OM skin - 19	53
SS skin - 13	57	SS skin - 65	72	OM skin - 20	54
SS skin - 14	58	SS gill - 1	39	OM skin - 21	50
SS skin - 15	70	SS gill - 2	47	OM skin - 22	57
SS skin - 16	60	SS gill - 3	41	OM skin - 23	49
SS skin - 17	55	SS gill - 4	46	OM skin - 24	51
SS skin - 18	65	SS gill - 5	49	OM skin - 25	76
SS skin - 19	60	SS gill - 6	54	OM skin - 26	60
SS skin - 20	90	SS gill - 7	46	OM skin - 27	52
SS skin - 21	64	SS gill - 8	39	OM skin - 28	41
SS skin - 22	65	SS gill - 9	53	OM skin - 29	53
SS skin - 23	82	SS gill - 10	30	OM skin - 30	67
SS skin - 24	48	SS gill - 11	46	OM skin - 31	47
SS skin - 25	79	SS gill - 12	63	OM skin - 32	51
SS skin - 26	76	SS gill - 13	37	OM skin - 33	58
SS skin - 27	93	SS gill - 14	79	OM skin - 34	64
SS skin - 28	58	SS gill - 15	79	OM skin - 35	45
SS skin - 29	47	SS gill - 16	43	OM skin - 36	47
SS skin - 30	47	SS gill - 17	43	OM skin - 37	62
SS skin - 31	69	SS gill - 18	44	OM skin - 38	48
SS skin - 32	64	SS gill - 19	47	GA skin - 1	44
SS skin - 33	55	SS gill - 20	43	GA skin - 2	49
SS skin - 34	61	SS gill - 21	38	GA skin - 3	66
SS skin - 35	53	SS gill - 22	55	GA skin - 4	43
SS skin - 36	47	SS gill - 23	58	GA skin - 5	64
SS skin - 37	116	SS gill - 24	51	GA skin - 6	58
SS skin - 38	59	SS gill - 25	51	GA skin - 7	55
SS skin - 39	57	SS gill - 26	70	GA skin - 8	36
SS skin - 40	58	SS gill - 27	40	GA skin - 9	36
SS skin - 41	104	SS gill - 28	51	GA skin - 10	38
SS skin - 42	47	SS gill - 29	47	GA skin - 11	26
SS skin - 43	63	SS gill - 30	52	GA skin - 12	71
SS skin - 44	43	SS gill - 31	41	GA skin - 13	68
SS skin - 45	104	SS gill - 32	44	GA skin - 14	46
SS skin - 46	67	OM skin - 1	48	GA skin - 15	45
SS skin - 47	59	OM skin - 2	40	GA skin - 16	55
SS skin - 48	48	OM skin - 3	58	GA skin - 17	30
SS skin - 49	77	OM skin - 4	48	GA skin - 18	78
SS skin - 50	76	OM skin - 5	59	GA skin - 19	66
SS skin - 51	89	OM skin - 6	85	GA skin - 20	41
SS skin - 52	39	OM skin - 7	62	GA skin - 21	93

Trichodina

Dimensions of *Trichodina*-cells from skin and gills of different hosts (SS = *Salmo salar,* ST = *Salmo trutta,* GA = *Gasterosteus aculeatus*) in freshwater. Salmon marked with an asterisk (*) is hatchery reared, the other hosts are wild caught fish. Dimensions are given as diameters (in µm) of the adhesive disc (AD) and denticulate ring (DR), and numbers of denticles (D) and radial pins per denticle (RP). All measurements of *Trichodina*-cells are of 2D images from smears stained with Diff-Quick® (DQ) or impregnated with silvernitrate (Klein's method).

***Trichodina* cells**	**Dimensions**				**Staining/ impregnation**
	AD	DR	D	RP	
SS skin* - 1	38.8	32.2	26	10	Silvernitrate
SS skin* - 2	55.7	-	-	-	Silvernitrate
SS skin* - 3	47.7	34.8	26	10	Silvernitrate
SS skin* - 4	42.1	30.8	27	10	Silvernitrate
SS skin* - 5	49.0	-	-	-	Silvernitrate
SS skin* - 12	59.3	23.7	-	-	DQ
SS skin* - 13	47.4	31.6	25	-	DQ
SS skin* - 14	57.5	35.0	-	-	DQ
SS skin* - 15	57.5	35.0	27	-	DQ
SS skin - 1	43.9	28.7	27	-	DQ
SS skin - 2	50.1	28.7	25	-	DQ
SS skin - 3	50.6	28.7	25	-	DQ
SS skin - 4	49.7	29.1	-	-	DQ
SS skin - 5	49.7	29.6	25	-	DQ
SS skin - 6	54.4	32.0	26	-	DQ
SS skin - 7	43.9	24.8	-	-	DQ
SS skin - 8	46.8	28.2	26	-	DQ
SS skin - 9	52.5	30.6	24	-	DQ
SS skin - 10	47.8	30.1	28	-	DQ
SS skin - 11	52.5	32.0	27	-	DQ
SS skin - 12	56.3	35.3	27	-	DQ
SS skin - 13	46.8	30.6	-	-	DQ
SS skin - 14	48.7	31.0	27	-	DQ
SS skin - 15	58.3	33.4	26	-	DQ
SS skin - 16	47.8	30.1	27	-	DQ
SS skin - 17	50.1	30.6	27	-	DQ
ST skin - 1	32.4	51.9	27	11	DQ
ST skin - 2	32.4	50.0	26	-	DQ
ST skin - 3	33.3	51.4	27	10	DQ
ST skin - 4	35.2	-	27	10	DQ
ST skin - 5	35.2	55.7	25	10	DQ
ST skin - 6	34.8	55.7	26	10	DQ
ST skin - 7	30.0	50.5	27	-	DQ
ST skin - 8	37.7	56.4	26	11	DQ
ST skin - 9	36.8	57.9	27	-	DQ
ST skin - 10	39.7	60.0	-	-	DQ
ST skin - 11	33.8	52.8	26	10	DQ
ST skin - 12	32.0	59.1	-	-	DQ
ST skin - 13	38.6	59.2	25	10	DQ
ST skin - 14	29.4	48.9	-	-	DQ
ST skin - 15	29.6	48.5	27	-	DQ
ST skin - 16	36.6	58.5	25	-	DQ
ST skin - 17	33.6	54.5	27	10	DQ
ST skin - 18	29.6	48.5	27	-	DQ
ST skin - 19	36.6	58.5	25	-	DQ
GA skin - 1	41.5	26.3	20	-	Silvernitrate
GA skin - 2	39.7	24.5	20	-	Silvernitrate
GA skin - 3	52.9	31.3	22	10	Silvernitrate
GA skin - 4	44.9	27.9	20	-	Silvernitrate
GA skin - 5	40.3	25.2	20	-	Silvernitrate
GA skin - 6	47.8	29.4	22	-	Silvernitrate
GA skin - 7	39.2	25.4	22	-	Silvernitrate
GA skin - 8	47.4	30.9	22	-	Silvernitrate
GA skin - 9	47.3	29.2	20	-	Silvernitrate
GA skin - 10	40.9	26.8	23	-	Silvernitrate
GA skin - 11	46.7	28.8	-	-	Silvernitrate
GA skin - 12	42.5	27.6	-	-	Silvernitrate
GA skin - 13	43.9	29.3	-	-	Silvernitrate
GA skin - 14	38.6	24.8	22	-	Silvernitrate
GA skin - 15	46.4	29.8	21	10	Silvernitrate
GA skin - 16	48.0	29.1	21	9	Silvernitrate
GA skin - 17	46.2	30.8	22	-	Silvernitrate
GA skin - 18	39.0	24.2	21	-	Silvernitrate
GA skin - 19	47.8	28.8	19	-	Silvernitrate
GA skin - 20	40.5	23.8	21	-	Silvernitrate
GA skin - 21	50.6	30.3	-	-	Silvernitrate
GA skin - 22	47.6	29.6	19	-	Silvernitrate
GA skin - 23	47.1	28.1	22	10	Silvernitrate
GA skin - 24	47.1	28.1	22	-	Silvernitrate
GA skin - 25	47.5	28.1	22	-	Silvernitrate
GA skin - 26	44.5	25.9	20	-	Silvernitrate
GA skin - 27	45.5	26.8	23	-	Silvernitrate
GA skin - 28	49.2	31.0	21	-	Silvernitrate
GA skin - 29	52.0	29.5	20	-	Silvernitrate
GA gill - 1	26.8	43.8	20	-	Silvernitrate
GA gill - 2	24.8	38.5	20	-	Silvernitrate
GA gill - 3	24.8	39.4	21	9	Silvernitrate
GA gill - 4	28.9	47.1	22	10	Silvernitrate
GA gill - 5	30.6	47.7	30	8	Silvernitrate
GA gill - 6	35.0	53.4	30	-	Silvernitrate
GA gill - 7	36.5	59.5	35	-	Silvernitrate
GA gill - 8	42.1	64.9	35	-	Silvernitrate

Apiosoma

Measurements of *Apiosoma* cells in smears from skin and gills of different hosts in freshwater. Salmon (SS, *Salmo salar*) is hatchery reared, while brown trout (ST, *Salmo trutta*) and three-spined sticklebacks (GA, *Gasterosteus aculeatus*) are wild caught. All measurements are of 2D images from stained smears. Skin smears from salmon were stained with haematoxylin and eosin, while smears from brown trout and sticklebacks were stained with Diff-Quick®. Cell dimensions (lengths, L1-L10) are given in µm. **L1:** Total length of the cell. **L2:** Maximum width. **L3**: Size of scopula. **L4** and **L5**: Position of macronucleus and micronucleus. **L6** and **L7**: Size of macronucleus. **L8** and **L9**: Size of micronucleus. **L10**: Distance between pectinellar wreath and scopula.

***Apiosoma* cells**	**Dimensions.**									
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
SS skin - 1	55.6	27.9	12.0	30.1	-	17.2	14.0	-	-	38.0
SS skin - 2	54.2	27.6	9.9	30.0	-	14.3	13.2	-	-	-
SS skin - 3	61.6	29.4	13.2	34.5	-	21.3	18.9	-	-	42.9
SS skin - 4	56.1	24.5	9.0	31.2	-	19.3	13.9	-	-	34.3
SS skin - 5	55.7	29.0	9.7	28.8	-	18.8	14.6	-	-	36.6
SS skin - 6	57.1	27.6	9.9	31.1	-	17.2	15.7	-	-	31.5
SS skin - 7	52.5	28.2	10.5	22.9	-	13.3	11.9	-	-	34.1
SS skin - 8	50.5	23.1	9.3	29.9	-	19.3	13.5	-	-	31.9
SS skin - 9	46.7	-	8.3	26.3	-	18.6	10.8	-	-	-
SS skin - 10	51.1	20.3	7.3	28.7	-	18.2	11.7	-	-	-
SS skin - 11	42.6	18.2	7.6	23.7	-	15.8	13.6	-	-	28.4
SS skin - 12	42.6	18.4	8.1	25.3	-	16.1	12.2	-	-	28.4
SS skin - 13	55.2	24.4	8.7	29.5	-	18.4	13.1	-	-	34.9
SS skin - 14	58.6	28.3	8.9	31.2	-	18.9	15.4	-	-	36.9
SS skin - 15	39.6	18.0	7.3	21.1	-	16.0	12.9	-	-	24.5
SS skin - 16	63.0	31.4	12.0	-	-	-	-	-	-	41.5
SS skin - 17	51.1	21.1	8.0	28.5	-	17.6	11.5	-	-	30.5
SS skin - 18	48.9	22.0	6.9	-	26.5	14.2	10.0	-	-	31.7
SS skin - 19	40.8	19.3	4.4	22.8	-	13.9	10.3	-	-	-
SS skin - 20	47.0	25.3	8.7	24.5	-	17.2	11.7	-	-	25.6
SS skin - 21	55.3	28.2	9.4	28.0	-	19.6	17.9	-	-	33.8
SS skin - 22	45.6	24.8	10.0	24.7	-	16.5	13.4	-	-	31.6
SS skin - 23	52.5	24.2	8.4	30.0	-	17.4	12.4	-	-	33.8
SS skin - 24	50.8	23.9	7.7	25.5	-	16.6	15.1	-	-	33.1
SS skin - 25	53.7	30.5	12.5	27.1	-	17.5	16.2	-	-	33.4
SS skin - 26	61.6	36.1	22.6	30.7	27.3	17.1	14.5	3.3	2.4	36.8
SS skin - 27	46.5	25.7	8.0	23.8	-	14.8	13.2	-	-	29.0
SS skin - 28	52.1	26.4	8.5	26.6	-	16.4	11.9	-	-	33.5
SS skin - 29	52.1	30.2	14.2	30.6	-	19.8	18.2	-	-	34.5
SS skin - 30	56.4	30.3	15.4	29.2	-	19.0	14.8	-	-	35.5
SS skin - 31	51.2	29.4	14.2	30.0	-	17.6	12.8	-	-	34.0
ST skin - 1	53.9	28.9	9.7	30.4	25.6	19.2	15.1	-	-	34.3
ST skin - 2	64.8	34.1	11.7	31.2	21.6	24.8	19.2	-	-	37.3
ST skin - 3	84.9	31.7	10.3	47.9	39.6	23.5	18.9	-	-	56.4
ST skin - 4	56.2	21.2	5.9	31.7	-	17.9	11.5	-	-	38.6
ST skin - 5	97.6	37.7	14.8	61.7	67.9	27.3	22.9	2.7	6.4	69.3
ST skin - 6	61.6	22.7	11.3	35.3	25.8	22.9	15.0	-	-	40.8
ST skin - 7	70.2	36.0	13.0	41.2	23.9	30.4	22.0	-	-	44.8
ST skin - 8	65.1	29.4	11.9	32.9	26.2	24.9	18.5	-	-	40.7
ST skin - 9	78.4	37.6	15.4	44.8	35.5	28.9	21.1	5.3	3.3	49.5
ST skin - 10	55.9	24.4	8.9	35.1	24.8	18.8	15.4	4.0	2.7	39.2
ST skin - 11	61.6	35.8	11.7	30.7	26.8	22.0	18.7	4.9	-	-
ST skin - 12	61.6	31.7	12.7	31.9	24.3	24.6	16.3	5.1	2.5	37.4
ST skin - 13	68.2	40.9	19.5	34.5	25.3	33.8	20.5	-	-	38.0
ST skin - 14	65.0	32.7	12.4	29.5	-	23.8	21.0	-	-	34.0
ST skin - 15	70.9	33.1	9.3	38.7	-	23.8	23.0	-	-	45.8
ST skin - 16	54.9	32.6	8.7	22.8	14.6	18.8	18.4	4.2	-	29.9
ST skin - 17	60.2	35.8	10.1	27.3	20.2	22.4	19.9	-	-	34.5
ST skin - 18	68.8	37.4	-	30.2	23.2	23.1	17.3	-	-	36.6
ST skin - 19	78.1	41.8	12.9	38.1	-	30.3	24.4	-	-	47.3
ST skin - 20	70.6	30.1	12.8	37.3	-	24.3	23.6	-	-	39.5
ST skin - 21	60.6	34.8	10.2	29.2	-	25.4	20.3	-	-	36.4
ST skin - 22	64.1	34.6	9.1	29.6	-	25.5	21.4	-	-	34.9
GA gill - 1	58.7	36.4	12.0	22.2	11.0	20.5	18.2	2.6	2.3	32.6
GA gill - 2	64.8	36.0	14.3	25.2	15.6	21.1	21.3	3.4	2.8	34.0
GA gill - 3	72.6	35.4	11.8	28.2	16.3	18.7	19.0	2.9	2.3	38.2
GA gill - 4	71.6	35.7	10.4	31.7	21.7	-	-	-	-	33.8
GA gill - 5	63.5	34.7	9.9	24.7	25.1	18.6	17.4	-	-	35.1
GA gill - 6	53.9	32.0	7.8	19.6	11.7	13.8	16.4	-	-	25.8
GA gill - 7	79.0	33.7	7.5	36.1	24.4	16.4	17.7	2.9	3.4	42.4
GA gill - 8	54.1	38.0	20.9	19.9	11.5	21.8	20.5	-	-	28.6
GA gill - 9	55.2	37.7	15.9	20.4	11.5	16.3	20.5	-	-	27.6
GA gill - 10	58.8	37.3	8.9	17.6	10.0	14.3	17.6	-	-	23.9
GA gill - 11	73.1	35.7	9.5	28.0	18.2	20.4	21.0	-	-	36.7
GA gill - 12	56.1	33.5	7.9	17.9	7.2	17.3	16.2	-	-	28.4
GA gill - 13	52.2	40.8	15.0	16.5	9.2	17.1	21.3	-	-	24.2
GA skin - 1	44.1	33.2	10.4	14.9	6.7	14.4	22.0	2.2	2.7	-
GA skin - 2	35.8	26.0	7.5	9.9	1.6	14.0	16.1	-	-	21.4
GA skin - 3	35.6	25.4	6.6	11.4	4.2	11.7	16.4	-	-	15.5
GA skin - 4	50.6	39.3	23.5	15.8	5.9	23.9	21.2	3.8	-	32.7
GA skin - 5	57.4	37.9	16.1	21.2	10.2	21.9	26.0	6.1	-	29.4
GA skin - 6	39.2	29.8	15.4	13.1	6.3	11.0	20.6	-	-	20.6
GA skin - 7	39.0	33.2	9.2	13.9	5.2	14.3	15.3	-	-	23.5
GA skin - 8	45.5	38.9	19.6	18.1	11.2	14.3	22.0	2.6	3.5	26.6
GA skin - 9	44.6	36.3	9.0	16.9	-	12.1	18.6	-	-	23.4
GA skin - 10	44.3	33.2	10.7	15.4	6.4	14.4	16.1	2.2	1.8	22.7
GA skin - 11	60.9	44.7	13.7	20.8	-	20.5	23.8	-	-	32.5

Live measurements. *Apiosoma* cells from the skin of hatchery-reared salmon. The ciliates were measured under a light microscope equipped with an ocular scale. All cell dimensions (L1-L3) are given in µm. **L1:** Total length of the cell (measured from scopula to epistomial disc). **L2:** Maximum body width. **L3:** Size of the scopula. Dimensions are given in range of minimum-maximum and mean ± standard deviation (SD).

Date	Host (salmon)		*Apiosoma* cells	*Apiosoma* dimensions		
	Length (cm)	Weight (g)		L1	L2	L3
02 July 2000	13.3	25.0	SS1	70.0	27.5	-
02 July 2000	14.3	29.4	SS3	51.0	23.3	7.5
02 July 2000	14.3	29.4	SS2	63.2	31.6	11.9
02 July 2000	14.8	38.9	SS4	51.7	23.7	7.9
17 July 2000	10.5	12.2	SS5	51.4	19.8	-
17 July 2000	10.0	10.4	SS6	55.0	20.0	-
17 July 2000	12.3	20.7	SS7	63.2	27.7	-
n	7	7		7	7	3
Min	10.0	10.4		51.4	19.8	7.9
Max	14.8	38.9		70.0	31.6	11.9
Mean	12.8	23.7		57.9	24.8	9.2
SD	1.9	10.1		7.5	4.3	2.3

Riboscyphidia

Measurements of *Riboscyphidia* cells in smears from skin of hatchery reared salmon (SS), and wild caught brown trout (ST). All measurements are of 2D images from stained smears. Skin smears from salmon were stained with haematoxylin and eosin, while smears from brown trout were stained with Diff-Quick®. Cell dimensions (lengths, L1-L6) are given in µm. **L1:** Total length of the cell measured from scopula to epistomial disc. **L2:** Maximum body width. **L3:** Width of scopula. **L4:** Position of macronucleus as distance from scopula to centre of the nucleus. **L5:** Length of one "arm" of the macronucleus. **L6:** Position of infundibulum as distance from scopula to the lower part of infundibulum.

Riboscyphidia	Dimensions					
cells	L1	L2	L3	L4	L5	L6
SS1-1	42.4	40.2	21.2	11.9	-	26.8
SS1-2	36.8	48.0	27.8	10.0	-	20.2
SS1-3	36.4	39.9	-	7.3	-	18.7
SS1-4	38.6	32.9	27.3	8.8	16.6	26.0
SS1-5	30.8	25.7	22.9	10.2	-	-
SS1-6	36.5	35.4	23.4	7.8	-	-
SS1-7	32.3	30.7	13.9	12.3	-	-
SS1-8	28.1	32.8	14.6	13.6	12.5	-
SS1-9	40.8	40.5	23.0	19.5	16.4	26.0
SS1-10	40.2	39.6	29.7	8.2	-	24.1
SS1-11	46.1	51.2	37.6	18.4	-	30.2
SS1-12	50.1	46.8	33.9	22.9	-	28.5
SS1-13	46.2	53.7	38.8	24.1	-	30.4
SS1-14	35.0	40.2	35.3	10.1	-	18.4
SS1-15	49.3	44.0	30.6	15.9	18.5	-
SS1-16	49.6	43.0	35.4	20.9	14.5	35.0
SS1-17	39.0	29.8	15.6	18.7	14.3	28.5
SS1-18	32.5	34.8	16.1	6.3	-	-
SS1-19	51.5	44.8	27.5	9.5	-	33.4
SS1-20	48.2	36.3	29.8	13.0	-	32.4
SS1-21	48.4	47.4	25.0	17.4	-	30.4
SS1-22	40.0	38.3	22.2	15.3	-	23.9
SS1-23	36.3	35.7	23.1	8.8	-	-
SS1-24	39.0	39.2	27.1	14.8	-	26.4
SS1-25	47.5	34.2	17.1	17.0	-	38.6
SS1-26	43.9	41.4	29.7	14.3	16.1	31.8
SS1-27	45.2	42.4	33.7	10.5	-	28.8
SS1-28	38.6	47.3	29.7	18.2	17.8	28.5
SS2-1	40.9	37.9	29.8	19.0	-	26.1
SS2-2	49.7	43.7	35.7	16.3	-	-
ST1-1	49.6	40.2	33.0	9.1	16.0	-
ST1-2	42.1	36.1	27.7	13.1	14.5	21.4
ST1-3	42.1	39.3	19.9	16.9	-	-
ST1-4	52.1	41.3	28.7	-	-	-
ST1-5	47.5	44.1	38.0	8.2	-	24.6
ST1-6	60.2	50.2	30.5	23.7	-	-
ST1-7	42.3	35.8	26.3	-	-	-
ST1-8	30.6	36.0	21.9	11.1	16.9	18.7
ST1-9	43.2	47.0	37.0	20.3	-	21.7
ST1-10	41.7	40.5	20.5	20.1	18.0	-
ST1-11	45.0	39.1	29.4	13.7	15.8	-
ST1-12	45.7	44.8	30.8	12.4	-	24.5
ST1-13	49.1	37.8	32.9	16.6	-	-
ST1-14	45.8	40.2	27.3	18.5	-	-
ST1-15	37.0	37.0	27.1	12.1	-	16.3
ST1-16	44.2	48.6	40.7	12.8	-	18.5
ST1-17	43.9	45.5	40.5	12.6	-	21.2
ST1-18	34.2	42.4	33.4	9.7	-	-
ST2-1	46.8	39.9	29.1	13.8	24.6	-
ST2-2	49.4	42.1	29.4	-	-	-
ST2-3	39.4	41.0	27.9	7.7	16.1	-

Live measurements. *Riboscyphidia* cells from the skin of net-pen reared salmon (28 September 2000). The ciliates were measured under a light microscope equipped with an ocular scale. **L1:** Total length of the cell (measured from scopula to epistomial disc). **L2:** Maximum body width. **L3:** Size of the scopula.

	Host (salmon)		***Riboscyphidia***	***Riboscyphidia* dimensions**		
	Length (cm)	Weight (g)	**cells**	L1 (µm)	L2 (µm)	L3 (µm)
	13.1	21.2	SS1	47.5	35.0	25.0
	13.1	21.2	SS2	50.0	31.3	20.0
	13.1	21.2	SS3	27.5	27.5	20.0
	13.1	21.2	SS4	45.0	37.5	20.0
	13.1	21.2	SS5	40.0	32.5	25.0
	23.8	161.9	SS6	42.5	27.5	25.0
	23.8	161.9	SS7	40.0	27.5	20.0
	19.3	77.7	SS8	55.0	37.5	30.0
	22.4	130.7	SS9	37.5	27.5	22.5
	22.4	130.7	SS10	37.5	35.0	35.0
	18.7	75.1	SS11	37.5	30.0	25.0
	21.7	111.0	SS12	40.0	27.5	25.0
	22.0	120.9	SS13	37.5	30.0	32.5
	22.0	120.9	SS14	37.5	32.5	25.0
	22.0	120.9	SS15	45.0	40.0	37.5
	15.4	40.4	SS16	37.5	35.0	27.5
	21.6	117.2	SS17	42.5	30.0	22.5
	16.4	46.1	SS18	47.5	32.5	27.5
n	18	18		18	18	18
Min.	13.1	21.2		27.5	27.5	20.0
Max.	23.8	161.9		55.0	40.0	37.5
Mean	18.7	84.5		41.5	32.0	25.8
SD	4.2	51.8		6.2	4.0	5.1

Capriniana

Live measurements of *Capriniana* cells from the gills of hatchery-reared salmon. The ciliates were measured under a light microscope equipped with an ocular scale. Cell dimensions are measured as maximum length (exclusive of tentacles) and width.

Date	Host (salmon)		*Capriniana* cells	*Capriniana* dimensions	
	Length (cm)	Weight (g)		Length (µm)	Width (µm)
15 June 2000	7.5	4.12	SS-1	71.1	31.6
15 June 2000	12.8	24.3	SS-2	79.0	63.2
15 June 2000	11.0	15.5	SS-3	71.1	47.4
15 June 2000	12.7	23.2	SS-4	71.1	47.4
15 June 2000	11.9	18.5	SS-5	63.2	47.4
15 June 2000	10.5	12.1	SS-6	63.2	-
01 July 2000	11.5	17.8	SS-7	90.9	75.1
01 July 2000	11.5	17.8	SS-8	79.0	63.2
01 July 2000	10.0	12.0	SS-9	79.0	35.6
01 July 2000	11.2	15.2	SS-10	55.3	39.5
01 July 2000	11.3	14.6	SS-11	79.0	59.3
01 July 2000	11.3	14.6	SS-12	63.2	59.3
01 July 2000	8.4	6.1	SS-13	98.8	59.3
01 July 2000	8.4	6.1	SS-14	39.5	43.5
01 July 2000	14.1	32.3	SS-15	31.6	23.7
01 July 2000	14.0	33.1	SS-16	43.5	21.7
01 July 2000	11.7	16.8	SS-17	98.8	27.7
01 July 2000	13.9	28.9	SS-18	51.4	31.6
01 July 2000	13.9	28.9	SS-19	75.1	43.5
01 July 2000	12.3	20.0	SS-20	90.9	59.3
01 July 2000	12.3	20.0	SS-21	94.8	55.3
01 July 2000	12.3	20.0	SS-22	79.0	55.3
01 July 2000	12.1	19.6	SS-23	67.2	43.5
01 July 2000	13.3	25.0	SS-24	70.0	50.0
19 July 2000	13.7	30.4	SS-25	50.0	40.0
19 July 2000	15.5	41.3	SS-26	77.5	37.5
n	26	26		26	25
Min	7.5	4.1		31.6	21.7
Max	15.5	41.3		98.8	75.1
Mean	11.9	19.9		70.5	46.4
SD	1.9	8.9		17.7	13.6

APPENDIX D. Wild fish

Protozoan ectosymbionts (genera) observed on wild fish caught in Sævareid watercourse in the period March 2000 – October 2001. Protozoan symbionts observed or not observed are denoted as "1" and "0" respectively.

	Hosts			*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*		*Epistylis*	
Date	Species	Length (cm)	Weight (g)	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
26 Mar 2000	*O. mykiss*	23.0	122	0	0	0	0	0	0	0	0	0	0	0	0
26 Mar 2000	*O. mykiss*	23.0	111	0	0	0	0	0	0	0	0	0	0	0	0
26 Mar 2000	*O. mykiss*	23.4	114	0	0	0	0	0	0	0	0	0	0	0	0
26 Mar 2000	*O. mykiss*	23.3	125	0	0	0	0	0	0	0	0	0	0	0	0
26 Mar 2000	*O. mykiss*	24.1	120	0	0	0	0	0	0	1	0	0	0	0	0
26 Mar 2000	*O. mykiss*	23.0	131	0	0	0	0	0	0	0	0	0	0	0	0
26 Mar 2000	*O. mykiss*	22.6	113	0	0	0	0	0	0	0	0	0	0	0	0
26 Mar 2000	*O. mykiss*	25.6	189	0	0	0	0	0	0	0	0	0	0	0	0
26 Mar 2000	*O. mykiss*	22.2	90	0	0	0	0	1	0	0	0	0	0	0	0
26 Mar 2000	*O. mykiss*	25.0	195	0	0	0	0	0	0	0	0	0	0	0	0
26 Mar 2000	*S. salar*	24.1	141	0	0	0	0	0	0	1	0	0	0	0	0
26 Mar 2000	*S. salar*	29.1	177	0	0	0	0	0	0	0	0	0	0	0	0
26 Mar 2000	*S. salar*	27.3	200	0	0	0	0	0	0	1	0	0	0	0	0
26 Mar 2000	*S. salar*	31.2	267	0	0	0	0	0	0	1	0	0	0	0	0
26 Mar 2000	*S. salar*	27.9	179	0	0	1	0	0	0	1	0	0	0	0	0
26 Mar 2000	*S. salar*	27.0	159	0	0	0	0	1	0	0	0	0	0	0	0
26 Mar 2000	*S. salar*	24.5	140	0	0	0	0	0	0	1	0	0	0	0	0
26 Mar 2000	*S. salar*	25.1	170	0	0	0	0	0	0	0	0	0	0	0	0
26 Mar 2000	*S. salar*	25.0	125	0	0	0	0	0	0	1	0	0	0	0	0
26 Mar 2000	*S. salar*	29.0	236	0	0	1	0	0	0	0	0	0	0	0	0
26 Mar 2000	*S. trutta*	24.7	142	0	0	0	0	0	0	0	0	0	0	0	0
26 Mar 2000	*S. trutta*	26.3	161	0	0	0	0	1	0	0	0	0	0	0	0
26 Mar 2000	*S. trutta*	26.0	163	0	0	0	0	0	0	0	0	0	0	0	0
26 Mar 2000	*S. trutta*	27.2	199	0	0	0	0	1	0	0	0	0	0	0	0
26 Mar 2000	*S. trutta*	26.3	168	0	0	0	0	0	0	0	0	0	0	0	0
26 Mar 2000	*S. trutta*	24.0	132	0	0	0	0	0	0	1	0	1	0	0	0
26 Mar 2000	*S. trutta*	28.8	188	0	0	0	0	0	0	1	0	0	0	0	0
26 Mar 2000	*S. trutta*	27.9	189	0	0	0	0	0	0	1	0	0	0	0	0
26 Mar 2000	*S. trutta*	29.0	209	0	0	0	0	1	0	1	0	0	0	0	0
26 Mar 2000	*S. trutta*	25.8	152	0	0	0	0	0	0	0	0	0	0	0	0
26 Mar 2000	*S. trutta*	26.3	170	0	0	0	0	0	0	0	0	0	0	0	0
26 Mar 2000	*S. alpinus*	-	139	0	0	0	0	0	0	0	0	0	0	0	0
26 Mar 2000	*S. alpinus*	-	190	0	0	0	0	0	0	0	0	0	0	0	0
8 Apr 2000	*O. mykiss*	21.4	97	0	0	0	0	0	0	0	0	0	0	0	0
8 Apr 2000	*O. mykiss*	22.7	113	0	0	0	0	0	0	0	0	0	0	0	0
8 Apr 2000	*O. mykiss*	27.2	174	0	0	0	0	0	0	0	0	0	0	0	0
8 Apr 2000	*O. mykiss*	23.0	116	0	0	0	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. salar*	25.4	145	0	0	0	0	0	0	1	0	0	0	0	0
8 Apr 2000	*S. salar*	28.5	205	0	0	1	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. salar*	27.0	190	0	0	0	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. salar*	25.7	136	0	0	0	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. salar*	32.3	255	0	0	1	0	0	0	1	0	0	0	0	0
8 Apr 2000	*S. salar*	31.0	256	0	0	1	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. salar*	30.5	266	0	0	1	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. salar*	26.3	142	0	0	1	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. salar*	24.5	115	0	0	0	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. salar*	25.0	121	0	0	1	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. salar*	31.0	336	0	0	1	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. salar*	24.5	121	0	0	1	0	0	0	1	0	0	0	0	0
8 Apr 2000	*S. salar*	27.6	153	0	0	0	0	0	0	1	0	0	0	0	0
8 Apr 2000	*S. salar*	27.4	139	0	0	0	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. salar*	28.0	233	0	0	0	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. salar*	24.2	132	0	0	0	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. salar*	26.4	166	0	0	1	0	0	0	0	0	0	0	0	0

Date	Hosts			*Ichthyobodo*		*Trichodina*		*Apiosoma*		*Riboscyphidia*		*Capriniana*		*Epistylis*	
	Species	Length (cm)	Weight (g)	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
8 Apr 2000	*S. salar*	22.5	113	0	0	0	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. trutta*	26.3	171	0	0	0	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. trutta*	26.7	188	0	0	0	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. trutta*	27.0	169	0	0	0	0	1	0	1	0	0	0	0	0
8 Apr 2000	*S. alpinus*	30.3	205	0	0	0	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. alpinus*	27.0	170	0	0	0	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. alpinus*	28.2	190	0	0	0	0	0	0	0	0	0	0	0	0
8 Apr 2000	*S. alpinus*	28.6	194	0	0	0	0	0	0	0	0	0	0	0	0
3 Nov 2000	*G. aculeatus*	-	-	0	0	1	1	0	1	0	0	0	0	0	0
3 Nov 2000	*G. aculeatus*	-	-	0	0	1	1	0	1	0	0	0	0	0	0
3 Nov 2000	*G. aculeatus*	-	-	0	0	1	0	0	1	0	0	0	0	1	0
3 Nov 2000	*G. aculeatus*	-	-	0	0	0	0	0	1	0	0	0	0	0	0
3 Nov 2000	*G. aculeatus*	-	-	0	0	1	1	0	1	0	0	0	0	0	0
3 Nov 2000	*G. aculeatus*	-	-	0	0	1	0	1	1	0	0	0	0	0	0
3 Nov 2000	*G. aculeatus*	-	-	0	0	1	1	1	1	0	0	0	0	0	0
3 Nov 2000	*G. aculeatus*	-	-	0	0	1	1	1	1	0	0	0	0	0	0
3 Nov 2000	*G. aculeatus*	-	-	0	0	1	0	1	1	0	0	0	0	0	0
3 Nov 2000	*G. aculeatus*	-	-	0	0	1	1	0	1	0	0	0	0	0	0
1 Jun 2001	*G. aculeatus*	3.3	-	0	0	1	1	1	1	0	0	0	0	0	1
1 Jun 2001	*G. aculeatus*	3.9	-	0	0	1	1	1	1	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	4.5	-	1	0	1	0	1	0	0	0	0	0	0	0
1 Jun 2001	*G. aculeatus*	4.3	-	0	0	1	0	0	1	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	4.5	-	0	1	1	1	1	1	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	4.6	-	0	0	1	1	1	1	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	3.8	-	1	0	1	1	0	1	0	0	0	0	1	0
1 Jun 2001	*G. aculeatus*	3.9	-	1	1	1	1	0	1	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	4.8	-	1	0	1	1	1	1	0	0	0	0	0	1
1 Jun 2001	*G. aculeatus*	4.0	-	1	0	1	1	0	1	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	4.5	-	1	0	1	1	1	1	0	0	0	0	0	1
1 Jun 2001	*G. aculeatus*	4.8	-	0	0	1	0	0	1	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	4.6	-	1	0	1	1	0	1	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	4.9	-	1	0	1	1	0	1	0	0	0	0	1	0
1 Jun 2001	*G. aculeatus*	4.6	-	1	1	1	1	0	1	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	3.9	-	1	0	1	1	1	1	0	0	0	0	0	0
1 Jun 2001	*G. aculeatus*	-	-	1	1	1	1	0	1	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	3.3	-	1	0	1	1	1	1	0	0	0	0	1	0
1 Jun 2001	*G. aculeatus*	4.3	-	1	0	1	1	1	1	0	0	0	0	0	0
1 Jun 2001	*G. aculeatus*	4.7	-	0	0	1	1	0	0	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	4.6	-	0	0	1	1	1	1	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	4.7	-	1	0	1	1	0	1	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	4.1	-	1	0	1	1	1	1	0	0	0	0	1	0
1 Jun 2001	*G. aculeatus*	4.5	-	0	1	1	0	1	1	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	4.5	-	1	0	1	1	0	1	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	4.3	-	1	1	1	1	1	1	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	3.6	-	1	0	1	1	1	1	0	0	0	0	0	0
1 Jun 2001	*G. aculeatus*	4.0	-	1	0	1	1	1	1	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	4.6	-	1	1	1	1	0	1	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	3.7	-	0	0	1	1	1	1	0	0	0	0	1	1
1 Jun 2001	*G. aculeatus*	4.7	-	1	0	1	1	0	1	0	0	0	0	1	1
1 Jun 2001	*O. mykiss*	28.6	244	0	0	0	0	0	0	0	0	0	0	0	0
1 Jun 2001	*S. trutta*	21.3	94	0	0	1	0	1	0	1	0	0	0	0	0
1 Jun 2001	*S. trutta*	28.5	219	0	0	0	0	1	0	0	0	0	0	0	0
1 Jun 2001	*S. trutta*	22.1	94	1	0	0	0	0	0	1	0	0	0	0	0
1 Jun 2001	*S. trutta*	27.5	180	0	0	0	0	1	0	1	0	0	1	0	0
1 Jun 2001	*S. trutta*	28.2	213	0	0	0	0	1	0	1	0	0	0	0	0
1 Jun 2001	*S. trutta*	30.4	232	1	0	0	0	1	0	1	0	0	1	0	0
1 Jun 2001	*S. trutta*	24.0	138	0	0	0	0	1	0	1	0	0	1	0	0
1 Jun 2001	*S. trutta*	31.7	290	0	0	0	0	0	0	1	0	0	1	0	0
1 Jun 2001	*S. trutta*	35.2	364	1	0	0	0	1	0	1	0	0	1	0	0
1 Jun 2001	*S. trutta*	25.2	145	0	0	0	0	1	0	1	0	0	0	0	0

	Hosts			***Ichthyobodo***		***Trichodina***		***Apiosoma***		***Riboscyphidia***		***Capriniana***		***Epistylis***	
Date	Species	Length (cm)	Weight (g)	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill	Skin	Gill
12 Jun 2001	*S. trutta*	28.3	211	0	0	0	0	1	0	1	0	0	1	0	0
12 Jun 2001	*S. trutta*	28.4	203	0	0	0	0	1	0	1	0	0	1	0	0
12 Jun 2001	*S. trutta*	30.9	264	0	0	0	0	1	0	1	0	0	0	0	0
12 Jun 2001	*S. trutta*	24.9	141	0	0	1	0	1	0	1	0	0	0	0	0
12 Jun 2001	*S. trutta*	27.0	181	1	0	0	0	1	0	1	0	0	0	0	0
18 Oct 2001	*G. aculeatus*	3.6	-	0	0	1	1	0	1	0	0	0	0	0	1
18 Oct 2001	*G. aculeatus*	2.5	-	0	0	1	1	0	1	0	0	0	0	0	1
18 Oct 2001	*G. aculeatus*	4.1	-	0	0	1	1	0	1	0	0	0	0	0	1
18 Oct 2001	*O. mykiss*	23.0	117	0	0	0	0	0	0	0	0	0	1	0	0
18 Oct 2001	*S. salar*	24.5	114	0	0	0	0	0	0	1	0	0	0	0	0
18 Oct 2001	*S. salar*	28.0	181	1	0	1	0	0	0	0	0	0	0	0	0
18 Oct 2001	*S. salar*	23.0	99	1	0	0	0	0	0	1	0	0	1	0	0
18 Oct 2001	*S. salar*	20.2	73	0	0	0	0	0	0	1	0	0	1	0	0
18 Oct 2001	*S. salar*	18.5	58	0	0	0	0	0	0	1	0	0	0	0	0
18 Oct 2001	*S. trutta*	18.4	64	0	0	1	0	0	0	1	0	0	1	0	0
18 Oct 2001	*S. trutta*	29.8	250	0	0	0	0	0	0	0	0	0	0	0	0
18 Oct 2001	*S. trutta*	19.9	73	0	0	0	0	0	0	1	0	0	1	0	0