Southeastern Cooperative Fish Parasite & Disease Laboratory

-AU personnel
-state & federal partners
-infrastructure investments for SE-US
-future challenges/opportunities

GSMFC ANS Small Grants Program:

"Novel tools to detect, track, and trace Myxobolus cerebralis (causative agent of salmonid whirling disease) in the Southeastern United States"

"THE COOPERATIVE"

*8x multiplier

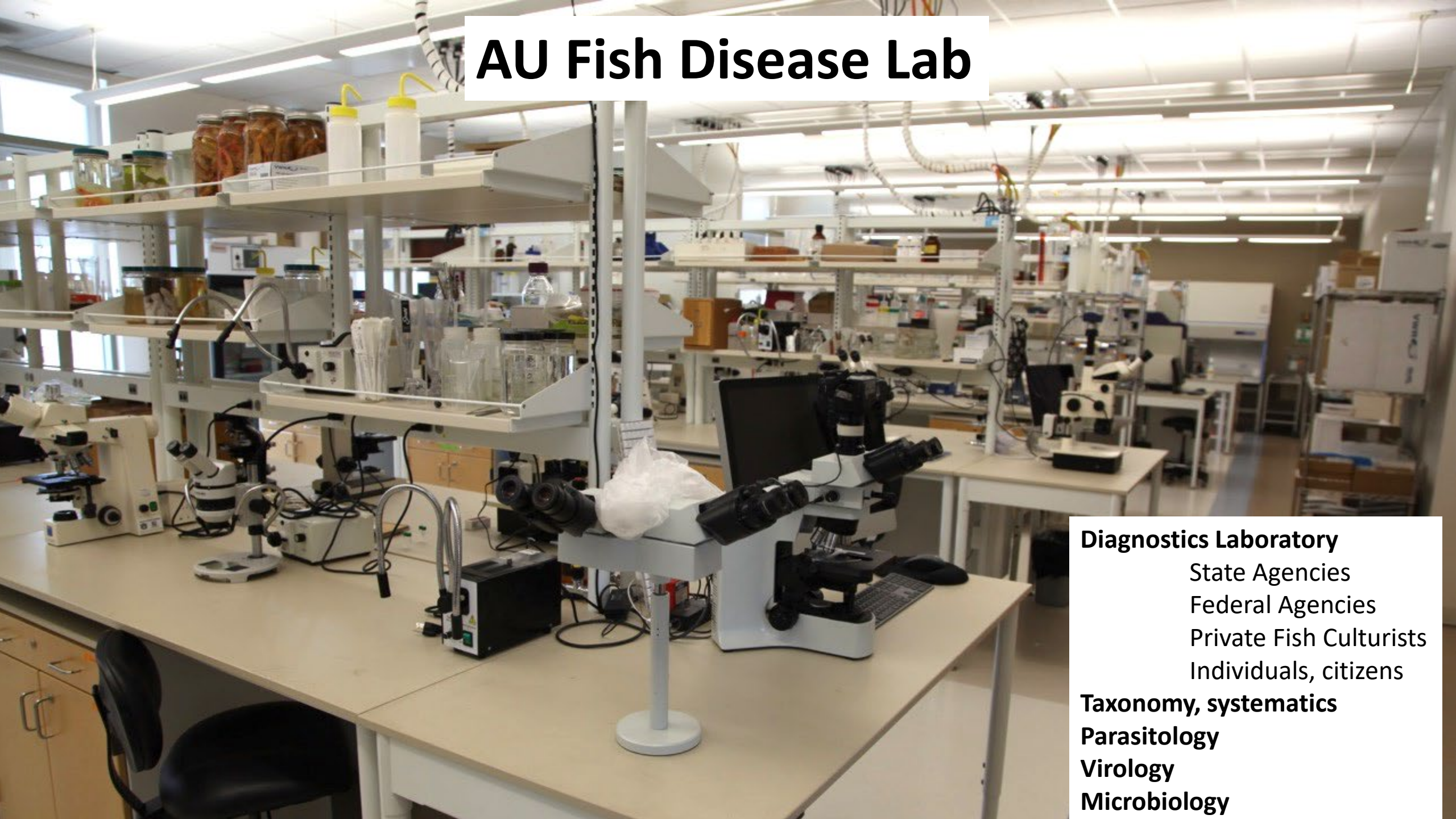
Cooperative state contracts

- Alabama Marine Res Division (AL-MRD)
- Alabama Inland Fisheries (ADCNR)
- Georgia Dept. Conservation & Nat Res (GADNR)
- South Carolina Dept. Cons & Nat Res (SCDNR)
- North Carolina Wildlife Resource Comm (NCWRC)
- West Virginia Dept. Nat. Res. (WVDNR)
- Tennessee Wildlife Res Agency (TWRA)
- +supplemental contracts (deep dive projects)

Other contracts

- Southern Regional Aquaculture Center (SRAC)
- USFWS
- NSF
- USDA
- Gulf of Mexico Research Initiative
- National Sea Grant
- MS-AL SeaGrant

AU Fish Disease Lab



Diagnostics Laboratory

- State Agencies
- Federal Agencies
- Private Fish Culturists
- Individuals, citizens

Taxonomy, systematics

Parasitology

Virology

Microbiology

Stephen A. Bullard, BSc, MSc, PhD

-Professor, School of Fisheries, Auburn University
-Director, Southeastern Cooperative Fish Parasite & Disease Project
-Lab head, Aquatic Parasitology Laboratory
-Associate Editor (Journal of Parasitology)

-Consulting & applied disease diagnostics for...
    -State and federal partners (marine and inland)
    -Private fish culturists
    -What do we do now?

$3.5M in extramural grants and contracts
3 Research Assistants
5 PhD students
2 MSc students

Haley Dutton, BSc, MSc

-Research Associate, ***Diagnostics Lab Manager***

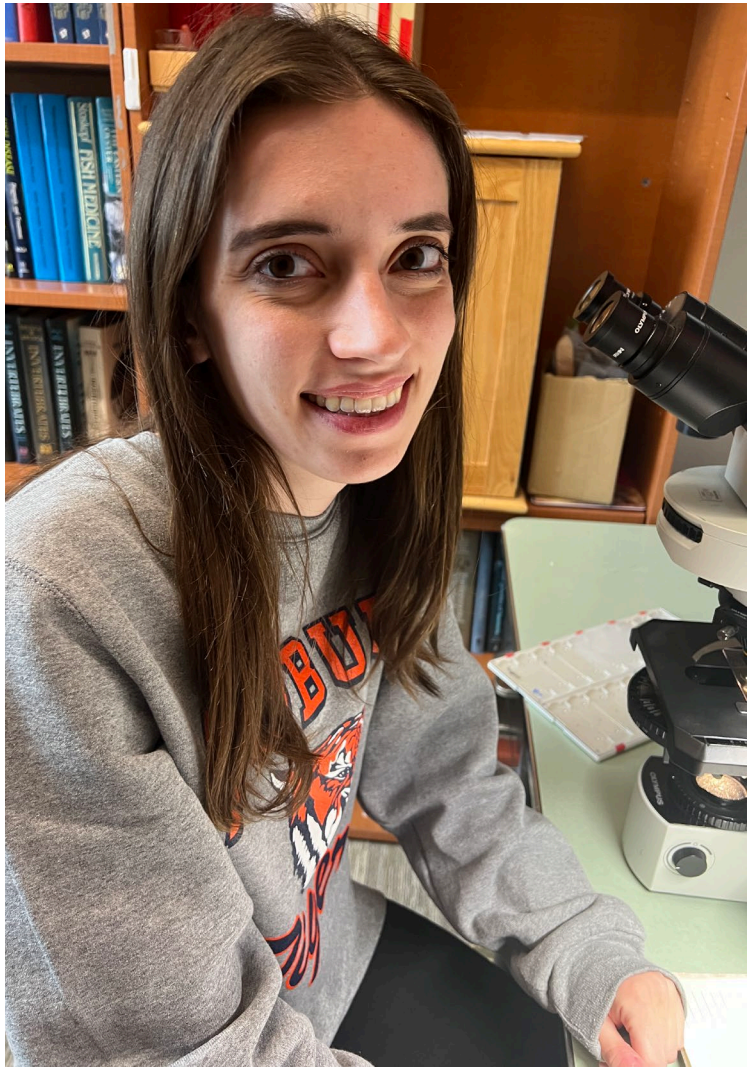
-Parasitology, pathology, virology, microbiology

Steve Curran, BSc, MSc, PhD

-Research Associate

-Parasite taxonomy & systematics

Current MSc students



Haley P. Knudson, BSc
-helminths

John H. Brule, BSc
-invasive carp pathogens

Current PhD students / diagnosticians

Brett Warren, BSc, MSc
-helminths

Steve Ksepka, BSc, MSc
-myxozoans

Triet Nhat Truong, BSc, MSc
-helminths

Justin Krol, BSc, DVM
-viruses

Salmonid Whirling Disease (*Myxobolus cerebralis*)

-First detection of *M. cerebralis* in the Southeastern United States
-First documentation of whirling disease in wild trout population in SE US
-First evidence of altered life cycle for *M. cerebralis*

Vol. 126: 185–198, 2017
https://doi.org/10.3354/dao03170

DISEASES OF AQUATIC ORGANISMS
Dis Aquat Org

Published November 21

Morphological and molecular confirmation of *Myxobolus cerebralis* myxospores infecting wild-caught and cultured trout in North Carolina (SE USA)

Carlos F. Ruiz[1], Jacob M. Rash[2], Cova R. Arias[3], Doug A. Besler[2], Raphael Orélis-Ribeiro[1], Matthew R. Womble[1], Jackson R. Roberts[1], Micah B. Warren[1], Candis L. Ray[3], Stacey Lafrentz[3], Stephen A. Bullard[1,*]

[1]Aquatic Parasitology Laboratory, School of Fisheries, Aquaculture, and Aquatic Sciences and Southeastern Cooperative Fish Parasite and Disease Laboratory (SCFPDL), Auburn University, Auburn, AL 36849, USA
[2]North Carolina Wildlife Resources Commission (NCWRC), Marion, NC 28752, USA
[3]Aquatic Microbiology Laboratory, Auburn, AL 36832, USA

ABSTRACT: We used microscopy and molecular biology to provide the first documentation of infections of *Myxobolus cerebralis* (Myxozoa: Myxobolidae), the etiological agent of whirling disease, in trout (Salmonidae) from North Carolina (USA) river basins. A total of 1085 rainbow trout *Oncorhynchus mykiss*, 696 brown trout *Salmo trutta*, and 319 brook trout *Salvelinus fontinalis* from 43 localities across 9 river basins were screened. Myxospores were observed microscopically in pepsin-trypsin digested heads of rainbow and brown trout from the Watauga River Basin. Those infections were confirmed using the prescribed nested polymerase chain reaction (PCR; 18S rDNA), which also detected infections in rainbow, brown, and brook trout from the French Broad River Basin and the Yadkin Pee-Dee River Basin. Myxospores were 9.0–10.0 µm (mean ± SD = 9.6 ± 0.4; N = 119) long, 8.0–10.0 µm (8.8 ± 0.6; 104) wide, and 6.0–7.5 µm (6.9 ± 0.5; 15) thick and had polar capsules 4.0–6.0 µm (5.0 ± 0.5; 104) long, 2.5–3.5 µm (3.1 ± 0.3; 104) wide, and with 5 or 6 polar filament coils. Myxospores from these hosts and rivers were morphologically indistinguishable and molecularly identical, indicating conspecificity, and the resulting 18S rDNA and ITS-1 sequences derived from these myxospores were 99.5–100 % and 99.3–99.8 % similar, respectively, to published GenBank sequences ascribed to *M. cerebralis*. This report comprises the first taxonomic circumscription and molecular confirmation of *M. cerebralis* in the southeastern USA south of Virginia.

KEY WORDS: Trout · Salmonid · Southeastern USA · Whirling disease · Morphology · Molecular diagnostics

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Why do you care about that?

It's probably been there for a long time...

and it hasn't caused a problem

It has all been done before.

That thing won't cause disease down here.

"Nothing to see here."

Myxobolus cerebralis detections in NC Streams

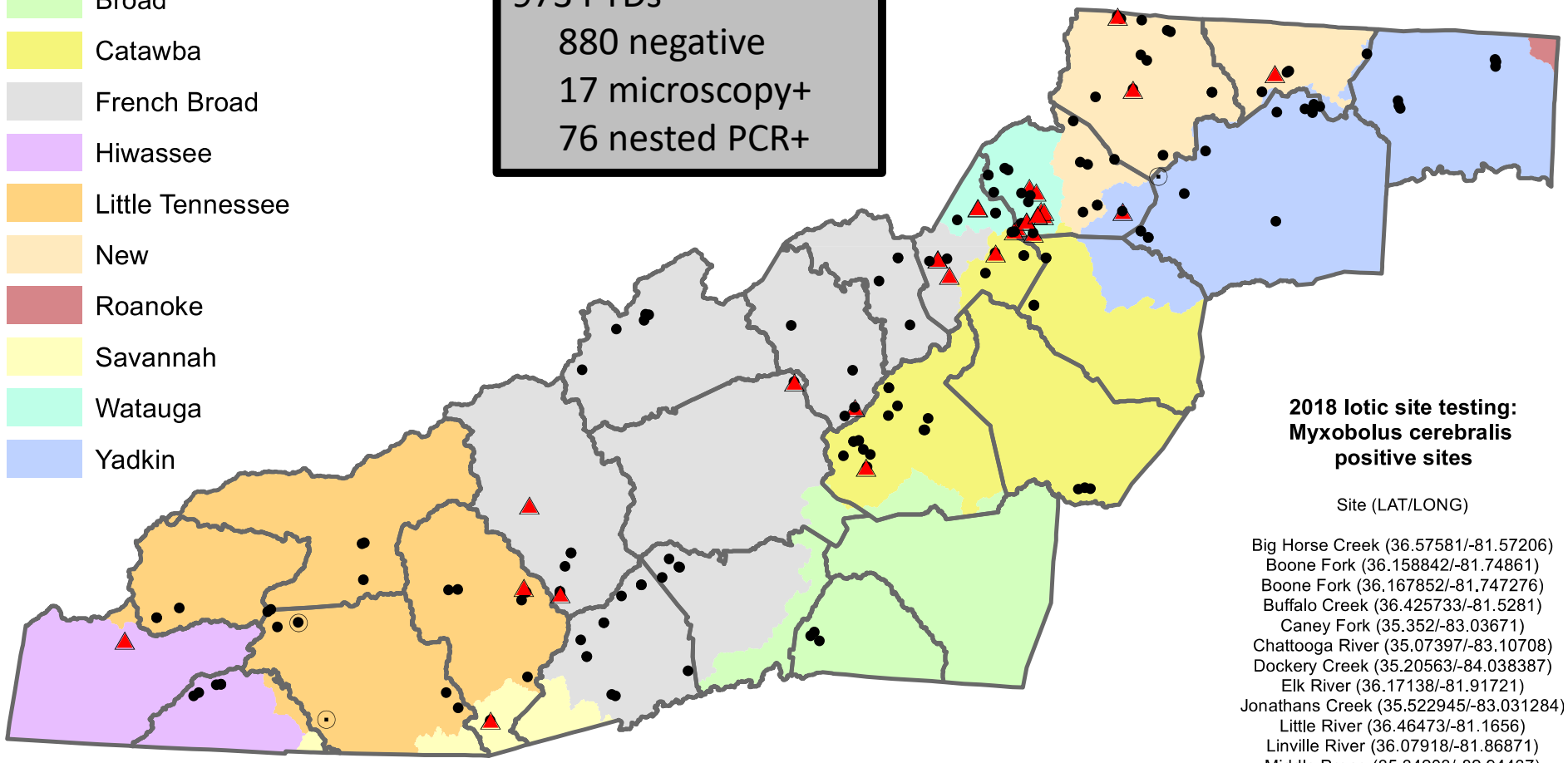
All lotic Myxobolus cerebralis sample sites (2015-2018)

- Negative collections
- Positive collections
- Results pending
- County boundary

River basin

- Broad
- Catawba
- French Broad
- Hiwassee
- Little Tennessee
- New
- Roanoke
- Savannah
- Watauga
- Yadkin

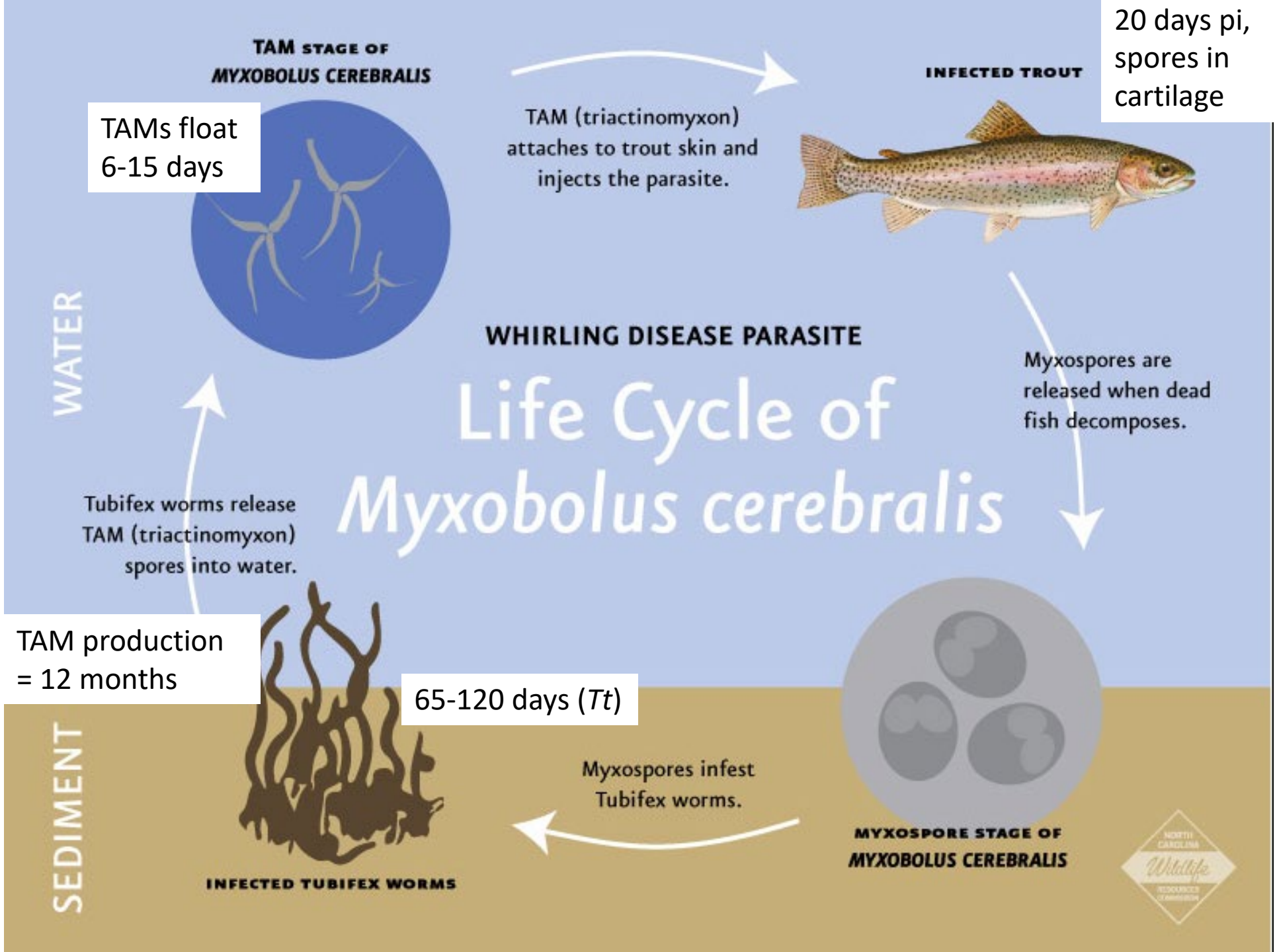
RBT: 1,699
BKT: 701
BNT: 1,690
130 discrete localities
973 PTDs
880 negative
17 microscopy+
76 nested PCR+



2018 lotic site testing: Myxobolus cerebralis positive sites

Site (LAT/LONG)

Big Horse Creek (36.57581/-81.57206)
Boone Fork (36.158842/-81.74861)
Boone Fork (36.167852/-81.747276)
Buffalo Creek (36.425733/-81.5281)
Caney Fork (35.352/-83.03671)
Chattooga River (35.07397/-83.10708)
Dockery Creek (35.20563/-84.038387)
Elk River (36.17138/-81.91721)
Jonathans Creek (35.522945/-83.031284)
Little River (36.46473/-81.1656)
Linville River (36.07918/-81.86871)
Middle Prong (35.34203/-82.94437)
N. Fork Ivy Creek (35.79803/-82.37017)
Plumtree Creek (36.03007/-81.98531)
Roaring Creek (36.06326/-82.01505)
Watauga River (36.160324/-81.76379)
Watauga River (36.14651/-81.79192)



TAMs float
6-15 days

20 days pi,
spores in
cartilage

TAM production
= 12 months

65-120 days (*Tt*)

Vol. 143: 51–56, 2021
https://doi.org/10.3354/dao03554

DISEASES OF AQUATIC ORGANISMS
Dis Aquat Org

Published online January 28

Detection of *Myxobolus cerebralis* (Bivalvulida: Myxobolidae) in two non-*Tubifex tubifex* oligochaetes in the southeastern USA

Steven P. Ksepka[1,*], Jacob M. Rash[2], Wenlong Cai[3], Stephen A. Bullard[1]

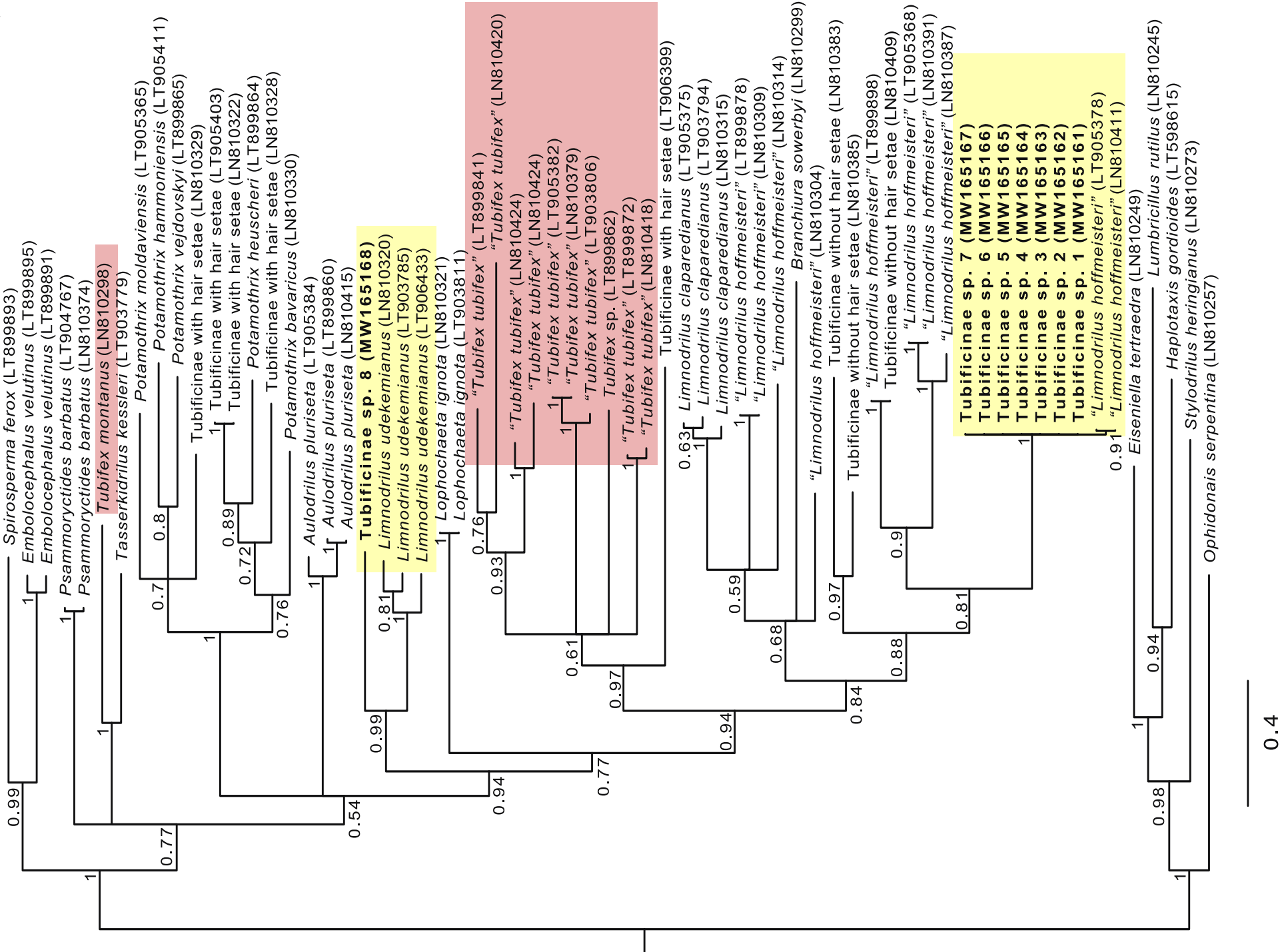
[1]Aquatic Parasitology Laboratory, School of Fisheries, Aquaculture, and Aquatic Sciences, College of Agriculture, Auburn University, 203 Swingle Hall, Auburn, AL 36849, USA

[2]North Carolina Wildlife Resources Commission, 645 Fish Hatchery Road, Marion, NC 28752, USA

[3]Department of Pathology and Microbiology, Atlantic Veterinary College, University of Prince Edward Island, 550 University Ave, Charlottetown, PEI C1A 4P3, Canada

ABSTRACT: *Myxobolus cerebralis* (Hofer, 1903), the etiological agent of salmonid whirling disease, reportedly matures in only the oligochaete '*Tubifex tubifex*'. The concept of '*T. tubifex*' is problematic because it is renowned as a species complex (or having 'strains'), and many sequences ascribed to this taxon in GenBank are misidentified or indicate several cryptic species. These facts cast doubt on the long-held notion that *M. cerebralis* is strictly host-specific to the single definitive host, *T. tubifex*. Herein, as part of an ongoing regional whirling disease monitoring project, oligochaetes (452 specimens) were collected from 31 riverine sites in western North Carolina (August through September 2015) and screened for infection by *M. cerebralis*. The species-specific nested PCR for *M. cerebralis* was positive for 8 oligochaete specimens from the French Broad River Basin (Mill Creek and Watauga River) and New River Basin (Big Horse Creek). We individually barcoded these *M. cerebralis*-

CO1 phylogeny of Tubificinae



Watauga River, French Broad River Basin, Tennessee

rainbow trout (*Oncorhynchus mykiss*) (Salmoniformes: Salmonidae)

Jonathans Creek, French Broad River Basin, North Carolina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[2]North Carolina Wildlife Resources Commission (NCWRC), Marion, NC 28752, USA
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KEY WORDS: Trout · Salmonid · Southeastern USA · Whirling disease · Morphology · Molecular diagnostics

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INTRODUCTION

Myxobolus cerebralis Hofer, 1903 (Bivalvulida: Myxobolidae), the causative agent of 'whirling disease' of salmonids (Sarker et al. 2015), infects rainbow trout *Oncorhynchus mykiss* (Walbaum, 1792) (Salmoniformes: Salmonidae), brown trout *Salmo trutta* Linnaeus, 1758, (Salmoniformes: Salmonidae), brook trout (char) *Salvelinus fontinalis* (Mitchill, 1814), (Salmoniformes: Salmonidae), and other salmonids in the USA and abroad (O'Grodnick 1979, Lorz et al. 1989, Hoffman 1990). It was first discovered infecting naive rain-

*Corresponding author: ash.bullard@auburn.edu

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KEY WORDS: Tubificinae · Oligochaete · Myxozoa

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1. INTRODUCTION

The cartilage/bone-infecting myxozoan species *Myxobolus cerebralis* (Hofer, 1903) (Bivalvulida: Myxobolidae), the causative agent of whirling disease, is a demonstrable pathogen of salmonids and is one of the most extensively studied species of *Myxobolus*. It has a complex life cycle, infecting trouts (Salmoniformes: Salmonidae) as the intermediate host and the oligochaete *Tubifex tubifex* (Müller, 1774) (Haplotaxida: Naididae) as the definitive host (Markiw & Wolf 1983, El-Matbouli et al. 1992, Hedrick & El-Matbouli 2002). In the salmonid host, myxospores are produced asexually within the cranial cartilage until

*Corresponding author: spk0014@auburn.edu

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ORIGINAL ARTICLE

Journal of Fish Diseases — WILEY

An updated geographic distribution of *Myxobolus cerebralis* (Hofer, 1903) (Bivalvulida: Myxobolidae) and the first diagnosed case of whirling disease in wild-caught trout in the south-eastern United States

Steven P. Ksepka[1] | Jacob M. Rash[2] | Brandon L. Simcox[3] | Doug A. Besler[1] | Haley R. Dutton[1] | Micah B. Warren[1] | Stephen A. Bullard[1]

[1]Aquatic Parasitology Laboratory, School of Fisheries, Aquaculture, and Aquatic Sciences, College of Agriculture, Auburn University, Auburn, AL, USA
[2]North Carolina Wildlife Resources Commission, Marion, NC, USA
[3]Tennessee Wildlife Resources Agency, Nashville, TN, USA

Correspondence
Steven P. Ksepka, Aquatic Parasitology Laboratory, School of Fisheries, Aquaculture, and Aquatic Sciences, College of Agriculture, Auburn University, 203 Swingle Hall, Auburn, AL 36849, USA.
Email: spk0014@auburn.edu

Funding information
Alabama Department of Conservation and Natural Resources; Tennessee Wildlife Resources Agency; North Carolina Wildlife Resources Commission; Alabama Agricultural Research Station

Abstract

Myxobolus cerebralis (Bivalvulida: Myxobolidae), the aetiological agent of salmonid whirling disease, was detected in 2 river basins of North Carolina during 2015, which initiated the largest spatial–temporal monitoring project for the disease ever conducted within the south-eastern United States (focused mainly in eastern Tennessee and western North Carolina). A total of 2072 rainbow trout *Oncorhynchus mykiss*, 1,004 brown trout *Salmo trutta* and 468 brook trout *Salvelinus fontinalis* were screened from 113 localities within 7 river basins during June 2017 through October 2019. Infections were detected by pepsin–trypsin digest, microscopy and the species-specific nested polymerase chain reaction (PCR) in 19 localities across 6 river basins. Myxospore morphology was indistinguishable from the published literature. In 2019, five rainbow trout that symptomatic for whirling disease (sloping neurocranium and lordosis) were captured and processed for histopathology. Myxospores were detected in the calvarial cartilage of two deformed trout with associated erosion of the cartilage consistent with reported whirling disease lesions. This is the first report of *M. cerebralis* in Tennessee and the first histologically confirmed cases of whirling disease in southern Appalachian (south-eastern United States) rivers and streams and expands the distribution of *M. cerebralis* throughout western North Carolina and eastern Tennessee.

KEYWORDS
epidemiology, histology, myxobolus, myxozoa, salmonidae

1 | INTRODUCTION

The cartilage/bone-infecting myxozoan species, *Myxobolus cerebralis* (Hofer, 1903) (Bivalvulida: Myxobolidae), the causative agent of whirling disease, was first documented in naive rainbow trout *Oncorhynchus mykiss* (Walbaum, 1792) (Salmoniformes: Salmonidae) exported from the United States to Germany (Hofer, 1903). These trout were alleged to be originally infected in Germany and developed the clinical signs of the disease (tail chasing, disequilibrium, erratic swimming, and skeletal and pigment abnormalities) that are obvious and can alarm anglers (Halliday, 1976; Hoffman, 1990; Lorz, Amandi, Banner, & Robovec, 1989; Sarker, Kallert, Hedrick, & El-Matbouli, 2015). Hoffman (1970) suggested this parasite is likely endemic to brown trout *Salmo trutta* Linnaeus, 1758 (Salmoniformes: Salmonidae), which are endemic to rivers in Europe, western Asian and north Africa and are resistant to developing clinical signs of

Why do you care about that?

It's probably been there for a long time...

and it hasn't caused a problem

That thing won't cause disease down here.

"Nothing to see here."

The pathogen is not everywhere (some trout populations infected, others not).

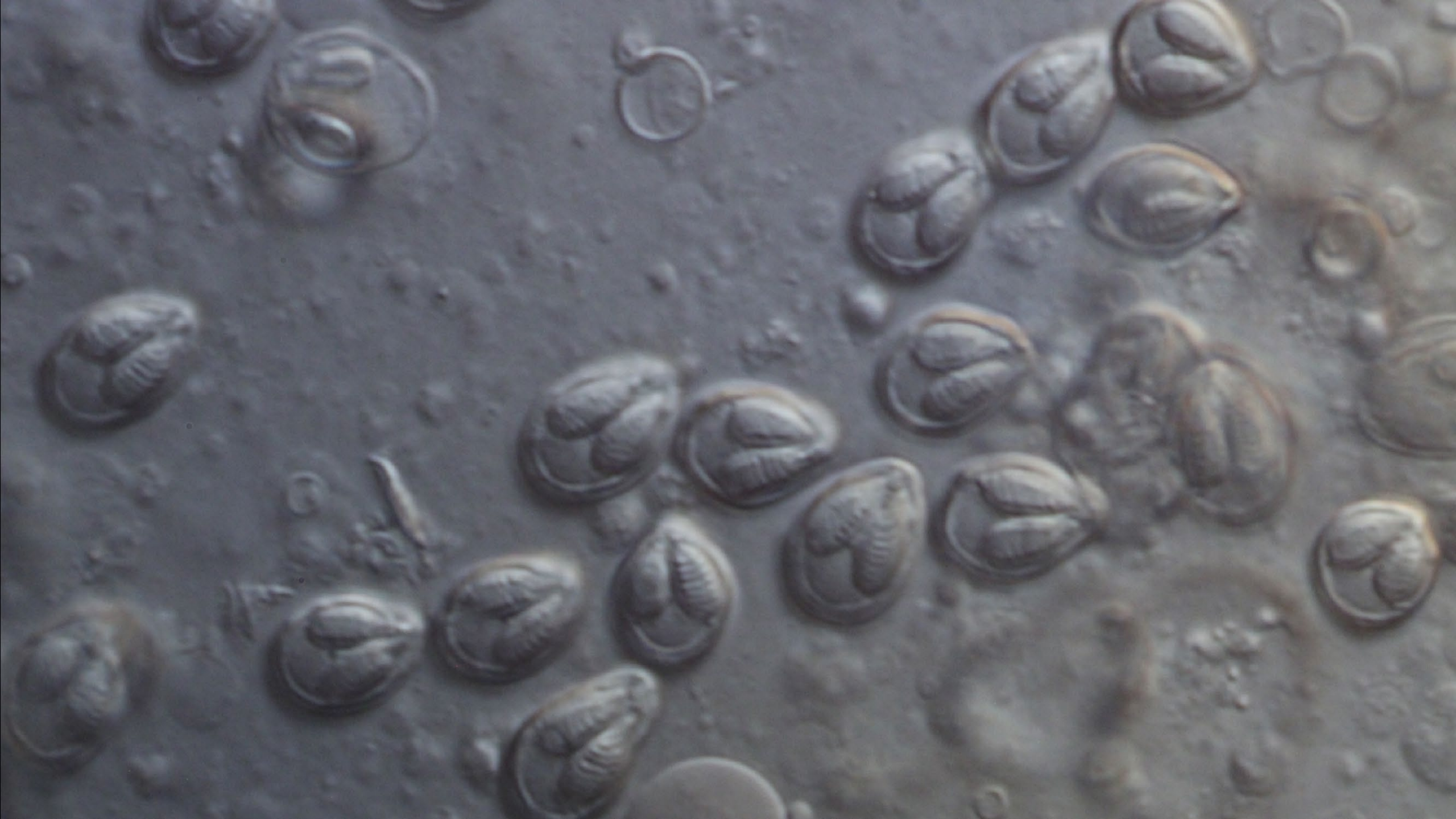
The dispersal strategy (life cycle) of the parasite is distinct in the Southeastern US.

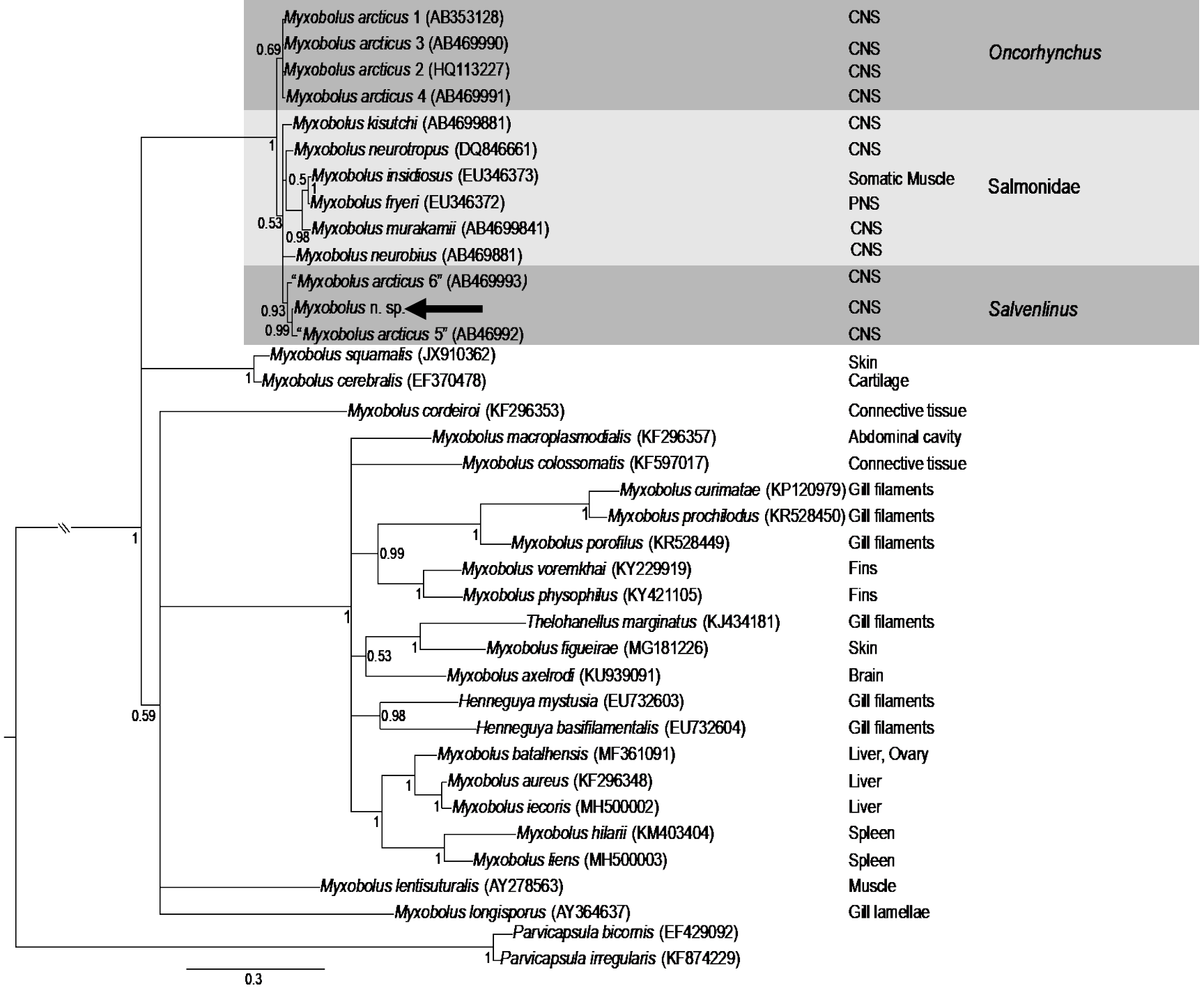
Distribution, host specificity, life cycles, abiotic factors, etc. need attention.

Diversity of related species is vastly underestimated (false positives).

Who cares?

- State agency biologists
- Federal biologists
- Private producers (fish disease inspections)
- Anglers, citizens
- 'River Keeper' groups

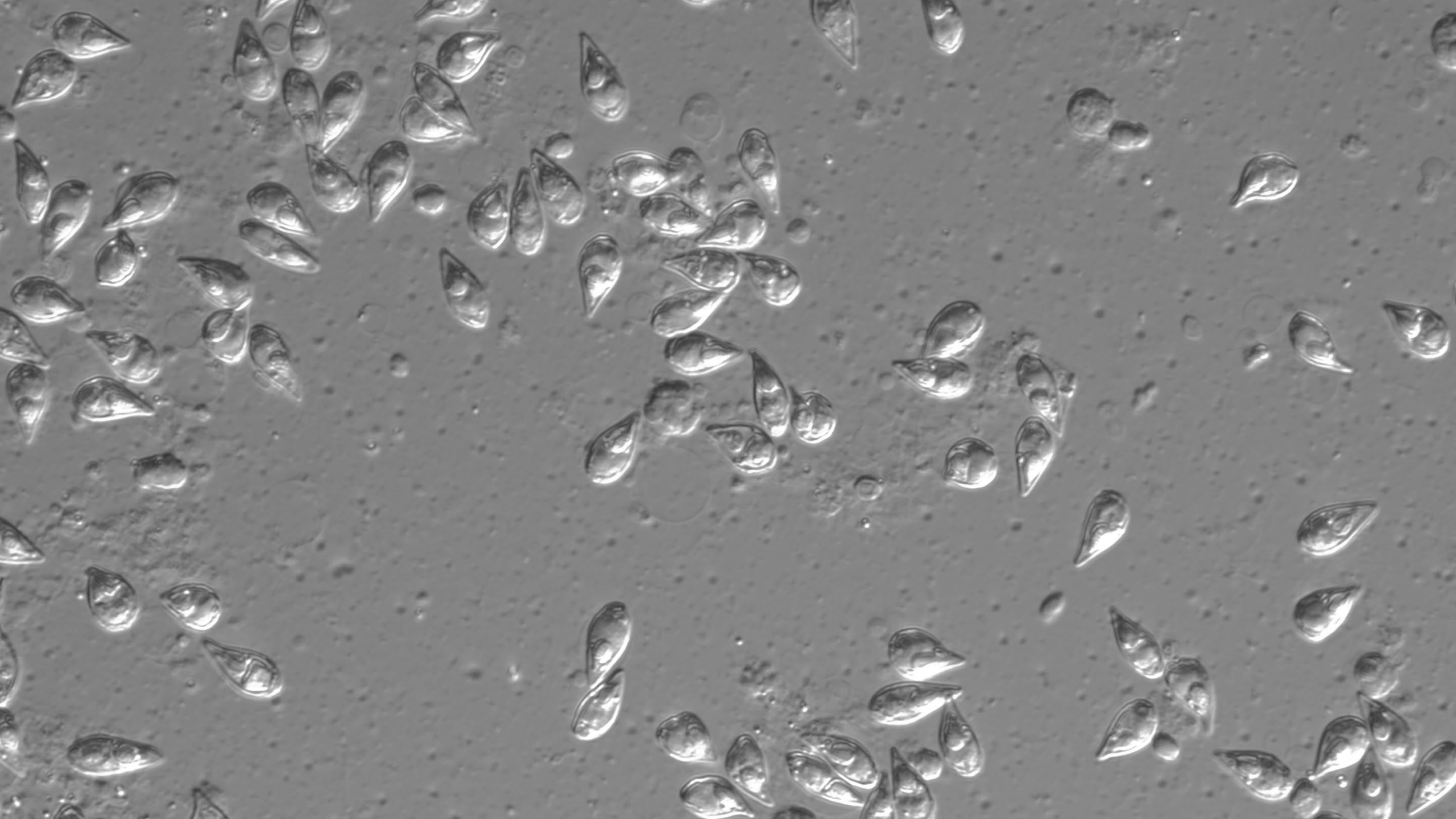



Myxobolus arcticus 1 (AB353128)
Myxobolus arcticus 3 (AB469990)
Myxobolus arcticus 2 (HQ113227)
Myxobolus arcticus 4 (AB469991)
Myxobolus kisutchi (AB4699881)
Myxobolus neurotropus (DQ846661)
Myxobolus insidiosus (EU346373)
Myxobolus fryeri (EU346372)
Myxobolus murakamii (AB4699841)
Myxobolus neurobius (AB469881)
"Myxobolus arcticus 6" (AB469993)
Myxobolus n. sp.
"Myxobolus arcticus 5" (AB46992)
Myxobolus squamalis (JX910362)
Myxobolus cerebralis (EF370478)
Myxobolus cordeiroi (KF296353)
Myxobolus macroplasmodialis (KF296357)
Myxobolus colossomatis (KF597017)
Myxobolus curimatae (KP120979)
Myxobolus prochilodus (KR528450)
Myxobolus porofilus (KR528449)
Myxobolus voremkhai (KY229919)
Myxobolus physophilus (KY421105)
Thelohanellus marginatus (KJ434181)
Myxobolus figueirae (MG181226)
Myxobolus axelrodi (KU939091)
Henneguya mystusia (EU732603)
Henneguya basifilamentalis (EU732604)
Myxobolus batalhensis (MF361091)
Myxobolus aureus (KF296348)
Myxobolus iecoris (MH500002)
Myxobolus hilarii (KM403404)
Myxobolus liens (MH500003)
Myxobolus lentisuturalis (AY278563)
Myxobolus longisporus (AY364637)
Parvicapsula bicornis (EF429092)
Parvicapsula irregularis (KF874229)
CNS
CNS
CNS
CNS
CNS
CNS
Somatic Muscle
PNS
CNS
CNS
CNS
CNS
CNS
Skin
Cartilage
Connective tissue
Abdominal cavity
Connective tissue
Gill filaments
Gill filaments
Gill filaments
Fins
Fins
Gill filaments
Skin
Brain
Gill filaments
Gill filaments
Liver, Ovary
Liver
Liver
Spleen
Spleen
Muscle
Gill lamellae
Oncorhynchus
Salmonidae
Salvenlinus
0.69
1
0.5
1
0.53
0.98
0.93
0.99
1
1
1
0.99
1
1
1
0.53
1
0.98
1
1
1
1
0.59
1
0.3

gy Research (2019) 118:3241–3252

FISH PARASITOLOGY - ORIGINAL PAPER

blacktail shiner, *Cyprinella venusta* (Cypriniformes: Cyprinidae)



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Ó American Society of Parasitologists 2020

Published 18 May 2020

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Journal of Parasitology

journal homepage: www.journalofparasitology.org

A NEW SPECIES OF THELOHANELLUS KUDO, 1933 (MYXOZOA: BIVALVULIDA) INFECTING SKELETAL MUSCLE OF BLACKTAIL SHINER, CYPRINELLA VENUSTA GIRARD, 1856 (CYPRINIFORMES: CYPRINIDAE) IN THE CHATTAHOOCHEE RIVER BASIN, GEORGIA

Steven P. Ksepka[1], Nathan Whelan[2,3], Christopher M. Whipps[4], and Stephen A. Bullard[1]

[1] Aquatic Parasitology Laboratory, School of Fisheries, Aquaculture, and Aquatic Sciences, College of Agriculture, Auburn University, 203 Swingle Hall, Auburn, Alabama 36849.

[2] Warm Springs Fish Technology Center, U.S. Fish and Wildlife Service, Auburn, Alabama 36849.

[3] School of Fisheries, Aquaculture, and Aquatic Sciences, College of Agriculture, Auburn University, 203 Swingle Hall, Auburn, Alabama 36849.

[4] College of Environmental Science and Forestry, State University of New York (SUNY–ESF), 1 Forestry Drive, Syracuse, New York 13210.

Correspondence should be sent to Steven P. Ksepka at: spk0014@auburn.edu

KEY WORDS

Bivalvulida
Cyprinella
Cypriniformes
Cyprinidae
Histology
Myxobolidae
Pathology
Phylogeny
Taxonomy
Thelohanellus

ABSTRACT

Thelohanellus magnacysta n. sp. (Bivalvulida: Myxobolidae) infects the skeletal muscle of blacktail shiner, Cyprinella venusta Girard, 1856 (Cypriniformes: Cyprinidae) in Bull Creek, Chattahoochee River Basin, eastern Georgia. Although numerous members of Thelohanellus Kudo, 1933 have overlapping myxospore dimensions with the new species, it differs from all nominal congeners by polar filament coil number and polar capsule width as well as by lacking a mucous envelope, iodinophilic vacuole, and sutural markings. With the use of novel primers for Myxozoa, a phylogenetic analysis of the small subunit ribosomal DNA (SSU rDNA) suggests that the new species shares a recent common ancestor with a clade of cyprinid-infecting species of Myxobolus Bütschli, 1882 (Bivalvulida: Myxobolidae) and Thelohanellus. Consistent with other published research concerning the systematics of Thelohanellus, this result suggested that Thelohanellus and Myxobolus are polyphyletic and need revision. Histological sections of infected blacktail shiners confirmed that myxospores were only found within a plasmodium and only infected skeletal muscle and that plasmodia were encapsulated by a granuloma comprising varying degrees of acute granulomatous inflammation. The new species is the fourth of Thelohanellus reported from North America and the first reported from Cyprinella, as well as the first myxozoan described from the

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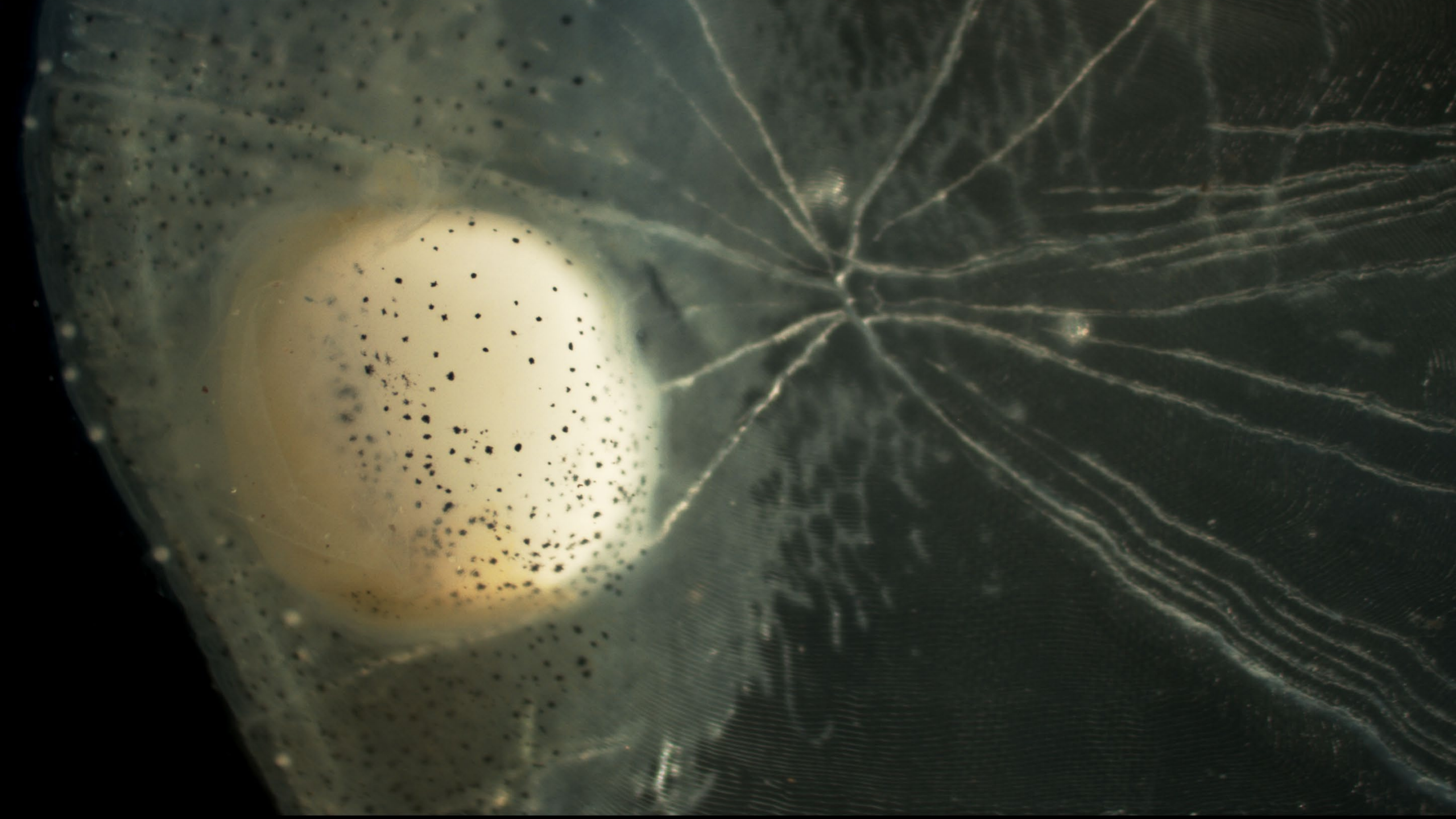
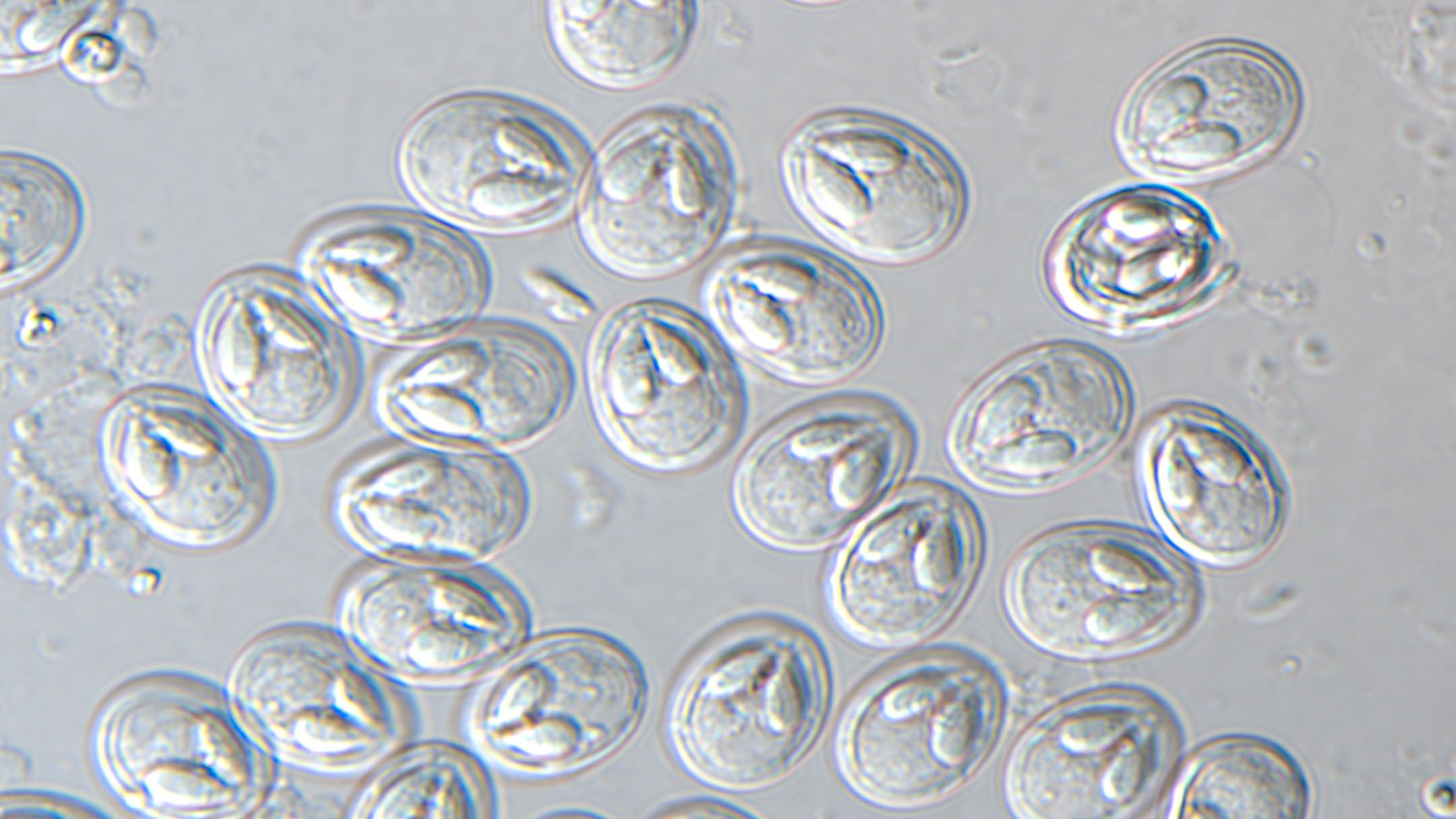
Sicklefin redhorse, *Moxostoma* sp. (Cypriniformes: Catostomidae)





Gill lice infections on trouts and white basses

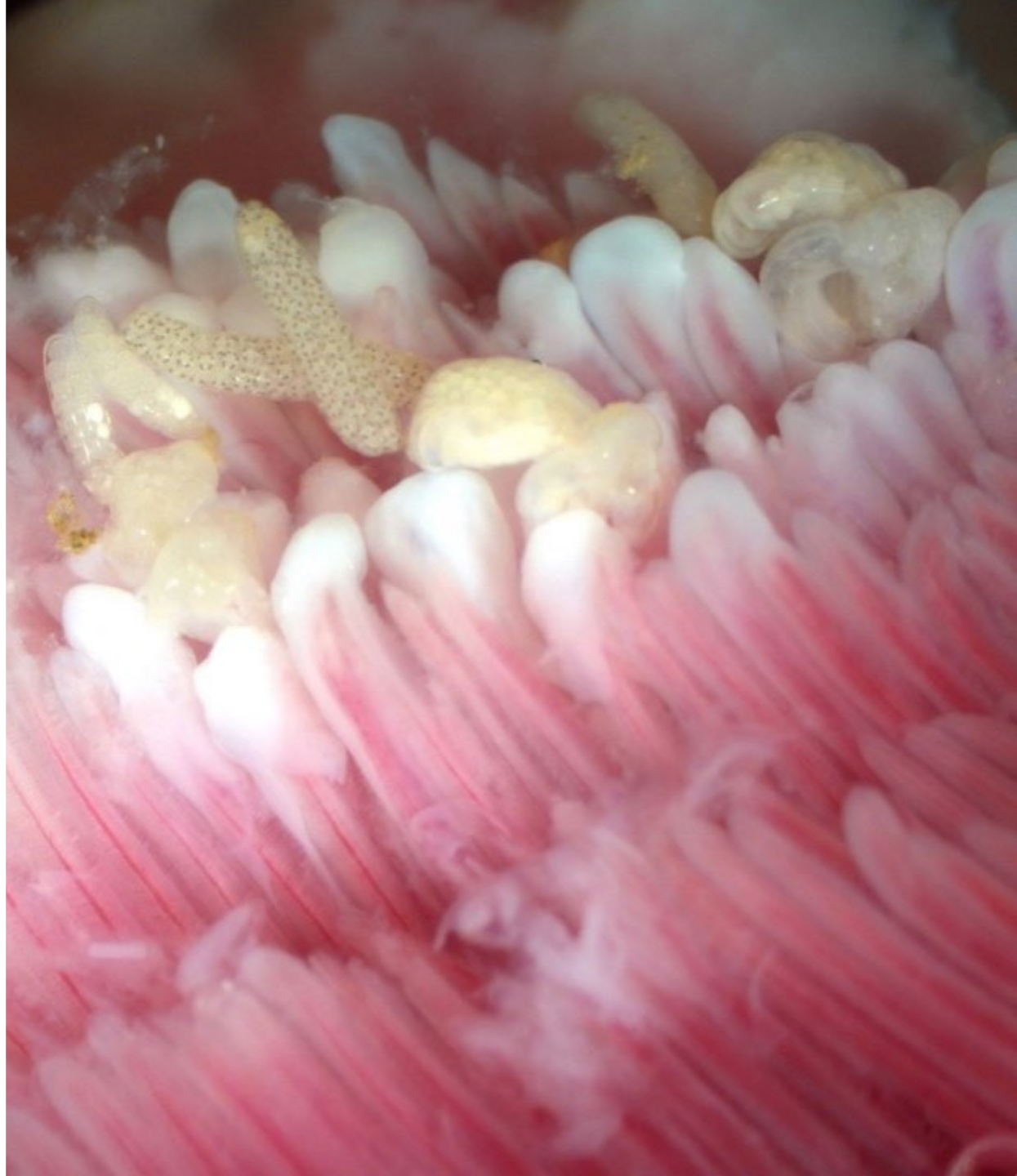
-First detection of *Salmincola* spp. in SE United States

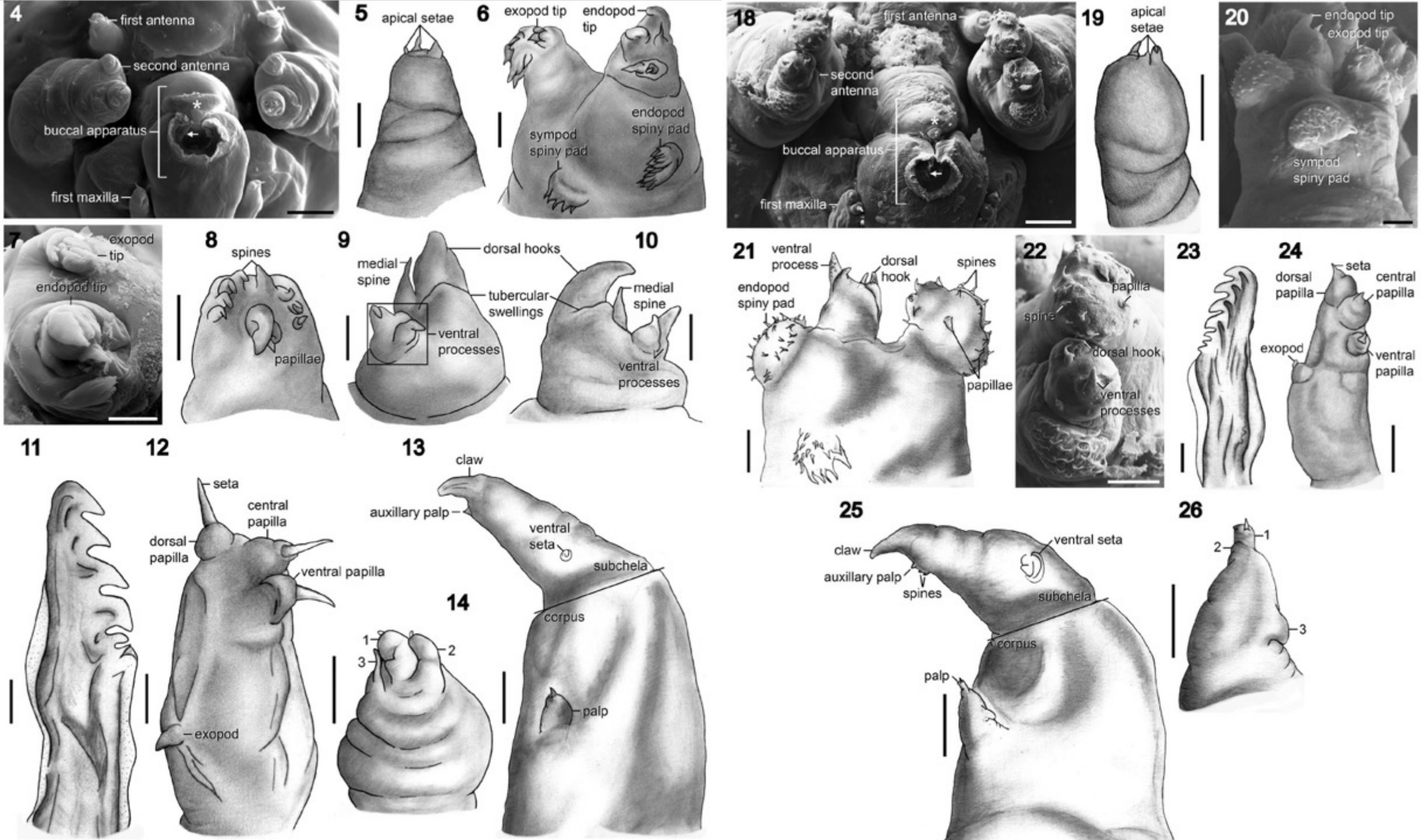
**both are exotic, invasive pathogens!*

-First pathobiology on infected wild trouts

-First nucleotide (DNA) sequences

-First morphological description in region




4
first antenna
second antenna
buccal apparatus
first maxilla
5
apical setae
6
exopod tip
endopod tip
endopod spiny pad
sympod spiny pad
18
first antenna
second antenna
buccal apparatus
first maxilla
19
apical setae
20
endopod tip
exopod tip
sympod spiny pad
7
exopod tip
endopod tip
8
spines
papillae
9
dorsal hooks
medial spine
tubercular swellings
ventral processes
10
medial spine
ventral processes
21
ventral process
dorsal hook
spines
endopod spiny pad
papillae
22
papilla
spine
dorsal hook
ventral processes
23
24
seta
dorsal papilla
central papilla
exopod
ventral papilla
11
12
seta
central papilla
dorsal papilla
ventral papilla
exopod
13
claw
auxillary palp
ventral seta
subchela
corpus
palp
14
1
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25
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ventral seta
auxillary palp
spines
subchela
corpus
palp
26
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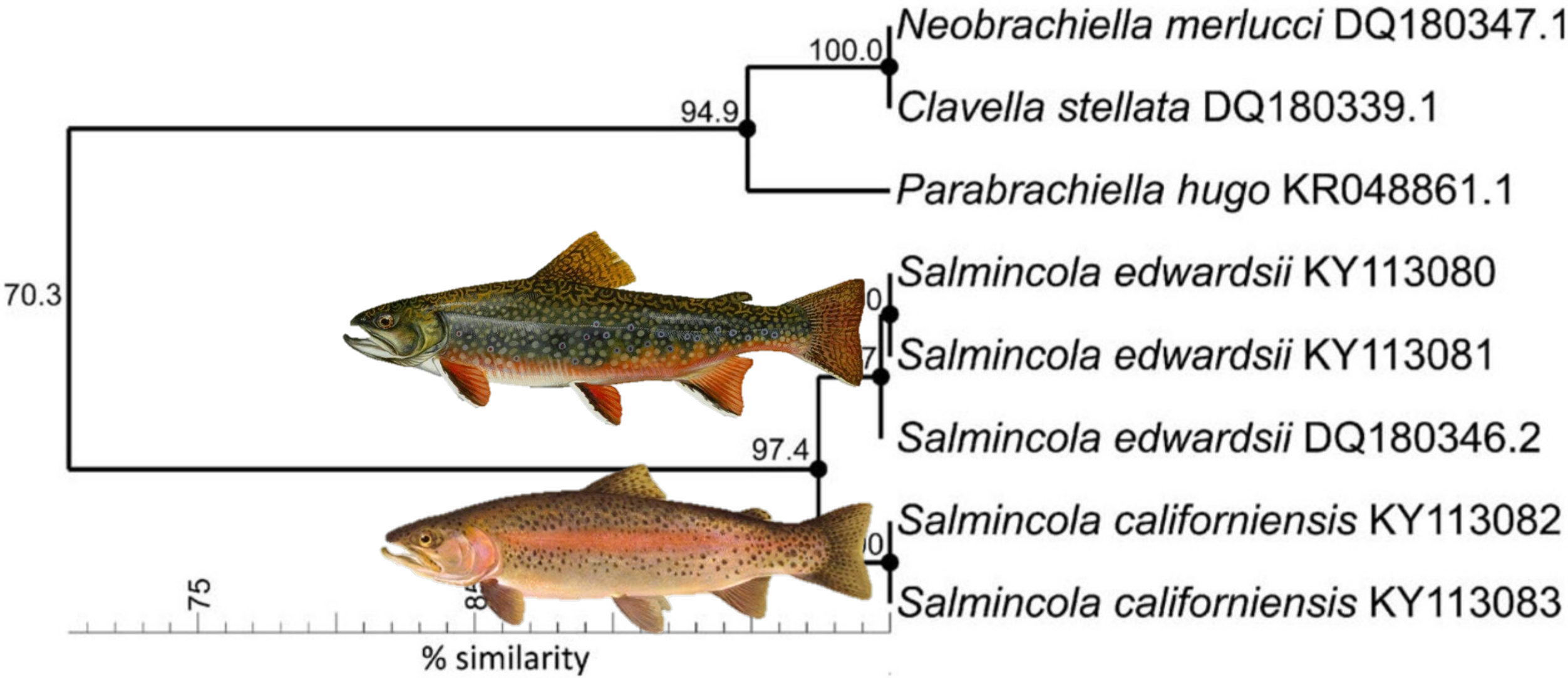
2
3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100.0
Clavella stellata DQ180339.1
94.9
Parabrachiella hugo KR048861.1
70.3
Salmincola edwardsii KY113080
0
Salmincola edwardsii KY113081
7
Salmincola edwardsii DQ180346.2
97.4
Salmincola californiensis KY113082
0
Salmincola californiensis KY113083
75
% similarity

7, pp. 377–389
© American Society of Parasitologists 2017

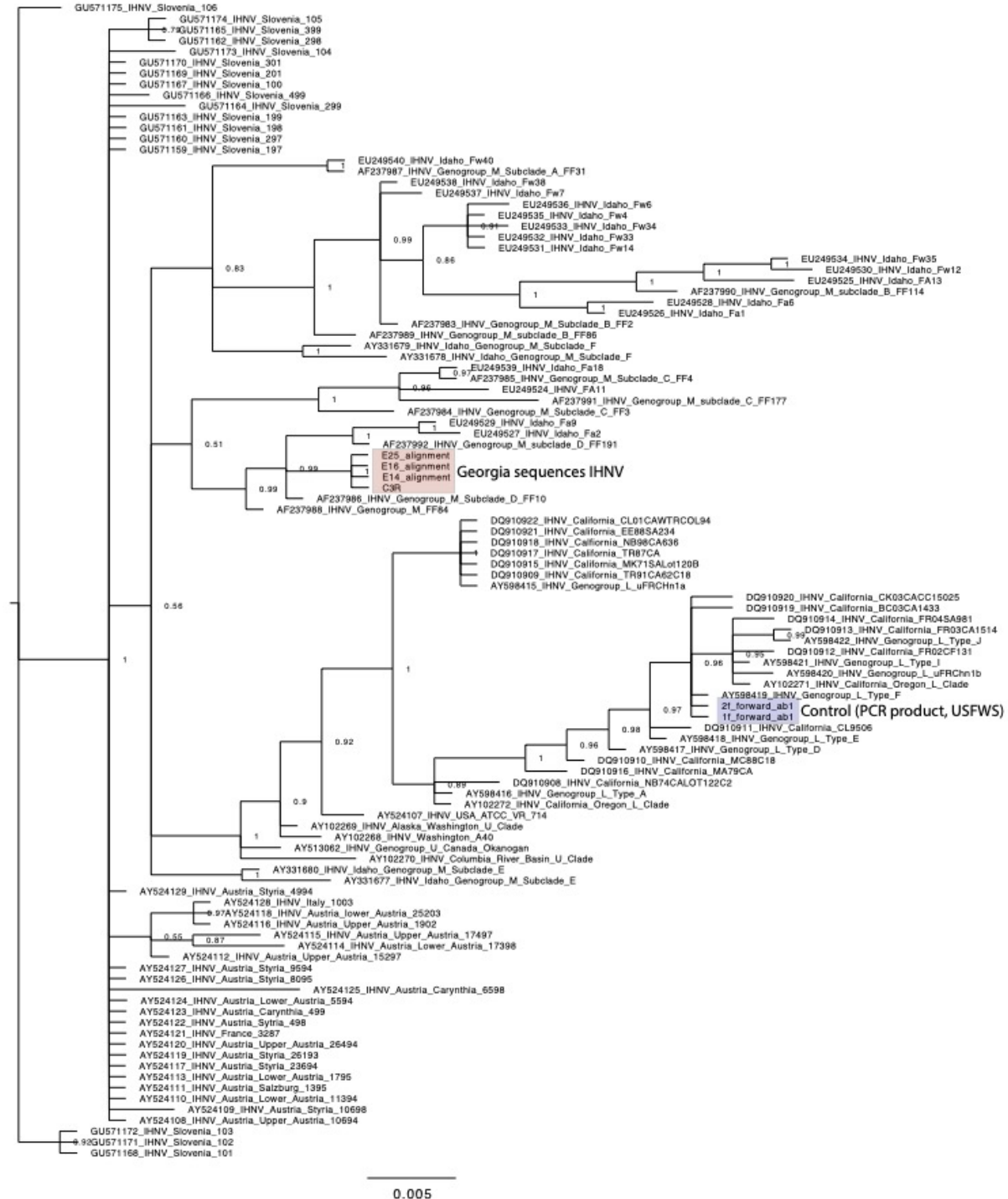
EXOTIC "GILL LICE" SPECIES (COPEPODA: LERNAEOPODIDAE: *SALMINCOLA* SPP.) INFECT RAINBOW TROUT (*ONCORHYNCHUS MYKISS*) AND BROOK TROUT (*SALVELINUS FONTINALIS*) IN THE SOUTHEASTERN UNITED STATES

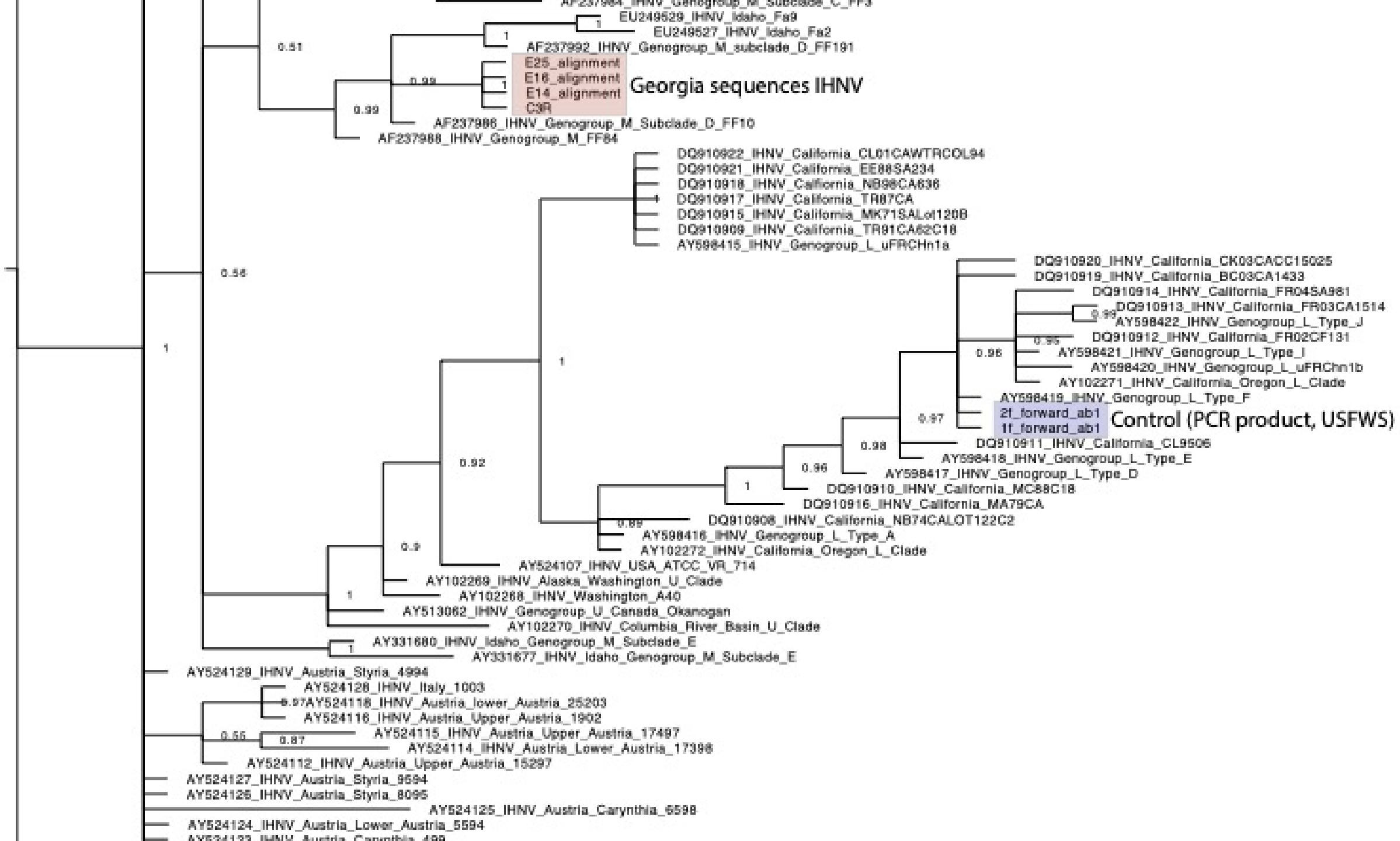
Carlos F. Ruiz, Jacob M. Rash*, Doug A. Besler*, Jackson R. Roberts, Micah B. Warren, Cova R. Arias†, and Stephen A. Bullard

Aquatic Parasitology Laboratory, School of Fisheries, Aquaculture, and Aquatic Sciences and Southeastern Cooperative Fish Parasite and Disease Project (SCFPDL), Auburn University, 203 Swingle Hall, Auburn, Alabama 36849. Correspondence should be sent to S. A. Bullard at: *ash.bullard@auburn.edu*

ABSTRACT: *Salmincola californiensis* infected 25 of 31 (prevalence 0.8; intensity 2–35 [mean 6.6 ± standard deviation 7.7; n = 25]) rainbow trout, *Oncorhynchus mykiss*, from a private trout farm connected to the Watauga River, North Carolina. *Salmincola edwardsii* infected all of 9 (1.0; 2–43 [9.3 ± 13.0; 9]) brook trout, *Salvelinus fontinalis*, from Big Norton Prong, a tributary of the Little Tennessee River, North Carolina. Both lernaeopodids are well-known salmonid pathogens, but neither is native to, nor has been previously taxonomically confirmed from, the southeastern United States. Herein, we (1) use light and scanning electron microscopy to identify and provide supplemental morphological observations of these lernaeopodids, (2) furnish complementary molecular sequence data from the 28S rDNA (28S), and (3) document the pathological effects of gill infections. We identified and differentiated these lernaeopodids by the second antenna (exopod tip with large [*S. californiensis*] vs. slender [*S. edwardsii*] spines; endopod terminal segment with subequal ventral processes shorter than [*S. californiensis*] vs. longer than or equal to [*S. edwardsii*] dorsal hook), maxilliped palp (length typically ≤1/3 [*S. californiensis*] vs. 1/3–1/2 [*S. edwardsii*] subchela length exclusive of claw), and bulla (sub-circular and concave on manubrium's side [*S. californiensis*] vs. non-stellate [*S. edwardsii*]). Analysis of the 28S rDNA sequences confirmed our taxonomic assignments as demonstrated by 100% sequence similarity among the sympatric, morphologically-conspecific isolates. Histopathology revealed focal gill epithelial hyperplasia, obstruction of interlamellar water channels, lamellar fusion, and crypting of gill filaments. High intensity infections by either lernaeopodid are surveillance-worthy because they are potentially pathogenic to trout in the southeastern United States.

Virology; IHNV detection

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E16_alignment
E14_alignment
C3R
Georgia sequences IHNV
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1f_forward_ab1
Control (PCR product, USFWS)
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AY598418_IHNV_Genogroup_L_Type_E
AY598417_IHNV_Genogroup_L_Type_D
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DQ910916_IHNV_California_MA79CA
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AY102269_IHNV_Alaska_Washington_U_Clade
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AY524124_IHNV_Austria_Lower_Austria_5594

Field application of salt, magnesium sulfate, organophosphate, formalin, and hydrogen peroxide treatments for killing parasitic copepods (Siphonostomatoidea: Lernaeopodidae: *Achtheres*) infecting white bass (*Morone chrysops*) and striped bass (*Morone saxatilis*).

GEORGIA
DEPARTMENT OF NATURAL RESOURCES
WILDLIFE RESOURCES DIVISION

NORTH CAROLINA
Wildlife
RESOURCES COMMISSION

SOUTH CAROLINA
DEPARTMENT OF NATURAL RESOURCES


U Plan
F=200

Red sore disease impacting game fishes and a note about river keeper groups and fish diseases....

https://www.youtube.com/watch?reload=9&v=2fZCe61rspU

https://www.wrdw.com/video/2020/06/24/hundreds-dead-fish-savannah-river/

Fish are dying in the Savannah River and "we" don't know why

By Celeste Springer

Published: Jun. 23, 2020 at 6:51 PM CDT

Savannah River Fish Kill Investigation

AUGUSTA, GA
Thursday, June 25, 2020 - 15:00
The Georgia Department of Natural Resources' Wildlife Resources Division (WRD) and Environmental Protection Division (EPD) are aware of ongoing fish mortality in the Savannah River near Augusta, Georgia, and are actively investigating this occurrence.
This fish kill is primarily affecting American shad, although several other species have been collected. A few hundred dead fish have been reported so far. Fish specimens are being examined by WRD Fisheries Management Section staff, and have been sent to the Auburn University Fish Disease Lab for further analysis.

Each spring, American shad migrate from the coast into the Augusta area to spawn, after which most of the shad die as part of their natural life history. This process is an important and natural component of the ecology of the Savannah River system, as the shad migration brings nutrients and resources upstream that benefit the local river system.

The Georgia Department of Natural Resources is responsible for investigating fish kills in Georgia waters. If you should observe dead or dying fish in your body of water, report the occurrence as quickly as possible by calling toll-free to 1-800-241-4113 (24 hours a day, seven days a week), or contacting your local Fisheries Management Section office (georgiawildlife.com/about/contact) during business hours (Monday–Friday, 8 a.m.–4:30 p.m.).

For more information on fishing in Georgia, visit www.georgiawildlife.com.

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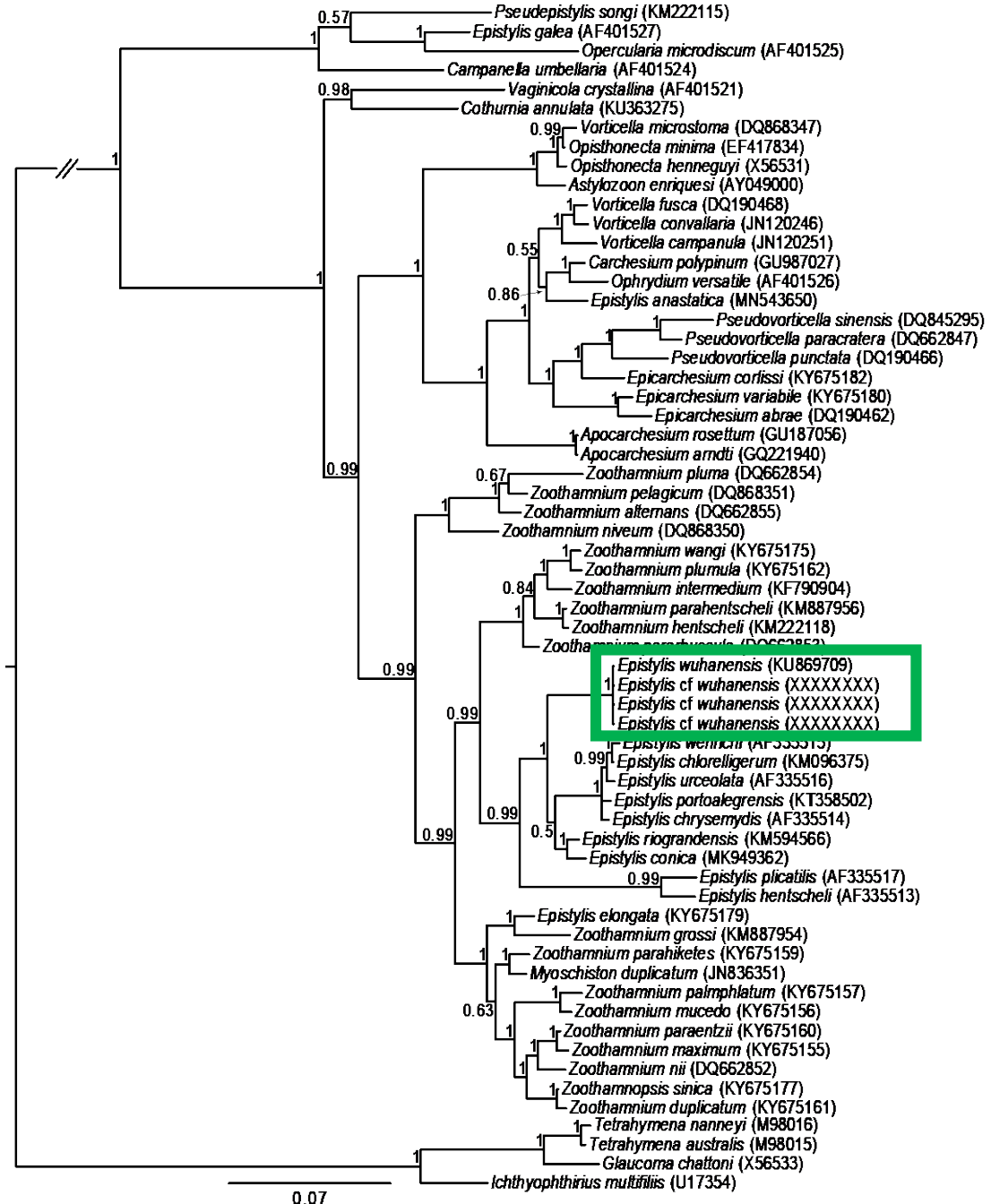
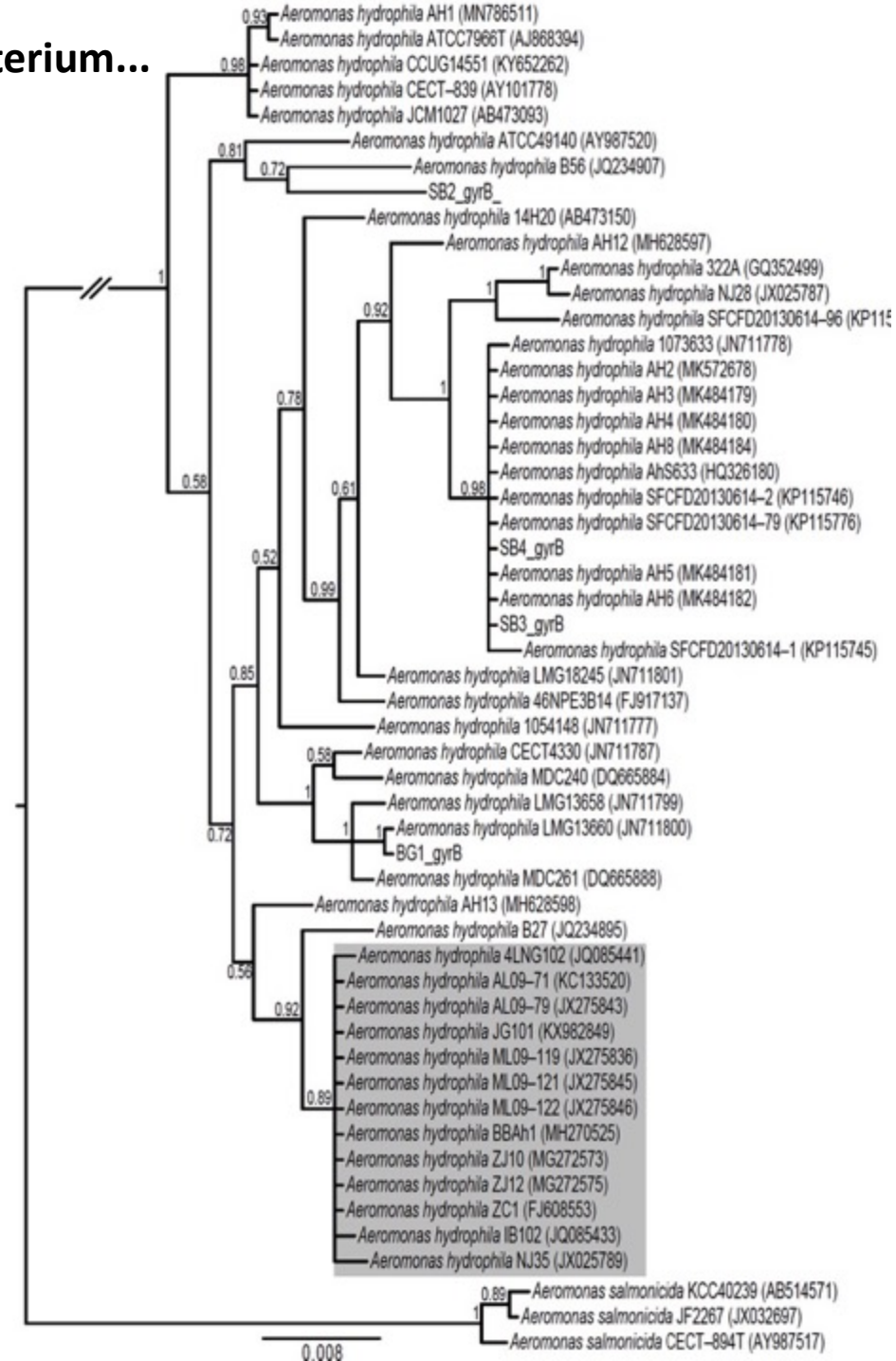
the ciliate...



the bacterium...



Received: 2 October 2020 | Revised: 15 January 2021 | Accepted: 18 January 2021

DOI: 10.1111/jfd.13344

RESEARCH ARTICLE

Journal of Fish Diseases WILEY

Morphology, phylogenetics and pathology of "red sore disease" (coinfection by *Epistylis* cf. *wuhanensis* and *Aeromonas hydrophila*) on sportfishes from reservoirs in the South-Eastern United States

Steven P. Ksepka | Stephen A. Bullard

Aquatic Parasitology Laboratory, School of Fisheries, Aquaculture, and Aquatic Sciences, College of Agriculture, Auburn University, Auburn, AL, USA

Correspondence
Steven P. Ksepka, Aquatic Parasitology Laboratory, School of Fisheries, Aquaculture, and Aquatic Sciences, College of Agriculture, Auburn University, 203 Swingle Hall, Auburn, Alabama 36849, USA.
Email: spk0014@auburn.edu

Funding information
Georgia Department of Natural Resources and Alabama Agricultural Research Station

Abstract

The aetiological agents of red sore disease (RSD) reportedly comprise a taxonomically ambiguous stalked ciliate (a species of *Epistylis*) and *Aeromonas hydrophila*. The taxonomic identity of each pathogen remains provisional: using supra-specific morphological features for the ciliate and culture-based methods that cannot delineate bacterial strain. On 7 and 9 November 2017 and 28 May 2020, biologists and anglers reported a local epizootic (Hiwassee and Chattahoochee river basins; Georgia) wherein some moribund fish presented RSD-like lesions. The ciliates were assigned to *Epistylis* by morphology. The ciliate is regarded as *Epistylis* cf *wuhanensis*, as nucleotide sequences from its small subunit ribosomal DNA were identical to those of *Epistylis wuhanensis*. The bacterium was identified as *Aeromonas hydrophila* by phenotypic markers and nucleotide sequences from the DNA gyrase subunit B; our sequences comprised 3 strains and phylogenetically were recovered sister to strains of Eurasian origin. Histological sections of lesions revealed effacement or partial

Parasitology and T & E species of concern...

TENNESSEE AQUARIUM


SIMMS

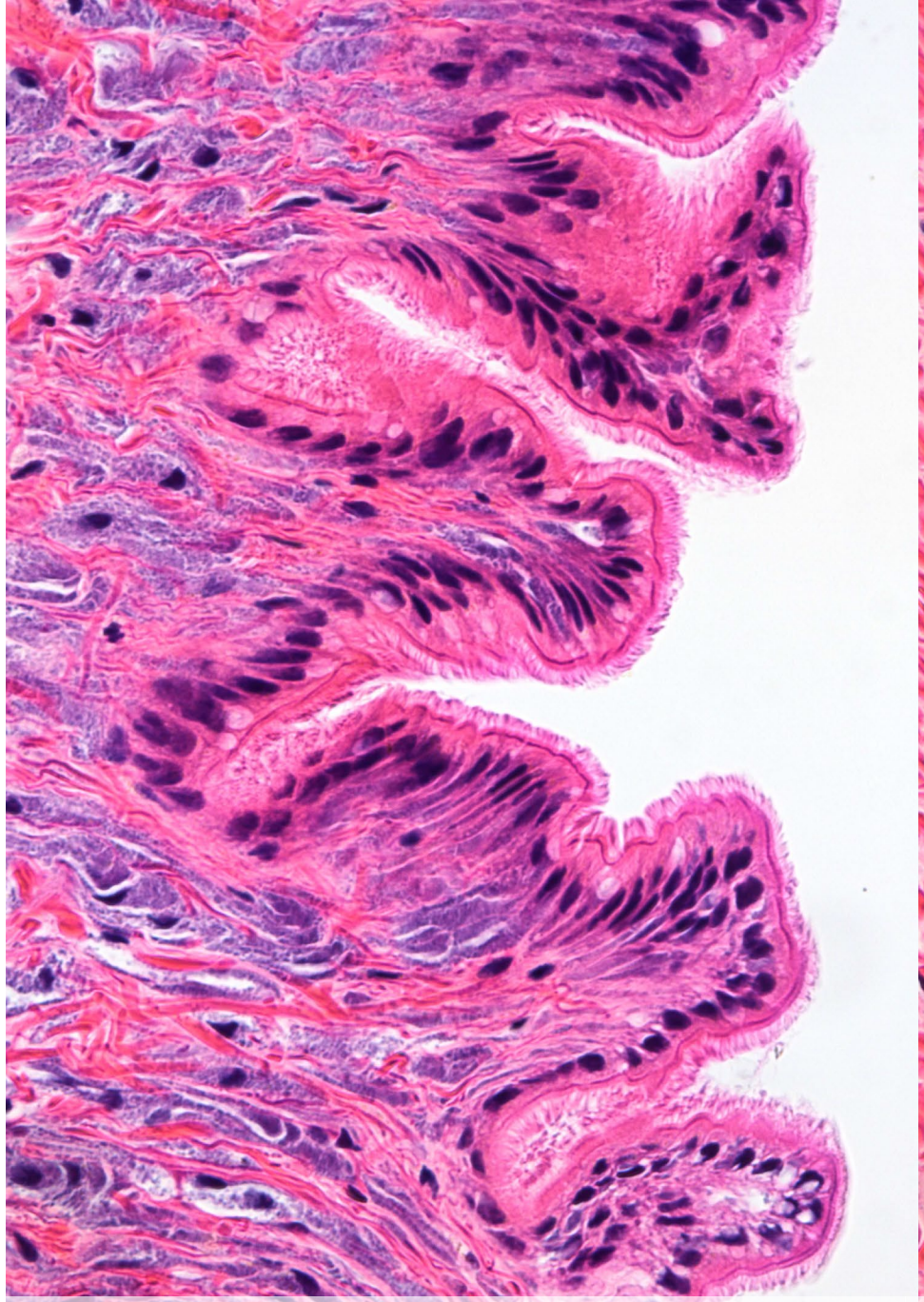

ICED FISH
EXAMINE
igloo

Alabama mussels

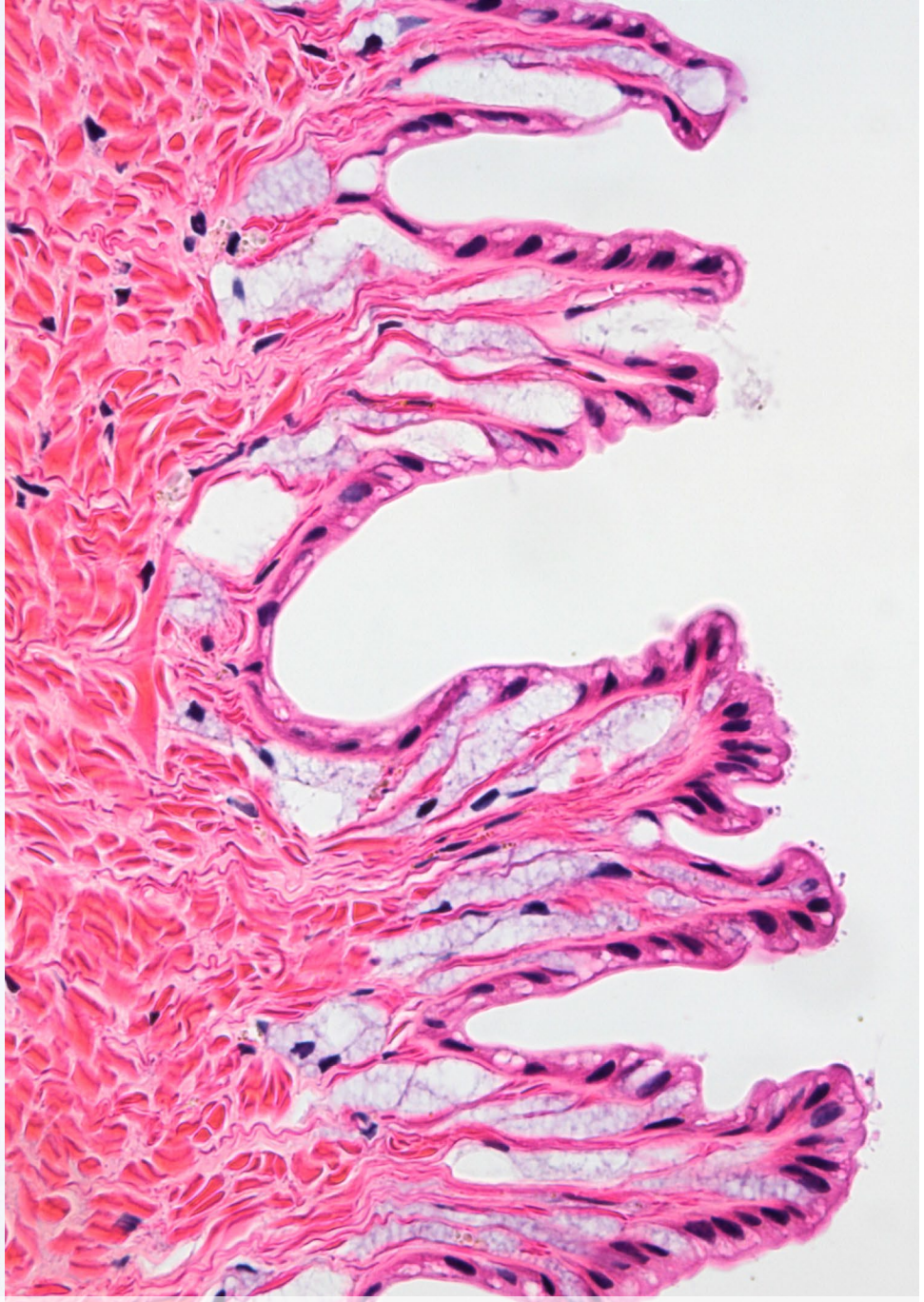
- 182 spp. (180 Unionidae, 2 Margaritiferidae)
- 24 spp. extinct
- 26 spp. extirpated
- 74 spp. with priority conservation status

Unionidae

Con. contradens
Unio pictorum
Caf. caffra
Las. compressa
Ala. marginata
Strophitus connasaugaensis
Pyg. grandis
Gon. angulata
Trit. verrucosa
Qua. quadrula
Amb. plicata
Ell. dilatata
Ple. coccineum
Fusconaia cerina
Ptycho. fasciolaris
Obl. reflexa
Tru. truncata
Lig. recta
Villosa nebulosa
Epi. triquetra
Act. carinata
Lamp. cardium



pedal integument 1 of *S. connasaugaensis*



pedal integument 2 of *S. connasaugaensis*

MALACOLOGIA, 2014, 57(1): 99–239

HISTOLOGICAL ATLAS OF FRESHWATER MUSSELS (BIVALVIA, UNIONIDAE): *VILLOSA NEBULOSA* (AMBLEMINAE: LAMPSILINI), *FUSCONAIA CERINA* (AMBLEMINAE: PLEUROBEMINI) AND *STROPHITUS CONNASAUGAENSIS* (UNIONINAE: ANODONTINI)

Andrew McElwain* & Stephen A. Bullard

Department of Biological Sciences, College of Liberal Arts and Sciences,
State University of New York at Oswego, 392 Shineman Center,
Oswego, New York 13126, U.S.A.

ABSTRACT

Freshwater mussels (Mollusca: Bivalvia: Unionoida) are a species-rich group of parasitic bivalves comprising approximately 843 nominal species in six families, including 300 species of Unionidae and five of Margaritiferidae in North America. Unionid shells have been studied extensively for the purposes of taxonomy, but less information exists about the cellular anatomy of their “soft tissues” (mantle cavity tissues and visceral tissues). No systematic histological atlas of any unionid has been published in the peer-reviewed literature, and this lack of information hinders basic and applied research topics involving freshwater mussels. Herein, we describe the tissue and cell anatomy of a representative species from each of three lineages (tribes) of Unionidae *sensu* Graf & Cummings (2006) ranging in North America: *Villosa nebulosa* (Ambleminae: Lampsilini), *Fusconaia cerina* (Ambleminae: Pleurobemini) and *Strophitus connasaugaensis* (Unioninae: Anodontini). Based on necropsy observations and light microscopy of serial histological sections, for each species we describe and compare mantle cavity tissues (i.e., tissue enclosed by mantle: mantle, adductor muscle,

Upcoming exciting opportunities...

EXPLANATORY STATEMENT FOR THE DEPARTMENT OF THE INTERIOR, ENVIRONMENT, AND RELATED AGENCIES APPROPRIATIONS BILL, 2022

SUMMARY OF BILL

For this bill, estimates totaling $51,284,970,000 in new obligational authority, including $2,450,000,000 in funds made available for the wildland fire suppression cap adjustment and $6,586,250,000 in advance appropriations, are provided for the programs and activities of the agencies and bureaus of the Department of the Interior, except the Bureau of Reclamation, and the following related agencies:

Environmental Protection Agency

Department of Agriculture:
- Undersecretary for Natural Resources and the Environment
- Forest Service

Department of Health and Human Services:
- Indian Health Service
- National Institute of Environmental Health Sciences
- Agency for Toxic Substances and Disease Registry

Other Related Agencies:
- Council on Environmental Quality and Office of Environmental Quality
- Chemical Safety and Hazard Investigation Board
- Office of Navajo and Hopi Indian Relocation
- Institute of American Indian and Alaska Native Culture and Arts Development
- Smithsonian Institution
- National Gallery of Art
- John F. Kennedy Center for the Performing Arts
- Woodrow Wilson International Center for Scholars
- National Foundation on the Arts and Humanities
- Commission of Fine Arts
- National Capital Arts and Cultural Affairs

Screenshot

EXPLANATORY STATEM
THE INTERIOR, ENVIR
APPROPRIATIONS BIL

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For this bill, estimat
obligational authority, in
available for the wildlan
$6,586,250,000 in advance
grams and activities of th
ment of the Interior, excep
lowing related agencies:

Environmental Protection
Department of Agriculture
Undersecretary for Natu
Forest Service
Department of Health and
Indian Health Service
National Institute of Environmental Health Sciences
Agency for Toxic Substances and Disease Registry
Other Related Agencies:
Council on Environmental
Quality
Chemical Safety and Hazar
Office of Navajo and Hopi I
Institute of American Indi
Arts Development
Smithsonian Institution
National Gallery of Art
John F. Kennedy Center for
Woodrow Wilson Internatio
National Foundation on the
Commission of Fine Arts
National Capital Arts and Cultural Affairs

National Fish Hatchery System Operations.—The bill provides $83,774,000 for National Fish Hatchery System Operations. This is $18,223,000 over the enacted level and $2,000,000 above the budget request. Funding in the amount of $5,000,000 is provided for the Warm Springs Fish Health Center (FHC) which provides disease diagnosis, biosecurity and disease management, disease treatment and prevention, fish health inspection services for Federal, State, and Tribal hatcheries responsible for production of salmonids and warm water species for recovery, restoration, and recreational fisheries, and inspections and certifications for the National Triploid Grass Carp Program.

SCOPE OF WORK: The aim of this cooperative project between Auburn University's Southeastern Cooperative Fish Parasite and Disease Lab (aka AU Fish Disease Lab, AU-FDL) and the US Fish and Wildlife Service's Fish Health Center (USFWS-FHC, Warm Springs, GA) is to increase capacity for fish disease diagnostics. Demand for fish disease diagnostics clearly exceeds existing infrastructure at AUFDL and USFWS-FHC. These funds will directly benefit the state fisheries agencies already in cooperation with AU-FDL (i.e., AL, GA, SC, NC, TN, WV, MO) while also providing a supporting role to the USFWS-FHC. These funds will hasten further university-federal entity partnerships in fish health, including the mission critical focus areas of state and federal hatchery system biosecurity, surveillance of wild fish populations for new and emerging pathogens (including exotic invasive species and aquatic nuisance species), in-service training and cross-fertilization of methodologies and approaches between the AU-FDL and USFWS-FHC. Personnel from both labs will routinely interact and cooperate on disease diagnostics to assist state and federal partners. Equipment purchased by this award will be sited at Auburn University but shared and used by both AU-FDL and USFWS-FHC personnel.

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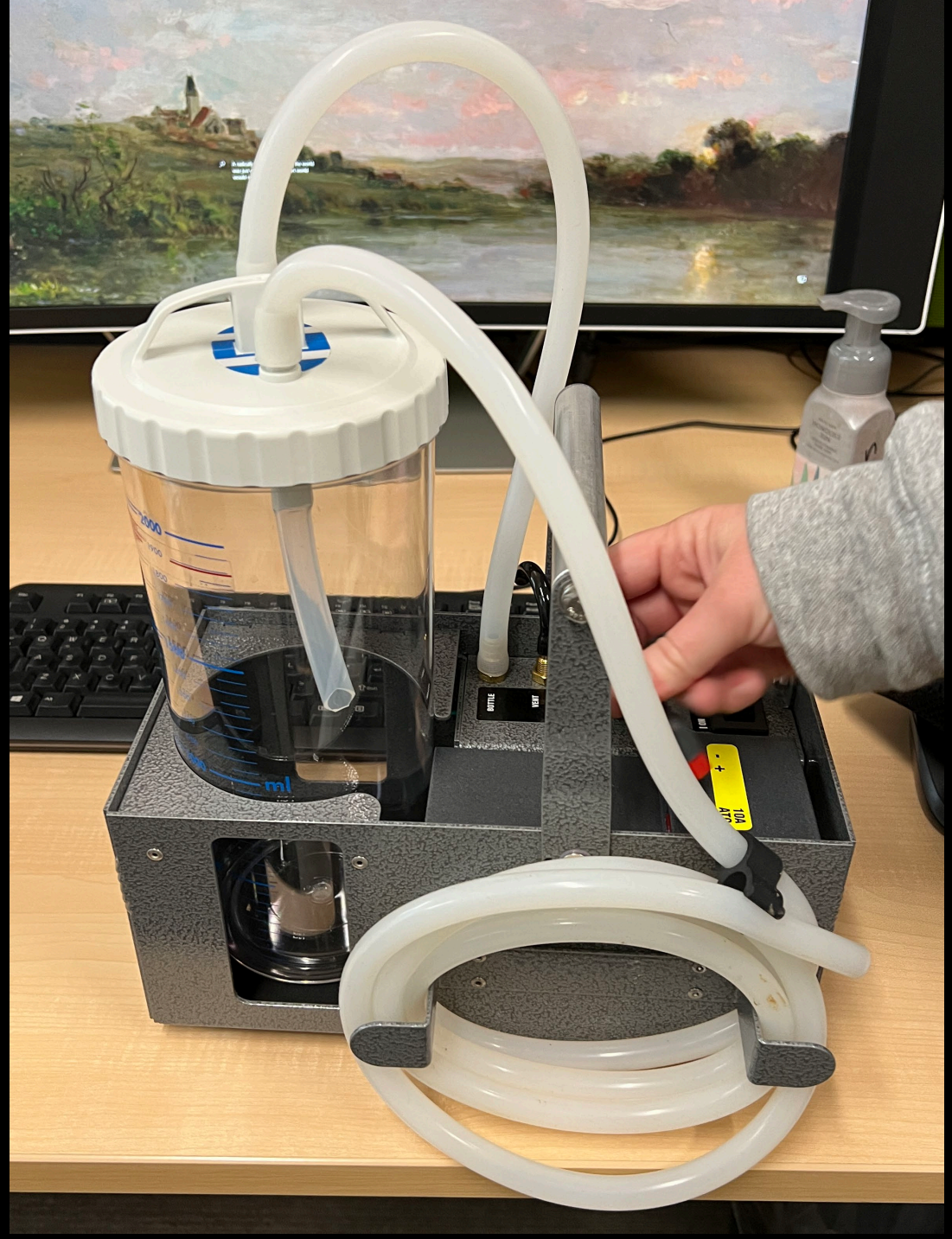
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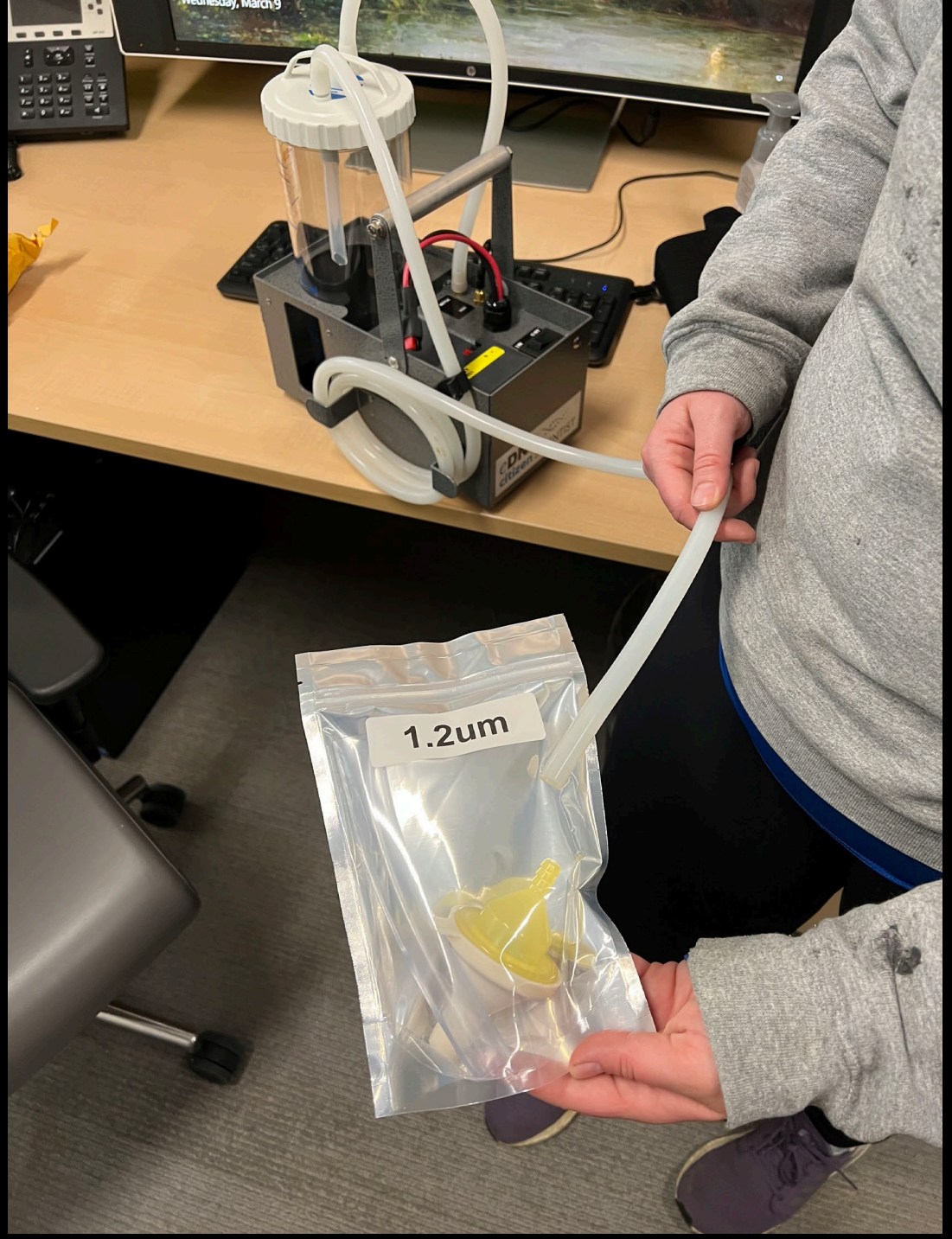
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National Aquatic Animal Health Plan

Last Modified: Jun 2, 2020

Print

National Aquatic Animal Health Plan

The National Aquatic Animal Health Plan (NAAHP) provides guidance for efficient, safe, and effective national and international commerce of aquatic animals; protection of cultured and wild aquatic animals from foreign pests and diseases; the U.S. government to meet its legal trade obligations; and, the availability of diagnostic and certification services for public, private, and tribal entities.

The National Aquatic Animal Health Plan (NAAHP) for aquaculture in partnership and cooperation with industry, regional organizations, State, local and Tribal governments and other stakeholders will:

- Facilitate the legal movement of all aquatic animals, their eggs, and products in interstate and international commerce;
- Protect the health and thereby improve the quality and productivity of farmed and wild aquatic animals;
- Ensure the availability of diagnostic, inspection, and certification services; and
- Minimize the impacts of diseases when they occur in farmed or wild aquatic animals.

NAAHP Goals

The goal of the NAAHP is to provide recommendations to industry, States, tribes, Federal agencies, and other stakeholders in support of the mission. These recommendations are not part of an overarching regulatory program to be implemented by the Federal government. Rather, the recommendations should be considered by all stakeholders, whose cooperation is essential if the mission of the NAAHP is to be met.

Activities addressed in the NAAHP include the following:

- Defining pathogens of national concern;
- Preventing, controlling and managing pathogens and/or the diseases caused by those pathogens;
- Describing and implementing surveillance programs;
- Creating and implementing disease management zones;
- Identifying priority areas for research and development in aquatic animal health, including identification of g funding structures and recommendations on leveraging resources;
- Describing strategies for continued outreach and awareness regarding national aquatic animal health

Screenshot

Plan Purpose

The purpose of this document is to describe the plan that replaces the 2008 National Aquatic Health Animal Plan (NAAHP). This new National Aquaculture Health Plan & Standards (NAHP&S) presents the USDA vision for a strong domestic infrastructure for supporting and determining aquatic livestock health. Further, this plan establishes USDA as the Federal lead agency for the oversight of the health and promotion of farm-raised aquatic livestock. This new plan does not apply to wild animals or public operations supporting wild animals. The domestic aquaculture industry has changed significantly in the past decade and is poised to expand even more in the decades to come. This expansion and growth are crucial for domestic food security and safety. The elements presented in this new national plan are deemed essential to support the needs and growth of U.S. aquaculture such that farm-raised aquatic livestock are produced in a manner which provides health and management oversight as well as addresses the integrity and consistency of services used to determine and evaluate aquatic animal health.

Plan Goal

The overarching goal of this new National Aquaculture Health Plan & Standards is to protect and support the health of farm-raised aquatic livestock reared in any private aquaculture operation setting for any end use. This goal is achieved by establishing oversight and implementing risk-based approaches for sound health assessment and development of management practices to protect and support the health of farm-raised aquatic animals and to prevent the introduction, spread, or release of pathogens of concern.

USDA is committed to working toward seeing these standards initiated in the first 2 years of this plan's inception by working collaboratively with all partners, including industry, Federal departments, State agencies, Tribal entities, and allied enterprises. Activities that support the plan goal are addressed in this plan and include the following:

"THE COOPERATIVE"

*8x multiplier

Cooperative state contracts

- Alabama Marine Res Division (AL-MRD)
- Alabama Inland Fisheries (ADCNR)
- Georgia Dept. Conservation & Nat Res (GADNR)
- South Carolina Dept. Cons & Nat Res (SCDNR)
- North Carolina Wildlife Resource Comm (NCWRC)
- West Virginia Dept. Nat. Res. (WVDNR)
- Tennessee Wildlife Res Agency (TWRA)
- +supplemental contracts (deep dive projects)

Other contracts

- Southern Regional Aquaculture Center (SRAC)
- USFWS
- NSF
- USDA
- Gulf of Mexico Research Initiative
- National Sea Grant
- MS-AL SeaGrant