

A SURVEY OF PARASITES OF JUVENILE SALMONIDS IN ENGLAND AND WALES

Emily Smith¹, Richard Gardiner², Steve Feist² & Matt Longshaw²

Introduction

As part of the routine monitoring of the health status of wild fish populations a survey of the parasite fauna of juvenile salmonids in British rivers was undertaken. The aim was to establish the degree of parasitism present in these salmonids and to assess whether specific parasites were inducing a pathological response. Particular attention was given to renal myxosporean infections with PKX (causative agent of Proliferative Kidney Disease) and *Chloromyxum* sp.



Henneguya zschokkei from a cyst on the gill of a brown trout. Normarski interference contrast.



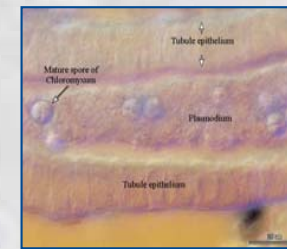
Fresh preparation of the flagellate *Spiroucleus barkhanus* from the gall bladder of brown trout. Phase contrast.



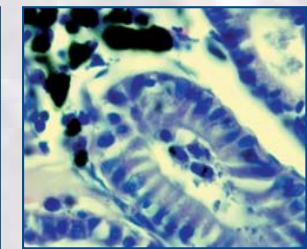
Metacercaria of *Diplostomum spathaceum* from the eyes of salmon. Normarski interference contrast.



Anterior region of the nematode *Camallanus lacustris* isolated from brown trout. Normarski interference contrast.



Chloromyxum cf. *majori*, infecting the renal tubules of brown trout. Normarski interference contrast.



Late stages of PKX within the renal tubules of salmon. Giemsa stain.

Discussion

There have been few studies on the parasite fauna of wild juvenile salmonids in the UK. Most studies have focused on specific parasite taxa (Bucke, 1993; Kennedy, 1969, 1978, 1996) or on helminths (Dorucu *et al.*, 1995; Thomas, 1964). Exceptions to this include Campbell (1974) and Wooten & Smith (1980).

There is a discontinuous distribution of parasites within the hosts studied as not all fish in all rivers were infected with all parasites. Several of the parasites recorded are considered pathogenic under the certain conditions and could potentially have an impact on survivability of their hosts. Sterud *et al* (1997) suggested that *Spiroucleus barkhanus* was a highly pathogenic diplomonad responsible for high level mortalities in six Norwegian fish farms. It is recorded here for the first time in brown trout in one river in Cornwall.

Fish clinically infected with PKD were found at 7 sites. These infections were confirmed histologically. However, in some cases the typical PKX organism could not be found. Infection with *Chloromyxum* sp. in the renal tubules were widespread in trout and salmon and co-infections with PKX were observed.

Although *Chloromyxum* sp. was found in fish exhibiting renal hypertrophy and with the apparent absence of PKX, it remains uncertain whether this species can be regarded as pathogenic based on the samples examined under this study. However, the closely related species *C.majori* is a significant pathogen of North American salmonids. (Lom & Dykova, 1993)

Interestingly, cestodes were not found in any salmon or trout - Kennedy (1974) reported five species of cestode in salmon and 13 in trout. Holland & Kennedy (1997) listed two species of cestodes in Irish salmon and five in trout. Fryer (1982) included *Ergasilus sieboldi* and *Salmincola* spp. as parasitic copepods of trout and salmon in the UK - these were not detected in the present study.

Kennedy (1996) suggested that *Pomphorhynchus laevis* was a poor coloniser of new habitats. This view is supported by this study as it was not found in any samples of trout and was only found in grayling collected from the River Wylie (a tributary of the Hampshire/Dorset Avon).

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Materials and Methods

Fish were collected from 26 sites on 23 rivers in England and Wales, mainly by electrofishing, between June and September 1997. Pectoral and dorsal fins were removed on site, placed in a small amount of water and maintained at +4°C until examination in the laboratory. Samples for microbiological investigation were routinely taken from visceral organs and the fish were then preserved in neutral buffered formalin (NBF) for a minimum of 24 hours. In the laboratory, fish were soaked overnight in distilled water prior to examination. NBF and water containing the fish was passed through a fine filter and examined for the presence of parasites. Total length, fork length, total weight and gutted weight were measured for each fish. Skin, fins, gills, nares and buccal cavity were examined under a stereo microscope and smears taken of all these organs. Samples of visceral organs were examined under stereo microscope and at x100 and x400 using conventional phase contrast microscopy. Kidneys from all fish were removed and prepared for wax histology using standard protocols. 5µm sections were stained using Giemsa and H&E and examined for the presence of myxozoan parasites. Parasites were identified from published host-parasite lists, published descriptions and by comparison with samples in the Registry of Aquatic Pathology (RAP) held at CEFAS Weymouth. Images of parasites were stored on a Lucia imaging system (Nikon UK Ltd) or photographed conventionally. Representative examples of all parasites were kept in NBF. The measures of infection were (i) prevalence, defined as the number of fish infected with a particular parasite divided by the total number of fish in the sample, expressed as a percentage, and (ii) abundance, defined as the total number of individuals of a particular parasite species in a sample of hosts divided by the total number of individuals of the host species in the sample (Margolis *et al.* 1982).

Results

A total of 215 trout, 160 salmon, 16 charr and 5 grayling were examined. Twenty-six parasite taxa were found in the four species of juvenile salmonids examined, including seven myxozoans, two protists, four monogeneans, two digeneans, three cestodes, five nematodes and three acanthocephalans. Protista were only recorded in trout and salmon, trout having a more diverse myxozoan fauna. *Spiroucleus barkhanus* was found in the gall bladders of two brown trout in Cornwall. *Chloromyxum* cf. *majori* was widely distributed in 20 of the 23 rivers sampled; approximately 50% of both trout and salmon were infected. PKX however, was only found in 15% of the fish. *Discocotyle sagittata* and *Gyrodactylus derjovini* were only found in two samples of salmon. *Crepidostomum farionis* was present in all four species of fish and in most rivers. Cestodes were only found in the small sample of charr. Nematodes were present in trout, salmon and charr; with *Cystidicoides ephemeridarum* found at high prevalences. Trout, salmon and charr were hosts for the acanthocephalan *Echinorhynchus truttae*; grayling were hosts for *Acanthocephalus anguillae* and *Pomphorhynchus laevis*. No copepods were found during this survey despite extensive searching.



Map showing locations of twenty-six rivers sampled for Salmon, Trout, Grayling and Charr

Parasite species	Location in host	Fish Host			
		Trout	Salmon	Charr	Grayling
PROTISTA					
<i>Chloromyxum</i> cf. <i>majori</i>	Kidney tubules	27	22	-	-
<i>Chloromyxum</i> <i>truttae</i>	Gill bladder	1	-	-	-
<i>Dermocystidium</i> sp.	Gills	1.9	1.9	-	-
<i>Henneguya zschokkei</i>	Gills	1	-	-	-
<i>Myxidium</i> <i>truttae</i>	Gill bladder; Liver	4	1.9	-	-
<i>Myxobolus neurobas</i>	Brain, spinal column	3.7	-	-	-
PKX	Kidney	11	1.25	-	-
<i>Sphaerospora</i> sp.	Kidney	-	0.6	-	-
<i>Spiroucleus</i> cf. <i>barkhanus</i>	Gill bladder	1	-	-	-
MONOGENEA					
<i>Discocotyle</i> <i>agostini</i>	Gills	-	1.9 (0-1)	-	-
<i>Gyrodactylus</i> <i>derjovini</i>	Skin, Fins	7 of 18*	2 of 13*	-	-
<i>G. thymalli</i>	Skin, Fins	-	-	-	1 of 1*
<i>G. truttae</i>	Skin, Fins	1 of 18*	-	-	-
DIGENEA					
<i>Crepidostomum</i> <i>farionis</i>	Intestine, Stomach, Pyloric caeca, Gall bladder	35 (0-16)	32 (0-50)	13 (0-10)	20 (0-3)
<i>Diplostomum</i> <i>spathaceum</i>	Eyes	19 (0-25)	4 (0-6)	-	-
CESTODA					
<i>Diphyllobothrium</i> <i>dentriticum</i>	Visceral cavity	-	-	46 (0-9)	-
<i>Eubothrium</i> <i>curassou</i>	Intestine	-	-	36 (0-2)	-
<i>Pseudophyllus</i> cf. <i>neglectus</i>	Intestine	-	-	44 (0-20)	-
NEMATODA					
<i>Camallanus</i> <i>lacustris</i>	Stomach	1 (0-9)	-	-	-
<i>Cystidicoides</i> <i>ephemeridarum</i>	Swim bladder	4 (0-35)	1.9 (0-1)	6 (0-1)	-
<i>Cystidicoides</i> <i>sphaeroidesum</i>	Stomach, Intestine, Pyloric caeca	37 (0-45)	36 (0-40)	-	-
<i>Pseudocapillaria</i> <i>sovelina</i>	Intestine	-	1.3 (0-3)	-	-
<i>Raphidascaris</i> <i>ocul</i>	Intestine	-	0.6 (0-1)	-	-
ACANTHOCEPHALA					
<i>Acanthocephalus</i> <i>anguillae</i>	Intestine	-	-	-	20 (0-1)
<i>Echinorhynchus</i> <i>truttae</i>	Intestine	20 (0-21)	7.5 (0-8)	6 (0-1)	-
<i>Pomphorhynchus</i> <i>laevis</i>	Intestine	-	-	-	40 (0-1)
TOTAL NUMBER OF FISH EXAMINED		215	160	16	5

* Number of rivers infected out of total number of rivers sampled for *Gyrodactylus* spp. (see Materials and methods for explanation)

Table: List of parasite species recorded in wild salmonids from England and Wales showing site of infection, prevalence and range.