



Volume 14, Number 2
Second Quarter, 2020

The



quatic

eterinarian



WHO ARE WE

MISSION

The Mission of the World Aquatic Veterinary Medical Association is to serve the discipline of aquatic veterinary medicine in enhancing aquatic animal health and welfare, public health, and seafood safety in support of the veterinary profession, aquatic animal owners and industries, and other stakeholders.

OBJECTIVES

- A.** To serve aquatic veterinary medicine practitioners by developing programs to support and promote our members, and the aquatic species and industries that they serve;
- B.** To be an advocate for, develop guidance on, and promote the advancement of aquatic animal medicine within the veterinary profession and with associated industries, governments, non-governmental entities and members of the public;
- C.** To develop and implement aquatic veterinary education programs, certifications and publications, including a credentialing process to recognize day-one competency in aquatic animal medicine;
- D.** To foster and strengthen greater interactions among: aquatic veterinarians, related disciplines, veterinary allied and supportive groups and industries, governments and animal owners.

The ideas presented in this publication express the views and opinions of the authors, may not reflect the view of WAVMA, and should not be implied as WAVMA recommendations or endorsements unless explicitly stated.

Information related to the practice of veterinary medicine should only be used within an established valid Veterinarian-Patient-Client Relationship.

© 2020 World Aquatic Veterinary Medical Association

ISSN 2329-5562



Editorial Staff

Nick Saint-Erne (USA) TAVeditor@wavma.org
Executive Editor

Communications Committee:

David Scarfe (USA) - Chair
Stephen Reichley (USA)
Chris Walster (UK)
Devon Dublin (Japan)

WAVMA Executive Board

Jena Questen (USA) President@wavma.org
President

Stephen Reichley (USA)
President-Elect

Devon Dublin (Japan)
Immediate Past President

David Scarfe (USA) Secretary@wavma.org
Secretary

Nick Saint-Erne (USA) Treasurer@wavma.org
Treasurer

Nelly Isyagi (Africa/Middle East)
Claudia Venegas (Americas)
Stephen Pyecroft (Asia/Pacific)
Dusan Palic (Europe)
Directors-at-Large

Non-voting Advisors:

Laura Urdes (Romania)
Fellowship Advisory Council

Chris Walster Administrators@WAVMA.org
Administrator

Past Presidents

Peter L. Merrill (USA)	2007
Ron Roberts (UK)	2008
Hugh Mitchell (USA)	2009
Fotini Athanassopoulou (Greece)	2010
Julius Tepper (USA)	2011
Dusan Palic (Germany)	2012
Mohamed Faisal (USA)	2013
Richmond Loh (Australia)	2014
Chris Walster (UK)	2015
Nick Saint-Erne (USA)	2016
Laura Urdes (Romania)	2017
David Scarfe (USA)	2018
Devon Dublin (Japan)	2019

Past Secretaries and Treasurers

Chris Walster, Secretary	2007-2013
Devon Dublin, Secretary	2014-2017
Stephen Reichley, Secretary	2018-2019
David Scarfe, Treasurer	2006-2007
Dusan Palic, Treasurer	2007-2010
Nick Saint-Erne, Treasurer	2011-2014
Sharon Tiberio, Treasurer	2015-2017

Editorial 4
 Advertising Rates 4

Executive Reports 5-10
 President’s Report 5
 Secretary’s Report 6
 Treasurer’s Report 7
 WAVMA Elections 8
 Meet the Regional Directors 8-10

Privileges & Benefits of WAVMA Membership 11

Committee Reports 11-18
 WAVMA Committees 11
 Credentialing Committee 12-13
 Certified Aquatic Veterinarians 13
 Fellows Advisory Council 14
 Executive Board Responsibilities 14
 Meetings Committee 14
 Exciting Changes Around the Corner.....15
 Join A WAVMA Committee 15
 Education & Student Committee.....16
 New Advantages For WAVMA Members.....17
 J.L. Pitts Aquatic Education Awards 17
 New Student Chapter—Edinburgh.....18

Instructions for Authors and Contributors ... 19

Colleague’s Connection 20
 Meet: Dr. Terra MacDonald 20-21

Centerfold 22-23
 Albino Alligator at the Wildlife World Zoo

Case Reports 24-39
 Cholangiocarcinoma and papillary mesothelioma in an albino American alligator (*A. mississippiensis*)
 By Sharmie Johnson 24-33
 Mycobacteriosis in a betta fish (*Betta splendens*)
 diagnosed after treatment with enrofloxacin
 By Jenifer L. Nix, BVSc 34-39

Grand Rounds Case 40-41
 Fish Parasites 40-41
 The Aquarium Vet E-Workshop – Parasite ID and their Management 41
 Websites with illustrated guides to fish parasites 41

Aquatic Veterinary Abstracts: Fish Parasites.. 42
 Guide to the Identification of Fish Protozoan and Metazoan Parasites in Stained Tissue Sections .. 42
 Parasitology and Necropsy of Fish 42
 Parasites of Juvenile Brook Trout (*Salvelinus fontinalis*) from Hunt Creek, Michigan, USA 42
 Helminth Parasites of South American Fishes: Current Status and Characterization as a Model for Studies of Biodiversity 42
 Use of praziquantel to control platyhelminth parasites of fish 43
 Helminth Communities of Four Commercially Important Fish Species From Chetumal Bay, Mexico 43

Aquatic Veterinary CE & PD 45-47
 Atlantic Salmon Conservation Foundation ... 45

Sponsors
 WAVMA Shop7, 9
 The Bug Company 39
 loLight Microscope 44
 ZooMed Laboratories 48

Cover Photo:

Betta Photo by Jenifer L. Nix
 See article on pages 34-39:

Mycobacteriosis in a betta fish (*Betta splendens*) diagnosed after treatment with enrofloxacin
 By Jenifer L. Nix, BVSc
jnix@hawaii.edu



Get The Fuller Picture From WAVMA WebCEPD Online Webinars

WAVMA’s WebCEPD Program - Webinars for Global Aquatic Veterinary Education

Given by leading experts, WAVMA’s real-time and recorded WebCEPD webinars are intended as educational programs on key aquatic veterinary issues and techniques to hone the knowledge and skills of aquatic veterinary students and practitioners.

<https://www.wavma.org/WebCEPD>

Discover core knowledge, skills & experience needed to become a WAVMA Certified Aquatic Veterinarian (CertAqV)

Did you know that WAVMA’s **CertAqV Program** offers members the opportunity to become recognized and certified as having competency in 9 core areas deemed necessary to practice aquatic veterinary medicine? Find out more information online at: <http://www.wavma.org/CertAqV-Pgm>.

Editor’s Note

One of the greatest rock music groups of all times, *The Moody Blues*, has a song entitled “Strange Times,” which has the lyrics: “We are living in Strange Times, Strange Times, Strange Times...What do we need? What do we hunger for? Who holds the secrets? Who will know?” These indeed are strange times we are living in now, and we don’t know what is in store for us in the near future. However, WAVMA continues to function and is moving forward.

Our illustrious President, Jena Questen has an equally poetic summary of the WAVMA activities during this Strange Time on page 5 of this issue. More information about all of the changes going on around WAVMA can be found in the report on page 15. The Executive Board has been very busy this year, along with all our committees (see page 11 for a list of committees), so be sure to read the Committee Reports starting on page 12 to get the latest information.

You might be interested to learn more about some of the Executive Board members, so there are profiles of our four Regional Directors on pages 8-10. And don’t forget our elections for 2021 Officers and Directors will happen shortly. All veterinarian members are able to run for office and to serve on committees. Other members can also serve on committees, so all members are welcome to join a committee.

We have two interesting Case Reports in this issue; one by Sharmie Johnson (pages 24-33) and another by Jennifer Nix (pages 34-39). Not all of our cases turn out the way we wish, but we can all learn from each others experiences. Please consider sending in a case report on one of your aquatic patients. Or, you can send in your story on how you became involved in Aquatic Veterinary Medicine, as Terra MacDonald did, for our Colleague’s Connection (see pages 20-21).

Hoping you have a great summer, and stay safe and healthy!

Nick Saint-Erne, DVM, CertAqV
 Executive Editor
TAVeditor@wavma.org



Download a QR reader onto your Smart Phone and scan the Quick Response Code to the right. It will take you to the WAVMA.org website page for accessing all of the past WAVMA Newsletters.



You will need your WAVMA User ID and Password to access the most recent issues of *The Aquatic Veterinarian*.

The latest editions are available for download at <https://www.wavma.org/TAV-Current-Issues>.

Past years’ editions are available for download at <https://www.wavma.org/TAV-Archives>.



The Aquatic Veterinarian

**The Quarterly Magazine of the
 World Aquatic Veterinary Medical Association**

**Consider promoting your products, services
 or programs to aquatic veterinarians,
 veterinary students, nurses &
 paraveterinary professionals
 throughout the world**

Advertising Rates (per issue)

	Commercial	Non-Profit
Full page (~7" x 9")	\$100	\$50
1/2 page (~7" x 4.5") or 1 column (3.5" x 9")	\$60	\$30
1/4 page (~3.5 x 4.5")	\$30	\$15

WAVMA Members

Free 1/8 page (business card size) advertisement
 Contact TAVeditor@wavma.org for information on
 advertising and payment options.

President's Report

Dear colleagues,

My sincerest hope is that this message finds you all healthy and safe. We all now get to experience a unique time in modern history as a human being. Recently, I heard it said that in times of utmost uncertainty comes clarity on what matters most. I believe this is true. The fact that WAVMA has continued to make large strides as an organization in the first half of this year, even in the face of the difficulties of this pandemic, is uplifting to me that we all continue to find WAVMA and its mission a priority. That says a lot about the professionalism of the members of this organization. I am now prouder than ever to be a part of it, as well as to observe the depth of its significance that the members feel in order to maintain such a strong commitment in the face of profound worldwide uncertainty.

Thank you, to all members who have continued to call in for meetings, answer a flurry of emails, and continued the commitment to furthering aquatic animal medicine, even when the whole outside world seemed to be turned upside down (or more like locked up inside). It could be that having something 'normal' to hold onto has helped us all get through these strange times; however, I believe it's more than that. It has not been easy to continue to work as an organization during this pandemic, yet work we have, and that speaks volumes about how important we feel the work of WAVMA ultimately is.

One day we will finally reach what we call the 'new normal', and in it, WAVMA will be ready to fulfill the mission to be the number one go-to organization in the world for all things related to aquatic animal medicine. We have been working hard for months on building a new website, for one task. The intricacies of how to make that work are likely more complex than you can imagine. Something seemingly simple like having a library of photographs of different diseases becomes a quagmire of verifying if the photo is legitimate and who is going to determine that, to copyright issues and giving credit where credit is due, as well as to not only providing education to the members, yet still upholding our level of science and professionalism, but to ensure what we provide is of the highest quality. I assure you it is much more complicated than just allowing members to upload to a photo gallery.

Besides that, there are the technical issues of moving webinars to the new platform, tracking when members pay dues and how that effects line items in the budget, making decisions about what educational opportunities to prioritize this year in the wake of so many in person meetings being canceled, as well as onboarding our new paid administrative assistants in such a way as to help make all the organizational tasks easier and more streamlined in the years to come for those who will step into their shoes one day.



WAVMA is working on a lot, in the background, week after week, from subcommittees to the Executive Board itself, to not only make the organization better and stronger, but is laying a solid framework for strong growth in the future. There are literally months of hard work needed to iron out almost unfathomable details to make the whole thing work.

I think it is important for you to know, what is happening on the backside of things, so to speak, so that although it may seem to the outside not much is happening, there certainly is, and it is inspiring to me to see all the selfless work of our members to help make this organization the great sleeping giant that it is. One day soon, the world will see just how amazing WAVMA is, and how dedicated it's members are, because, in this time of great uncertainty, WAVMA has remained a great priority, and that speaks volumes about how valuable the members feel this organization is for the future of aquatic animal education. It is awe inspiring to observe, and an honor to be a part of it.

I am so grateful to be serving as your president during this unique year, and even more grateful to my talented colleagues who help make the job easier and help me stay on track. Thank you all, especially for all you do for the fish that need us so much. Take care and stay healthy, everyone!

Jena Questen, DVM, CertAqV
2020 WAVMA President
President@WAVMA.org

Secretary's Report

The COVID-19 situation has disrupted everyone's activities around the world, and I hope all our members are taking all precautions necessary to not get infected, or spread this coronavirus to others. Despite these disruptions, the WAVMA Executive Board and Committees have continued to have virtual meetings to ensure WAVMA programs continue moving forward. But adversity usually opens opportunities, and crises often force us to find different ways of doing things. If we haven't learned what Charles Darwin's should have taught us about adaptability, we too would be destined for extinction.

With the Board meeting held almost monthly, several important decisions have been made in 2020 to help WAVMA become more effective and efficient, particularly as income from dues and non-dues programs have put WAVMA in a more secure financial position. Some initiatives spearheaded by the Board and Committees, and assisted by the administrative assistants we have hired, include:

- Examining a Strategic Plan to develop a "road map," in accord with WAVMA's Mission, Objectives, Values, that addresses member's needs, hopes and desires;
- Modernize the platform that the WAVMA website and membership database is built on to make it easier to use;
- Requesting the Meetings Committee to consider the feasibility of a stand-alone WAVMA 2020 virtual conference and AGM, particularly as most of the meetings that WAVMA presents aquatic sessions for have been cancelled or postponed until 2021;
- Revamping the WebCEPD Program with invited speakers to give webinars, and that members can earn continuing education and professional development credit from attending;
- Distributing important information to members and others through WAVMA e-News and social media platforms;
- Providing \$3,000 towards the 2020 Pitt's Aquatic Education Awards that support veterinary students and new graduates in activities that allow them to get more experience in aquatic veterinary medicine;



- Expanding outreach and support to Student Chapters at veterinary schools throughout the world, and providing up to \$500 to support active Student Chapters that submit proposal for activities to allow opportunities for more veterinary students to become involved with aquatic veterinary medicine; and,
- Considering recognizing individuals who have made significant contributions to WAVMA and advancing aquatic veterinary medicine as WAVMA Distinguished Fellows.

We encourage members to provide feedback to the Executive Board on any of these, or other issues you feel the Board might like to consider.

Stay healthy and keep in touch with WAVMA through the members Listserv:

WAVMA_Members-L@wavma.org

A. David Scarfe PhD, DVM, MRSSAf, CertAqV
WAVMA Secretary
Secretary@wavma.org

The Aquatic Veterinarian is meant to be read as a 2-page spread (like a paper magazine!). To view it this way on your computer, open the pdf document using Adobe Acrobat or Adobe Reader, then go to the menu bar at the top of the computer screen and click on View, then Page Display, then Two Page View. That will allow you to scroll through the issue seeing the cover page by itself first, followed by two pages side by side for the rest of the issue. Doing this, you will be able to see the Centerfold picture in all its ginormous glory!

**TO SUPPORT FUTURE STUDENT
SCHOLARSHIPS, PLEASE MAKE
A DONATION TODAY
TO THE SCHOLARSHIP FUND!**

[WWW.WAVMA.ORG/
SCHOLARSHIPS.](http://WWW.WAVMA.ORG/SCHOLARSHIPS)

Treasurer's Report

Due to the COVID-19 viral pandemic, many conferences around the world have been cancelled, postponed or have become online virtual conferences (see pages 46-47 for more information). Because of this, most of our allocation of funds for the Meetings Committee budget has not been spent this year. Assuming it is safe to travel in 2021, WAVMA will be able to have a much bigger presence in Veterinary meetings held around the world. Our funds are higher than anticipated in our WAVMA coffers, however, we are updating the WAVMA.org website and this is a major expenditure, so it is good to save some money this year. Overall, WAVMA is in great financial shape and the Executive Board has many new things planned for WAVMA members in the coming year.

Nick Saint-Erne, DVM CertAqV

WAVMA Treasurer

Treasurer@WAVMA.org**New Members—Second Quarter 2020**

Members are the life-blood of any professional Association. Please join us in welcoming the following new WAVMA members:

Veterinarians

Alicia McLaughlin
Tera Winters
Linda Nachtigal
Lucie Nedved
Latoya Latney
Andrei Hodadea
Devon Lycette
Maximilian Polyak
Corey Cole
Elizabeth Arnett
Thomas Wootton
Norrapat Towanabut
Susanne Seward

Veterinarian—New Graduate

Catherine Love

Vet Graduate Student, Intern or Residents

Gail Huckins
Sarah Wilson
Renata Fiedler
Melanie Peel
Michael Martinez
Sarah Balik
Yesutor Soku

Vet Student Members (enrolled in Vet Curriculum)

Kathy Fioretti
Bekah Weatherington
Scott Bergmann

Vet Student Members—continued

Patricia Fawley
Sophie Trowbridge
Megan Michitsch
Alex Hall
Keana Sloos
YeeChing Alison Liu
Benjamin Harrison
Chloe Roberts
Eileen Briceño Villanueva
Geoffrey Winger
Melanie Kiskanyan
Kayla Lashley
Christine Pedranghelu
Michelle Greenfield
Crystal Liu
Ehren Anderson
Sydney Byrd
Maddison Rokosh
Monica Hodapp
Maya Iyer
Rachel Plasterer
Kelsey Reames
Josie Thal
Shoshana Zenilman
Amanda Wen

Welcome to WAVMA!

**DO YOU HAVE A STORY TO TELL ABOUT
HOW YOU BECAME INVOLVED WITH
AQUATIC VETERINARY MEDICINE?**

Send your article (<1,000 words) with pictures to:

TAVeditor@wavma.org.

WAVMA Shop

A number of WAVMA branded items
(including shirts, mugs, caps) are available
at the WAVMA Store. Get yours today!

Go to: <http://www.wavma.org/Shop>

WAVMA Elections

It's not too soon to think about standing for election for a 2021 officer or director on the WAVMA Executive Board. The positions of President-Elect, Secretary, Treasurer, and the four Regional Directors are up for election each year. We rely on our veterinarian members to run for positions on the Executive Board to help keep the organization moving forward. The Executive Board meets monthly via web conferencing and we have had board members from all around the world. It doesn't matter where you live—only that you are willing to help out! Nomination for offices will open this summer and be available until the end of September. To nominate yourself or another person for a WAVMA Executive Board position, contact our Administrator, Chris Walster: Administrators@WAVMA.org.

All of the great programs and features you get from WAVMA membership are provided by volunteers. We are always looking for more helpers, whether veterinarians, veterinary students or veterinary nurses, to join us on the committees as well. If you are not interested in running for office, but would like to provide your input and guide the future of WAVMA, join one of our committees (no previous experience necessary!). See a list of our committees on page 10. Contact our Secretary or the committee chair for more information about the committee and the dates of the next meeting (also done via web conference). All are Welcome!

Join a WAVMA Committee today!



Meet our Regional Director-at-Large—Asia-Pacific:

Stephen B. Pyecroft (Australia) BVSc (Hons), PhD, MANZCVSc (Aquatic Animal Health Chapter), MANZCVSc (Pathobiology Chapter).

I have been working in the field of aquatic animal health for more than 30 years as a veterinarian, within private fish only practice, government diagnostic veterinary laboratories and now university research and teaching. Since 1995 I have been the Director of Aquatic Diagnostic Services International Pty Ltd., performing disease diagnosis and management of aquaculture species. I also am a lecturer at the University of Queensland, Parasitology Department, where we are conducting research on an as yet un-named protozoal parasite which causes generalised granulomatous pathology in the common goldfish (*Carassius auratus*), the identification of the causative organism, epidemiological investigations and describing the host response to the organism were aided by the use of DNA probes, PCR assays, cell culture, and in situ Hybridisation techniques..

I have been a WAVMA member for a couple of years and think it is about time I became involved in the workings of the organization. The members are a group of renown aquatic animal health experts and hence are a significant resource of expertise and information for all working in the field of AAH. I see a role for all board members to make this resource accessible to fellow veterinarians, aquaculturalists, aquarists and veterinary students. I see a role on the board enhancing my ability to understand the organisation and so enable promotion and access to it. A growing active membership is key to any organisation because if you are not growing you are moving backwards.

The Asia-Pacific is a region containing much of the worlds aquaculture production and hence an active veterinary engagement. We need to maximise WAVMA's exposure to these veterinarians and hence potential membership. With this global engagement then comes presence for the organisation in all things AAH. WAVMA becomes the go-to organisation for advice and scientific rigor when there are discussions of health and welfare of aquatic animals.

The WAVMA resource needs to be utilised for CPD as well as education of the next generations of AAH experts. With youth or new blood comes continued enthusiasm and new ideas for the organization. I see my role on the board as active promotion and organisation of CPD opportunities for AAH veterinarians in the Asia-Pacific region. Leveraging existing experience and developing new educational opportunities are some things I would like to explore and develop for the organisation.

Left: WAVMA Regional Director Stephen Pyecroft

Regional Director-at-Large—Africa and Mid-East:

Ajangale Nelly Isyagi (Uganda) BVSc (Makerere University, Kampala, Uganda); MSc, Aquaculture (Wageningen University, The Netherlands); PhD, Aquaculture (Stirling University, United Kingdom)

Membership: Uganda Veterinary Association, Uganda Association of Impact Assessors, World Aquaculture Society, WAVMA

Aquatic Veterinary Experience:

National level – clinical work, development of health management plans for farms, training vet students, technicians and farmers, policy formulation, developed the fish health management program at our national Aquaculture Research Center, reporting for OIE, currently developing OH fish health research with the vet faculty.

Continental/International – was responsible for all matters on aquatic animal health (AH) in Africa (African Union, Interafrican Bureau of Animal Resources); spearheaded and supervised development of regional frameworks for aquatic animal disease control and networks, disease mapping survey to up-date on status of AH, AU-ARIS aquatic animal health module, continental training for national vets/OIE aquatic focal points and fisheries officers, developed OIE Africa common positions, proposals for programs including for establishment of aquatic vet regional centers of excellence, developed AH input in Africa's continental Animal Health and Welfare Strategies, currently member of AU-IBAR animal health experts committee.

Vision and plans as an Executive Board Member:

Given my broad experience covering technical, training, policy and diplomacy on aquatic veterinary issues at both national and international level working with (different cultures, political and socio-economic contexts) as well as the fact that I have personally interacted with those responsible for aquatic animal health in all African Member States and Regional Economic Communities (including practitioners and producers), I intend to:

1. Mobilize African membership and participation in WAVMA,
2. Assist recognizing the role of WAVMA as a technical reference resource from which public and private sector entities could seek non-biased sound independent guidance on AH; including where trans-boundary co-operation/trust-building on AH is required, and
3. Promote the role and contribution of vets in AH particularly in rapidly growing aquaculture sector, fish trade, blue economy and aquatic natural resource conservation.



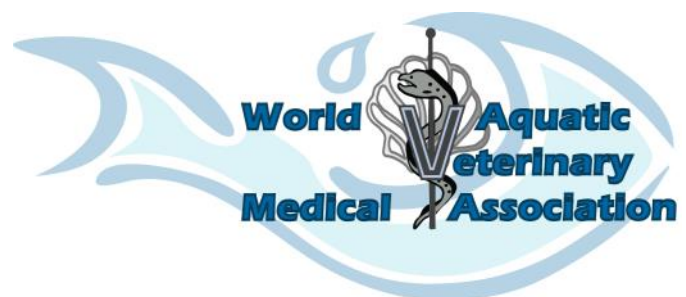
WAVMA Regional Director Ajangale Nelly Isyagi

WAVMA Shop

A number of WAVMA branded items
(including shirts, mugs, caps) are available
at the WAVMA Store. Get yours today!



Go to: <http://www.wavma.org/Shop>



Regional Director-at-Large—Europe:

Dušan Palic (Germany) DVM (Belgrade University 1997); MVSc (Veterinary Microbiology and Preventive Medicine, Immunology focus, Belgrade University 2002); PhD (Iowa State University, 2005, with honors, Immunobiology and Fisheries Biology); WAVMA CertAqV (2013); Dipl.ECAAH (Diplomate European College of Aquatic Animal Health, 2015).



Membership: WAVMA, ECAAH, IABS, AVMA, AFS-FHS, EAFP (also German Chapter)

Aquatic Veterinary Experience: University Professor and Chair of Fish Diseases and Fisheries Biology, Faculty of Veterinary Medicine, Ludwig-Maximilians University, Munich, Germany. WAVMA Fellow and former President (2012). Over 20 years work experience in aquatic (fish) veterinary medicine practice, teaching, research and service in the U.S. and Europe. FAO Senior Aquatic Animal Health Expert. Founding Diplomat and European College for Aquatic Animal Health.

Vision and plans as an Executive Board Member: I hope to work closely with the Executive Board, committees and general membership to assist in increasing WAVMA visibility and presence in Europe and globally, and also to strengthen WAVMA ties with current partners (e.g. World Veterinary Association, World Small Animal Veterinary Association) and establish formal partnerships with new organizations (e.g. Federation of Veterinarians of Europe, European College of Aquatic Animal Health).

Regional Director-at-Large—Americas:

Claudia Venegas (Chile) MV (Médico Veterinario, Facultad de Ciencias Veterinarias y Pecuarias, Universidad de Chile, Santiago, Chile); PhD (Faculty of Applied Biological Sciences, Hiroshima University, Japan), WAVMA Certified Aquatic Veterinarian.



Membership: WAVMA, EAFP, Japanese Society of Fish Pathology (JSFP), International Society of Aquatic Animal Epidemiology (ISAAE), Iberoamerican Society of Veterinary Epidemiology and Preventive Medicine (SIEVMP),

Aquatic Veterinary Experience: With more than 20 years of professional experience, I have been engaged in the academia as a lecturer (Universidad de Chile, Universidad Andres Bello), researcher and management. In the private sector I have been in salmon farming practice and diagnostics lab for the salmon industry in Chile. Since 2008 I was part of a joint venture of research institutions (Norwegian) with focus on research projects for the aquaculture sector in Chile dealing with fish health/diseases, feed and feeding, engineer and technology. Currently, I'm the Scientific Coordinator-Station Veterinarian of VESO, a CRO with main offices and facilities in Norway and Chile, where we mainly deal with clinical trials and R&D to develop new treatments (vaccines, VMPs, etc.) for the aquaculture industry both in Chile and Norway.

I serve as President of the National Scientific and Technical Committee for Aquaculture - Sanitary issues within the umbrella of the Undersecretariat of Fisheries and Aquaculture, Ministry of Economy, Chile (2018-2021).

Vision and plans as an Executive Board Member:

I hope to represent WAVMA members' interests and help to expand WAVMA's presence in my country, Chile, and in other countries in South America. I'm also interested in fostering the continuing education opportunities to already experienced veterinarians to provide updated information and in-depth discussions. I would like to create synergy with other veterinary and non-veterinary organizations (societies/associations) regarding the topics on aquatic animal health in order to generate a concrete impact of the improvement, promotion and expansion of aquatic veterinary medicine and fish health/welfare in general.

PRIVILEGES & BENEFITS OF WAVMA MEMBERSHIP

Aquatic Veterinary e-Learning

Supporting WAVMA's WebCEPD, PubCEPD
 CertAqV & Clinical Cases Programs.

- Enjoy on-line *e-Learning* programs & courses to advance your knowledge & skills
- Get continuing education credit through *WebCEPD, PubCEPD & Clinical Corner*
- Discover core knowledge, skills & experience needed to become a WAVMA Certified Aquatic Veterinarian (*CertAqV*)
- Receive *discounted* subscriptions to publications & meetings
- Utilize WAVMA's *picture & video libraries* for your own presentations
- Join *listservs* to discuss clinical cases & other issues
- Mentor & be mentored to expand your and other's aquatic veterinary skills
- Publish your articles in WAVMA's quarterly journal: *The Aquatic Veterinarian*
- Find world-wide externships, internships, residencies & jobs in all aquatic vet areas
- Access *Member Directories* & have your Clinic/Hospital listed on-line
- Benefit from *Educational grants* for vet students & new veterinary graduates
- Form & participate in *veterinary school chapters* throughout the world
- Participate in veterinarian and client surveys
- Help build additional member programs by serving as an Officer, Director or Committee Member

TO SUPPORT FUTURE STUDENT
 SCHOLARSHIPS, PLEASE MAKE
 A DONATION TODAY
 TO THE SCHOLARSHIP FUND!
[WWW.WAVMA.ORG/
 SCHOLARSHIPS.](http://WWW.WAVMA.ORG/SCHOLARSHIPS)

WAVMA Committees

As a member-driven organization, WAVMA relies on volunteers to help implement programs useful for all members. Any WAVMA member can volunteer on a Committee to help shape the direction of the Association, meet new colleagues, forge valuable and lasting relationships, and help address key issues affecting aquatic veterinary medicine today. To find out more about serving on a Committee, please contact the Committee Chair or the WAVMA Parliamentarian.

Budget and Finance Committee

This Committee develops and regularly revises the Association's annual budget and assists the Treasurer, as necessary, in developing the Association's annual financial reports and tax materials.

This Committee shall consist of the Treasurer (Chair); the President-Elect; and one other member of the Executive Board who will volunteer to serve a one-year renewable term.

Chair: Nick Saint-Erne, Treasurer@wavma.org

Communications Committee

This Committee manages the communications among members and others involved with aquatic veterinary medicine. It oversees the listservs, membership lists, publication of WAVMA's quarterly journal *The Aquatic Veterinarian*, e-News, Facebook, Twitter, LinkedIn and other social media accounts.

Chair: David Scarfe, Secretary@wavma.org

Credentialing Committee

This Committee oversees and administers the Cert-AqV Program for credentialing aquatic veterinary practitioners, and evaluates aquatic veterinary educational programs useful to members.

Chair: David Scarfe, dscarfe@ameritech.net

Meetings Committee

This Committee oversees and coordinates logistics for WAVMA-organized or sponsored aquatic veterinary educational meetings, including the Annual General Meeting.

Chair: Julius Tepper, cypcarpio@aol.com

Membership Committee

This Committee oversees membership issues to optimally serve individual members and the organization. Chris Walster, chris.walster@onlinevets.co.uk

Education & Student Committee

This Committee facilitates networking between student members and helps development of educational programs and services.

Chair: Bartolomeo Gorgoglione, BartGorg@msu.edu

Credentialing Committee

The WAVMA Certified Aquatic Veterinarian Program has proven to be exceedingly successful and a program being well used by members. Originally, the program was intended to provide guidance for veterinarians and veterinary students on what core (“Day-1”) competencies are necessary to practice aquatic veterinary medicine, and recognize those individuals who have attained the required knowledge, skill and experience (KSEs). Interestingly, the program is gaining attention by some veterinary schools, as it covers core subject matter on aquatic medicine easily incorporated into a veterinary curriculum.

After starting the program in 2013 with 11 Certified Aquatic Veterinarians, the number of individuals registering for the program has progressively increased every year. As of June 30 of this year, 206 individuals, in 31 countries have applied (Fig. 1 & 2). As we are now in our 8th year, and the Program requires members who have been certified to requalify every five years, showing they have acquired at least 50 credit hours of CEPD in the previous five years, 29 members have already re-certified for the next five years.

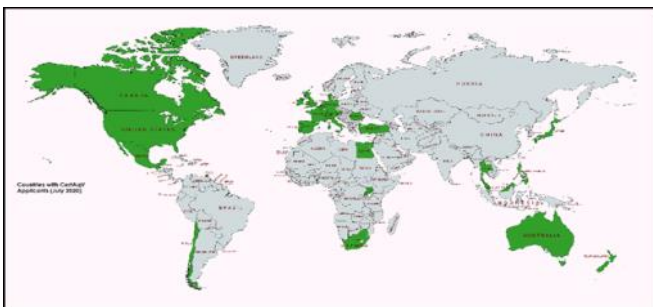


Figure 1. Countries having Certified aquatic veterinarians include: Australia, Belgium, Canada, Chile, Denmark, Egypt, France, Germany, Grenada, Holland, Hong Kong, Israel, Italy, Japan, Malaysia, Mauritius, Mexico, New Zealand, Philippines, Portugal, Romania, Singapore, South Africa, Spain, St. Kitts & Nevis, Switzerland, Thailand, Trinidad & Tobago, Turkey, Uganda, United Kingdom and USA.

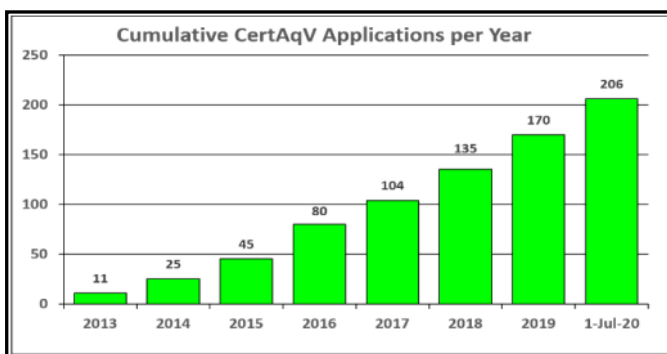


Figure 2. Cumulative CertAqV applications received each year, since starting the program in 2013.

With the continually increasing numbers of individuals wanting to be certified, we are in the process of attempting to automate a number of things, including the processes for registering, submitting the documentation required and for notifying applicants of the review/approval progress of their applications. We are grateful to the 15-members of the Credentialing Committee who evaluate what every applicant submits.

We offer congratulations to the following members that have been recognized as meeting all requirements for initial certification or renewal in 2020: June Ang, Nimrod Arad, Sarah Balik, Serena Brenner, Bart Gorgoglione, Eileen Henderson, Chelsea Hester, Leslie Jarrell, Sharmie Johnson, Denyse Khor, Alexandra Mason, Jena Questen, Eva Quijano Cardé, Zachary Ready, Stephen Reichley, Nuno Ribeiro, Patinan Rookachard, Komsin Sahatrakul, John Shelley, Esteban Soto Martinez, Greta Van de Sompel, Scott Weber, Michael Wenninger and Sarah Wright.

With having to clarify a number of questions received about the program since 2013, the Committee realized this is an appropriate time for revising the description of the Program to clarify a number of things for both applicants and mentors so that procedures are easy to follow. Once completed, they will replace the program description that is currently downloadable from <https://www.wavma.org/CertAqV-Pgm>. If any members have suggestions for the committee to consider, simply send those to: CertAqV-Admin@wavma.org.

Currently, to be credentialed as a Certified Aquatic Veterinarian and utilize the CertAqV honorific, individuals must be a WAVMA member, have earned their veterinary degree, and have demonstrated general knowledge and competency in the following nine core subject areas, as they apply aquatic species and veterinary medicine:

- Aquatic Environment and Life Support Systems
- Taxonomy, Anatomy and Physiology of Aquatic Species
- Aquatic Animal Husbandry and Industries
- Pathobiology and Epidemiology of Aquatic Animal Diseases
- Diagnostics and Treatment of Aquatic Animal Diseases
- Clinical Veterinary Experience and Client Communications
- Public Health, Zoonotics and Seafood Safety
- Legislation, Regulations, and Policies
- Principles of Aquatic Animal Welfare

While we allow applicants two years to document how they have obtained the KSEs in these areas, we advise members to not apply until you are close to having all your KSEs documented to ensure you can complete the process within two years. Veterinary students should not register until they are in their final clinical year of their degree. The process is intended to be simple for any participant, and involves:

Identifying a mentor to assist the registrant through the Program (all previously credentialed individuals are eligible to serve as a mentor, and should be contacted before a person applies; their contact information can be located in the Membership Directory at <https://www.wavma.org/directory>.

Provide the mentor with evidence of satisfactory completion of each of the core subject areas, on a form that is available after a person registers for the program.

After the mentor approves the KSEs in the applicant's credit record documents, these are reviewed and approved by the Credentialing Committee and the Executive Board before the applicant is certified and their Certificate, suitable for framing, is mailed to them.

For more information, go to the WAVMA website: <https://www.wavma.org/CertAqV-Pgm>.

A. David Scarfe PhD, DVM, MRSSAf, CertAqV
WAVMA CertAqV Program Coordinator
Credentialing Committee Chair
CertAqV-Admin@wavma.org

Certified Aquatic Veterinarians

Jessica Allen USA	Richmond Loh Australia
June Ang Singapore	Adolf Maas USA
Nimrod Arad USA	Raphael Malbrue USA
Farah Gonul Aydin Turkey	David Marancik Grenada
Sarah Balik USA	Victoria Maroun St. Kitts & Nevis
Madison Barnes St. Kitts & Nevis	Alexandra Mason USA
Heather Barron USA	Colin McDermott USA
Giana Bastos-Gomes Hong Kong	Matthijs Metselaar UK
Jenice Bell USA	Tim Miller-Morgan USA
Heather Bjornebo USA	Haiitham Mohammed Egypt
James Bogan USA	Alissa Mones USA
Pierre-Marie Boitard France	Danny Morick Israel
Serena Brenner USA	Ross Neethling UK
Erika Brigante St. Kitts & Nevis	Sally Nofs USA
Todd Cecil USA	Dušan Palić Germany
Bryony Chetwynd-Glover UK	Brian Palmeiro USA
Dondrae Coble USA	Christine Parker-Graham USA
Michael Corcoran USA	Lily Parkinson USA
Emily Cornwell USA	Ayanna Phillips Trinidad & Tobago
Rebecca Crawford St. Kitts & Nevis	Jena Qwesten USA
Charles Cummings USA	Eva Quijano Cardé USA
Nadav Davidovich Israel	Atisara Rangschol Thailand
Darren Docherty UK	Zachary Ready USA
Simon Doherty UK	Aimee Reed USA
Devon Dublin Japan	Stephen Reichley USA
Jacqueline Elliott USA	Nuno Ribeiro Portugal
Ashley Emanuele USA	Patinan Rookkachard Thailand
Azureen Erdman USA	Komsin Sahatrakul Singapore
Antonella Fabrissin Italy	Nick Saint-Erne USA
Mohamed Faisal USA	Jessie Sanders USA
Erika First USA	Sasha Saugh South Africa
Ari Fustukjian USA	David Scarfe USA
Christopher Good USA	Khalid Shahin UK
Bartolomeo Gorgoglione USA	Galit Sharon Israel
Krystan Grant USA	John Shelley USA
Miguel Grilo Portugal	Chris Shirkey USA
Stephanie Grimmett UK	Constance Silbernagel USA
Katharina Hagen-Frei Switzerland	Melissa Singletary USA
Orachun Hayakijkosol Australia	Esteban Soto USA
Eileen Henderson USA	Brittany Stevens USA
Chelsea Hester USA	Win Surachetpong Thailand
Nora Hickey USA	Gillian Taylor South Africa
John Howe USA	Julius Tepper USA
Kerryn Illes New Zealand	Sharon Tiberio USA
Leslie Jarrell USA	Laura Urdes Romania
Jimmy Johnson USA	Greta Van de Sompel Belgium
Sharmie Johnson USA	Claudia Venegas Chile
Kasper Jorgensen Denmark	Zachary Waddington Canada
Brian Joseph Canada	Sarah Wahlstrom USA
Parinda Kamchum Thailand	Chris Walster UK
Fritz Karbe Germany	Scott Weber USA
Sherri Kasper USA	Marcus Webster USA
Elizabeth Kaufman Israel	Trista Welsh USA
Denyse Khor Singapore	Michael Wenninger USA
Amy Kizer USA	Peter Werkman* Holland
Jessica Koppien-Fox USA	David Wilbur USA
Jack Kottwitz USA	Howard Wong Hong Kong
Elizabeth Leuchte UK	Sarah Wright USA
Jan Linkenhoker USA	Taylor Yaw USA
Eric Littman USA	Irene Yen St. Kitts & Nevis
Richard Lloyd UK	



Fellows Advisory Council

WAVMA has established a Distinguished Fellows program to recognize those world-renowned veterinarians who have advanced aquatic veterinary medicine as a discipline and devoted their time and efforts to serve WAVMA's mission. The Fellows Advisory Council allows the Fellows to advise the Executive Board with guidance on WAVMA initiatives, and mentor applicants for Aquatic Veterinarian Certification (CertAqV).

Our WAVMA Distinguished Fellows are:

Dr Peter L. Merrill
Dr Ronald J. Roberts
Dr A. David Scarfe
Dr Julius M. Tepper
Dr Christopher I. Walster
Dr Dusan Palic
Dr Grace Karreman
Dr Marian McLoughlin
Dr Mohamed Faisal
Dr Nick Saint-Erne
Dr Richmond Loh
Dr Laura Urdes

See: <http://www.wavma.org/wavma-fellows>.

Laura Urdes represents the Fellows Advisory Council with the Executive Board. Please contact Laura with questions or suggestions, at laurau_2005@yahoo.com.

Executive Board Responsibilities

The Executive Board has the responsibility for charting the course of WAVMA, fiduciary oversight of all issues, and, with input of committees, provides the oversight and approval for all WAVMA programs and services that fulfill the Mission and Objectives of the organization. The Board generally meets once a month through teleconferences, to discuss and approve WAVMA programs, services, and policies that drive the organization and issues that affect aquatic veterinary medicine. Members may submit items for discussion at the next Executive Board by contacting the [WAVMA Secretary](#).

**Discover core knowledge, skills & experience
needed to become a WAVMA Certified Aquatic
Veterinarian (CertAqV)**

Did you know that WAVMA's **CertAqV Program** offers members the opportunity to become recognized and certified as having competency in 9 core areas deemed necessary to practice aquatic veterinary medicine? Find out more information online at:

<http://www.wavma.org/CertAqV-Pgm>.

Meetings Committee

Due to the COVID-19 pandemic, the meeting schedule for this year has been completely reorganized due to cancellations and/or rescheduling by our partnering organizations. As the WSAVA conference has been postponed until March 2021, we are still planning to hold our pre-conference workshop. Please note the date changes below.

The Koi Practitioners Working Group is pleased to announce its third annual session (KoiPrax3), that will take place 21 March 2021 in Warsaw, Poland. KoiPrax 3: "Koi Ulcer Disease and Aeromonas species: Current Clinical Presentations, Diagnostic Resources and Treatments" Date: 21 March 2021 Time: 08:00 – 17:35 Place: Room D – Pavilion 4 Up to: 50 people. This full day meeting will feature speakers that are at the forefront of research on bacterial diseases of koi. Our honored keynote speaker will be Verena Jung-Schroers. Fees: WAVMA members: free of charge – registration required Non-WAVMA members: 100 EURO Registration & Information Please contact: J.M. Tepper, Meeting Chair for info and reservations at dvm2468@gmail.com.

Verena Jung-Schroers is a specialized veterinarian in fish diseases working at the Fish Disease Research Unit of the University of Veterinary Medicine in Hannover, Germany. She is the leader of the ECAAH (European College of Aquatic Animal Health) approved training centre of the Fish Disease Research Unit in Hannover. Verena Jung-Schroers is involved in many research projects of different topics, like microflora and bacteriology, welfare of aquatic animals, and fish and shrimp and virology.

As of this writing, the Meetings Committee is actively trying to organize virtual conference events for the membership. Please watch the Members listserv for announcements of these upcoming conferences.

Julius M. Tepper, DVM, CertAqV
Meetings Committee Chair
dvm2468@gmail.com

The Aquatic Veterinarian is meant to be read as a 2-page spread (like a paper magazine!). To view it this way on your computer, open the pdf document using Adobe Acrobat or Adobe Reader, then go to the menu bar at the top of the computer screen and click on View, then Page Display, then Two Page View. That will allow you to scroll thorough the issue seeing the cover page by itself first, followed by two pages side by side for the rest of the issue. Doing this, you will be able to see the Centerfold picture in all its ginormous glory!

Exciting Changes Around the Corner

Jena Questen, President;
Stephen Reichley, President-Elect;
Chris Walster, Administrator

We hope you are staying healthy and safe during this difficult time. The Executive Board continues to meet monthly to maintain continuity of member programs and identify ways to enhance the value of your membership. We would like to take a moment to provide an overview of some exciting changes that will be implemented over the coming months.

Virtual 2020 Annual General Meeting. The Meetings Committee is working hard to transition our Annual General Meeting from in-person to virtual. More details to come as plans are finalized.

New and Improved WAVMA Website. We are working hard with our IT firm to roll out a new website. You will notice substantial improvements in the aesthetics and navigability. In addition, the new website will have enhanced capabilities that will allow us to improve existing programs.

Membership Management. Over the years, we have received feedback from members regarding confusion over when a member joins or renews and what that means for their membership in WAVMA. The current program can be confusing and is cumbersome to administer. To help address these concerns, WAVMA will be moving to a rolling 12-month membership. This means regardless of when a member joins or renews, his/her membership will be active for 12 months after dues are paid. More information on this change and how we will transition to this new process will be forthcoming.

Public and Members-Only Directories. Currently, WAVMA has a searchable directory that is only accessible to active members. This is an important tool for members to find other members, but it stops short of allowing potential clients to find aquatic veterinarians. In the coming months, we will be rolling out a directory that allows anyone accessing the WAVMA website to search for WAVMA members and those who have obtained the CertAqV designation. Members will have to ability to choose if their information is available in the public directory, members-only directory, both, or neither.

WAVMA WebCEPD Program. We are excited to be resuming the WAVMA WebCEPD program. The Education and Student Committee is working hard to reinvigorate this important program. Our new website will allow for easier administration and provide a more seamless experience for those accessing the WebCEPD program. Did you know we currently have over 45 hours of content available online and the Executive Board approved free membership for those providing WebCEPD content?

Paid WAVMA Administrators. WAVMA has achieved great things since its founding in 2006. To date, it has been entirely volunteer-based, which is a testament to the dedication and resiliency of members but presents limitations to what can be achieved and how timely member enquiries can be addressed. As WAVMA continues to grow and administrative burdens increase, we have hired two Administrators on a part-time basis. The Administrators will focus on the behind-the-scenes administrative tasks it takes to keep this large, global organization running smoothly as well as interaction with members and member programs. The Administrators can be reached at administrators@wavma.org.

We hope you are as excited as we are about WAVMA's future. Please reach out with any suggestions, questions, or comments. You can find contact information for the Executive Board and Committee Chairs at <https://www.wavma.org/WAVMA-Leadership>. We look forward to seeing your nomination to serve as a 2021 Officer or Director and your interest in joining a WAVMA committee to help us continually improve our organization.

Join A WAVMA Committee

All of the great programs and features you get from WAVMA membership are provided by volunteers. We are always looking for more helpers, whether veterinary students or graduate veterinarians, to join us on the committees as well. If you are not interested in running for office, but would like to provide your input and guide the future of WAVMA, join one of our committees (no previous experience necessary!). See a list of our committees on page 8. Contact our Secretary or the committee chair for more information about the committee and the dates of the next meeting (done via GoToMeeting). All are Welcome!

Join a WAVMA Committee today!

**DO YOU HAVE A STORY TO TELL ABOUT
HOW YOU BECAME
INVOLVED WITH AQUATIC
VETERINARY MEDICINE?**

Send your article (<1,000 words) with pictures to
TAVeditor@wavma.org.

Education & Student Committee

ESC worked intensively, even despite the complication due to the work-restriction measures imposed in many countries to face the current pandemic situation. We aim to increase the offer of educational opportunities through WAVMA to the aquatic veterinarians and pathologists around the world.

After being inactive since April 2018, the [WebCEPD program](#) has finally restarted! On 22nd June, 2020 Dr. Diane Elliott (WA-USA) provided a great webinar entitled “[Skin Deep: Microscopic Anatomy of Normal Finfish Integument](#)”. Her fascinating comparative lecture was definitely a success, subscribed by 280 people, it indeed saturated our current max live attendees’ capacity. The webinar generated an impressive 78% of attentiveness and was followed by 20 minutes of Q&A session! The recoding will remain available through WAVMA website.

But, ESC has already planned for new webinars! On 27th July, Dr. Snježana Zrnčić (Croatia) and Dr. Anna Toffan (Italy) are giving a two hours virtual lecture on bacterial and viral diseases with relevance for farmed marine fish species. This join event will foster further collaborations with the [European Association of Fish Pathologists \(EAFP\)](#). The WAVMA+EAFP webinar will be soon advertised through all our official communication channels.

ESC recently negotiated free or discounted access to “[The Aquarium Vet](#)” educational activity. WAVMA students can join for free their bi-monthly webinars, while all WAVMA member can claim a 15% discount to attend their Equarist course™ (see page 17 for details).



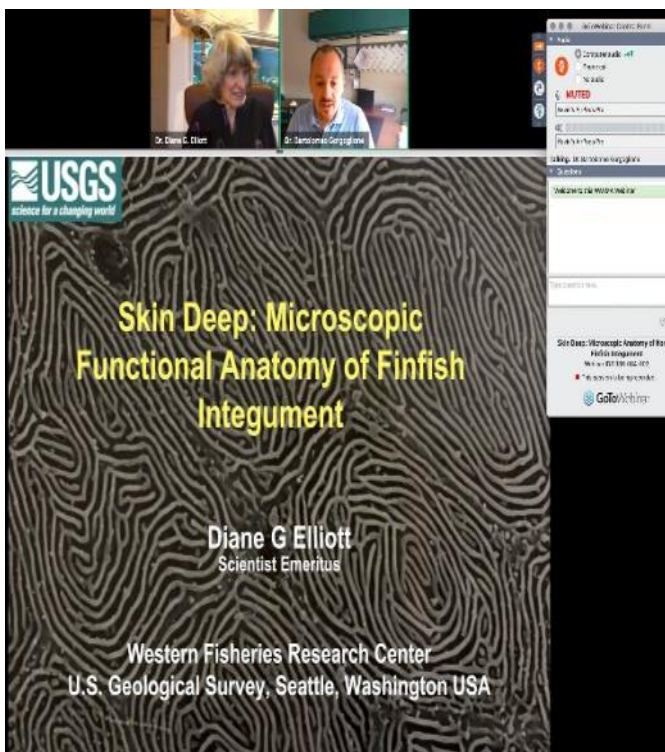
We aim to support the WAVMA student community. A new WAVMA Student Chapter was recently established at the University of Edinburgh Royal (Dick) School of Veterinary Studies in Edinburgh, Scotland (see page 18). To facilitate veterinary students around the world toward the establishment of a [WAVMA Student Chapter](#) at their universities, we are now providing instructions also in other common languages. Guidelines for veterinary school chapters are already available in [Spanish](#), with the French translation due to become available very soon. The template for preparing a Student Chapter Bylaws/Statute is now available upon email request to the ESC-Chair.

We aim to suggest new training opportunities to WAVMA members. The webpage with the list of externship opportunities has been re-activated and updated (see: www.wavma.org/Externships). Once more we invite WAVMA members to provide suggestions for worldwide educational opportunities, submitting any suitable externship through the designated [webpage](#).

With recent subcommittee virtual meetings and during the last ESC virtual meeting, held on 28th June, we articulated an ambitious program of activities to be completed by the end of the year. I would kindly invite any WAVMA member keen to collaborate with us to please contact me to be allocated in one of the dynamic ESC subcommittees.

Enjoy the Summer!

Dr. Bartolomeo Gorgoglione
Chair of Education & Student Committee
BartGorg@msu.edu



New Advantages for WAVMA Members!

Get new discounted or free learning opportunities through the online educational programs offered by "[The Aquarium Vet](#)"!

All WAVMA members can claim a **15% discount** to attend [The Aquarium Vet E-quarist course](#)[™]. This is the first online course providing aquarist education, suitable for veterinarians and veterinary technicians to increase knowledge in aquatic animal medicine. Each of the first five modules is approved for 15 hours of continuing education credit in jurisdictions that recognize RACE approval (total 75 hours). Please contact [Katrina Campbell](#) to obtain your unique WAVMA member coupon code!

WAVMA Student members get **free registration** to the **Aquarium Vet webinars**. These one-hour live webinars occur every two months in three different time zones and cover an array of topics related to aquatic animal medicine.

Save the date for the next 2020 webinars, on 12th August, 14th October, and 9th December. WAVMA Students must register in advance. People registered for the Aquarium Vet E-quarist course also have free access to the bi-monthly webinar series.

Please visit [The Aquarium Vet website](#) to learn more about [The Aquarium Vet E-quarist course](#)[™] and for the upcoming webinars.



Pitts Aquatic Veterinary Education Awards

The John L. Pitts Aquatic Veterinary Education Awards Program is excited to announce recipients for the 2020 Award Cycle! The following individuals were selected to receive an award from a large pool of applications. Please join us in congratulating them on this prestigious recognition.

Erica Chang; University of California-Davis, USA
Sloan Massie; University College Dublin, Ireland
Dr. Mohammed Modibbo; Univ. of Maiduguri, Nigeria
Charlene Morotti; The Ohio State University, USA
Sarah Nelson; University of Wisconsin-Madison, USA
Jessira Sosa; National University of San Marcos, Peru

We would like to note that due to the COVID-19 pandemic, there were a number of students who had cancelled activities that made them unable to participate in the Program this year. We are hopeful that all veterinary students whose educational opportunities have been affected by the pandemic will be able to re-schedule cancelled activities or find new opportunities and reapply to the program next year—we will be looking forward to reviewing your applications!

Since its inception in 2010, the John L. Pitts Aquatic Veterinary Education Awards Program has awarded over \$62,000 to 98 veterinary students and recent graduates from 46 colleges and universities across 4 continents. These funds, which have come from a small number of individuals and organizations, allow recipients to explore a career in aquatic veterinary medicine through participation in externships at public, private, and academic institutions and attendance at conferences and short courses all over the world.

The Program was started to honor the late John L. Pitts, DVM, who was passionate about student involvement in the profession and a global approach to aquatic veterinary medicine. His service to the profession began as a veterinary student in 1969 when he helped create a national chapter for the Student American Veterinary Medical Association. John also helped in the formation of the National Association of State Aquaculture Coordinators, the Aquaculture and Seafood Advisory Committee of the AVMA, and he worked tirelessly to shape and encourage the passage of the Minor Uses and Minor Species Act of 2004.

For more information regarding the Program please visit www.wavma.org/scholarships. Please help us support the next generation of aquatic veterinarians; donations of all amounts help tremendously.

Emily Munday & Nora Hickey
 Co-chairs,
 John L. Pitts Aquatic Veterinary Education Awards Program
PittsEduAwards-Admin@wavma.org

**New WAVMA Student Chapter
University of Edinburgh**

We are excited to announce the establishment of a WAVMA student chapter at University of Edinburgh’s Royal (Dick) School of Veterinary Studies. We noticed there was an interest amongst our classmates for aquatic veterinary medicine, but not many resources available for those interested in supplementing their education and pursuing a profession in this field. We are hoping to be able to connect our peers with each other and aquatic veterinary professionals to provide opportunities for networking and hands-on practical experience and lectures. We are looking forward to the beginning of something great!

Thank you,
Stephanie Bellinghausen
R(D)SVS Veterinary Student

The University of Edinburgh is a charitable body, registered in Scotland, with registration number SC005336.

Below are WAVMA Student Chapter members from Edinburgh’s Royal School of Veterinary Studies.



To initiate a new Student Chapter, download the [WAVMA Student Chapter Guidelines](#)

A Spanish version of the Student Chapter Guidelines can be [downloaded from the WAVMA website](#).

PROGRAMS AVAILABLE TO STUDENT CHAPTERS:

- Assistance in organizing and promoting Chapter programs and activities.
- Access to recorded webinars and live web-based presentations from experts around the world.
- Low annual WAVMA Student Membership (\$25) - 50% Chapter member’s dues may be available to support Chapter-organized activities.
- Reduced rate (50% off) WAVMA Full Membership the year after graduation.
- John L. Pitts Aquatic Veterinary Education Awards Program
- Access to WAVMA member-only programs.
- Aquatic veterinary externship and job listings.
- WAVMA promotional flyers, brochures and other materials for distribution to other students.
- Free or discounted registration for WAVMA meetings, conferences or educational webinars.

**TO SUPPORT FUTURE
STUDENT SCHOLARSHIPS, PLEASE
MAKE A DONATION TODAY TO THE
SCHOLARSHIP FUND!**

[WWW.WAVMA.ORG/SCHOLARSHIPS](http://www.wavma.org/scholarships)

- Participation in the WAVMA Certified Aquatic Veterinarian (CertAqV) Credentialing Program.
- Access to WAVMA e-mail listservs, including Members-L, and Student-L.

A list of all current WAVMA Student Chapters is available on the website:

<https://www.wavma.org/WAVMA-Student-Chapters>

Consider joining the [WAVMA Chapter Facebook Group](#) to find out what’s happening in other Chapters.

Instructions for Authors and Contributors

While any information relevant to aquatic veterinary medicine might be published, we particularly invite contributions for the following regular columns in *THE AQUATIC VETERINARIAN*:

Colleague's Connection

An article explaining why and how a veterinarian became interested in aquatic veterinary medicine and what that veterinarian has done in their aquatic veterinary career.

Peer-Reviewed Articles

Original research or review of any aquatic veterinary topic. Articles will be reviewed by 3 veterinarians and comments and changes referred back to the author prior to publication. The text for an article begins with an introductory section and then is organized under the following headings:

- Materials and Methods
- Results
- Discussion (conclusions and clinical relevance)
- References (cited in the text by superscript numbers in order of citation).

Clinical Cases

Clear description of a distinct clinical case or situation and how it was resolved. These may be submitted for peer-review. Begin with the signalment (species, age, sex, body weight or length) of the animal or animals, followed by a chronologic description of pertinent aspects of the diagnostic examination, treatment, and outcome, and end with a brief discussion.

Book Reviews

Brief review of a published book, including an overview and critique of the contents and where to obtain the book.

Publication Abstracts

Abstracts of published veterinary and scientific journals with full citation/reference (authors, date, title, and journal volume and page numbers – ½-1 page length).

News and Views

Brief synopsis or information about aquatic veterinary news published elsewhere. List original source of information.

Legislative & Regulatory Issues

Synopsis or description of emerging legislation or regulations with information on how to access further detailed information or a link to website.

Meetings and Continuing Education and Professional Development (CE&PD) Opportunities

Description or synopsis of upcoming aquatic veterinary or (veterinarian-relevant) non-veterinary in-person or on-line educational meetings noting the meeting title, dates, location, and contact person or website.

Jobs, Internships, Externships or Residencies

Description with specific contact information for veterinary student externships and post-graduate internships or residencies at private practices, institutions, universities or organizations. Description of available full or part-time employment for aquatic veterinarians, with contact information.

Advertising

See advertising rates on page 4.

Please send articles, clinical reports, or news items to the editor by the following submission dates:

- Issue 1 – February 15 (published in March)
- Issue 2 – May 15 (published in June)
- Issue 3 – August 15 (published in September)
- Issue 4 – November 15 (published in December)

All submissions should be in 10-point Arial font, single spaced. Submissions may be edited to fit the space available.

We can also use editors to proof-read submissions or review articles. Please contact the Editor if you are interested in assisting.

The World Aquatic Veterinary Medical Association also has opportunities for members to assist with committees. Contact any member of the Executive Board to volunteer to help.



QUICK LINKS TO WAVMA PROGRAMS & SERVICES:

(Press control then click on item using computer mouse)

[Online Member Directory](#)

[Certified Aquatic Veterinarian Program \(CertAqV\)](#)

[WebCEPD](#)

[The Aquatic Veterinarian Journal](#)

[Aquatic Veterinary Jobs Listing](#)

[WAVMA Student Chapters](#)

[Veterinary Student Externship Listing](#)

[John L. Pitts Aquatic Veterinary Education Awards Program](#)

Meet: Dr. Terra MacDonald
 Salmonid Veterinarian

I'm honoured to be asked to write this Colleague's Connection article and share my passion for aquatic veterinary medicine with others, so let me start by saying thank you! My experience is specific to salmonid (Atlantic salmon and rainbow trout) aquaculture but I really hope I can offer some insight into an aspect of veterinary medicine that a lot of the general public (and even some vets!) don't realize exists, or is an option.

I first became interested in aquatic veterinary medicine when I was in my first year of my undergraduate program. I attended the Nova Scotia Agricultural College, from which I am a 3rd generation alumni. I received a Natural Sciences and Engineering Research Council grant and I was introduced to a researcher, Dr. Derek Anderson, who had several projects looking at the use of plant proteins as an alternative to fish oil and meal in commercial aquaculture diets. It sounded interesting, and I decided to take the job for the summer. I worked with rainbow trout and Atlantic salmon, and I did everything from formulating the diets to mixing and pelleting them myself and then feeding it and tracking the results and eventually, 4 years later, I even presented the cumulative research as my honours thesis.

Through my time with that project I became more aware of salmon farming and I realized this could be a potential career path for me. I loved working with the fish and the more I learned about their incredible feed conversion abilities and growth rates, the more I realized the potential of this industry to provide healthy, sustainable protein. I come from an agricultural background, and grew up in a province shaped by fisheries and their unfortunate collapse, so farming in the sea seemed like the logical next step.

When I was accepted into the Atlantic Veterinary College in 2013, I already had an idea that I wanted to pursue aquatic medicine, specifically in the field of aquaculture. I knew that the AVC had a reputation of being the "fish vet school" so I knew I was in the right place. In my first year I reached out to Dr. Larry Hammell and got a position with the Centre for Aquatic



Health Sciences at UPEI. It was my first foray into the aquaculture in a field setting and travelling around the Atlantic provinces seeing salmon farming in practice confirmed that this was what I wanted to do.

During my time at AVC I continued to take aquaculture electives that were available in the curriculum, and sought out opportunities that related to aquaculture. In my fourth year I travelled to Norway, as well as going to British Columbia, to learn about the salmon industry in other parts of the world, and it further confirmed what I wanted to do after graduation.

When I graduated in 2017, there were no aquaculture positions immediately available so I worked in small animal general practice. Several of my mentors had also advised doing some time in general practice because once you enter the "niche" of aquaculture, skills like surgery and anesthesia can lapse, and it is good to be sure it is the field you want to enter before making the leap. I liked my time in general practice, but always kept my eyes on advertisements in the aquaculture field. Finally in summer of 2018, a job came up on Vancouver Island in BC, Canada. I jumped at the chance and in September 2018 I moved to BC to begin my Aquatic medicine career.

Today I work at Mowi Canada West as a veterinarian. I am so fortunate to have fantastic colleagues to learn from and work with. There's never a dull day, and through these recent challenging times I've seen exceptional capacity for innovation, compassion and work ethic in all levels of this industry. Outside of the current situation, my daily work involves site visits where I check the status of the fish including necropsy





of any mortalities, inspection of live fish with anesthetized handling, checking site records and discussing with site staff how things are going. Samples are taken on-site and submitted for a variety of diagnostics, both routine and also targeted if there is an issue identified. I also do a fair amount of data analysis and regulatory reporting, and prescribe medications as needed. I often compare it to work that would be done by a veterinarian who works with any other production species, like cattle or chickens, in that we look at the health of the whole population, rather than focusing on the individual.

During my short time in the aquatic industry I've seen amazing innovation; We are constantly researching and developing new and better ways to manage our fish. Fish welfare has been brought to the forefront as the interplay between health, welfare and production is better understood. The political environment isn't always welcoming to our industry, but it forces us to always be on top of every aspect of our production, so it can be very motivating as well. For our future I hope that we continue to innovate and develop technologies that allow us to produce healthy, quality protein in a sustainable and affordable manner. I also hope that more people, both within veterinary medicine and the general public, learn about aquaculture and what it really is.

To students, new graduates or vets looking for a change, I would say reach out! The industry is really quite small, and the connections you make with colleagues will get you really far. There aren't a lot of vets interested in it, so even expressing an interest will get you on a "list" somewhere next time they're looking to hire. There are so many areas to work in, as well – government, industry, pharmaceutical, or consultant to name a few. It's a wonderful career if you enjoy the outdoors, the ocean, and don't mind getting a bit wet sometimes! Anyone who has any questions or wants to learn more – please don't hesitate to ask! Stay healthy and best wishes!

Dr. Terra MacDonald
 Mowi Canada West
 Mobile: (250)202-2653
 Email: terra.macdonald@mowi.com





*Albino alligator (A. mississippiensis) on display at the Wildlife World Zoo and Aquarium
Litchfield Park, Arizona
Photograph by Nick Saint-Erne, DVM, CertAqV
June 2020*



Cholangiocarcinoma and papillary mesothelioma in an albino American alligator

(*Alligator mississippiensis*)

By Dr. Sharmie Johnson, DVM, CertAqV

Abstract: Neoplasia in reptiles is being recognized more frequently. Compared with snakes and lizards, neoplasia in crocodylians is reported less commonly. Cholangiocarcinoma and mesothelioma are rare neoplasms of reptiles. The alligator in this case was diagnosed initially with hepatic lipidosis, but failed to respond to hepato-supportive medications. On post-mortem examination, it was diagnosed with cholangiocarcinoma and papillary mesothelioma.

Key words: American alligator, cholangiocarcinoma, hepatitis, papillary mesothelioma, hepatic lipidosis

Introduction

Neoplasia in reptiles is being recognized more frequently. Compared with snakes and lizards, neoplasia in crocodylians is reported less commonly. This probably reflects a smaller number of animals being presented for veterinary examination and treatment, since few crocodylians are kept as pets. The majority of captive crocodylians are raised for meat and hides and don't live for extended periods in human care. Specimens in zoological institutions are the exception.

Cholangiocarcinoma is a common neoplasm affecting large animals. Neoplastic cells arise from intra- and extrahepatic bile duct epithelial tissue. Symptoms are vague and are typical for a hepatopathy with anorexia, weight loss, and gastrointestinal signs predominating. Diagnosis is by liver biopsy or post-mortem examination. Hepatic enzymes vary in their levels.

Mesothelioma is a rare neoplasm affecting humans at a greater rate than animals. Asbestos exposure is not a pre-requisite for developing this tumor in animals. Neoplastic cells arise from the mesothelial cells lining the pericardial, pleural and peritoneal cavities. It is typically diagnosed post-mortem.

Hepatic lipidosis is a common condition in many species. Over-conditioned reptiles that develop anorexia are predisposed. Diagnosis is supported by the presence of abnormal hepatic enzyme levels but is only confirmed by cytology or histopathology.

The case presented here involved an albino American alligator (*Alligator mississippiensis*) that developed all 3 conditions. Only hepatic lipidosis was diagnosed ante-mortem. Treatment attempts with hepato-supportive medications failed. The two neoplastic processes were diagnosed on post-mortem examination. This is the first reported case of cholangiocarcinoma and mesothelioma in a captive albino American alligator.

Case Presentation

A 14-yr-old, albino American alligator (*Alligator mississippiensis*) presented for anorexia of 1-month dura-



Dr. Sharmie Johnson

tion. Initially, the staff was not concerned since they suspected that she was pre-ovulatory based on her age, sex, and the time of year as she was able to see changes in the light/dark cycle through her exhibit glass. A nest was prepared in her lock-out with dirt and grass. Her health had always been good, and no abnormalities were detected during weekly rounds by the veterinary staff and aquarium curator. Her weight was stable (90 lb/40.9 kg) as was her body condition score (BCS) of 4/5. Measurements and blood had been taken 9 months earlier as part of her normal data base. Her snout-vent length was 42 in (106.68 cm), total body length was 80 in (203.20 cm), skull length and width were 9.75 in (24.76 cm) and 7 in (17.78 cm), respectively. Her prior blood work was normal.

Her exhibit was glass on 3 sides with a lock-out not visible to the public. The room measures 10 ft x 20 ft (32.80 x 65.62 m) and contains a 5 ft (16.40 m) deep pool that is approximately 3,000 gallons of water. She was fed a variety of prey once weekly, which consisted of rodents, fresh-water fish, a commercial carnivore diet^a, chicks, quail, a multi-vitamin^b, Vitamin E and Vitamin B₁.

The water source for the pond was well-water that was frequently monitored. The pool was drained weekly. The ambient air and water temperatures were 81°F (27.2°C). The water temperature was increased over the next 3 days to 86°F (30°C), while the ambient air temperature was increased to 90°F (32.2°C).

The staff tried novel food items to entice her to eat, with no response. She would sink under the water to avoid their approach. Feeding was attempted at different times and different places within her exhibit or lock-out. The pool was drained the following morning to facilitate an examination.

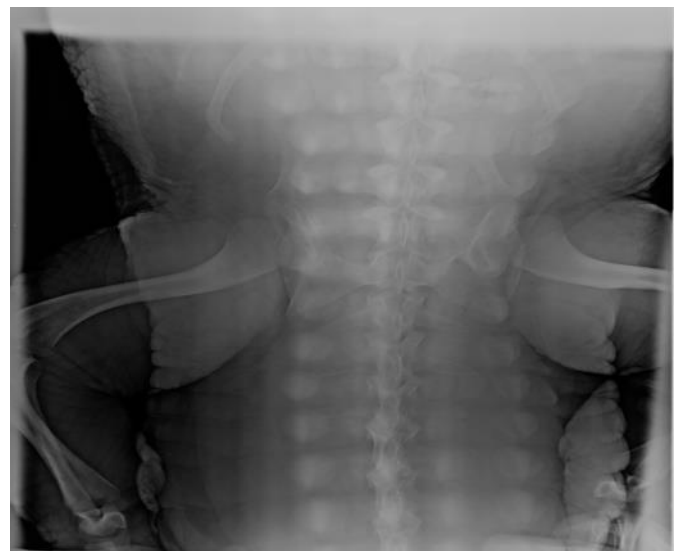
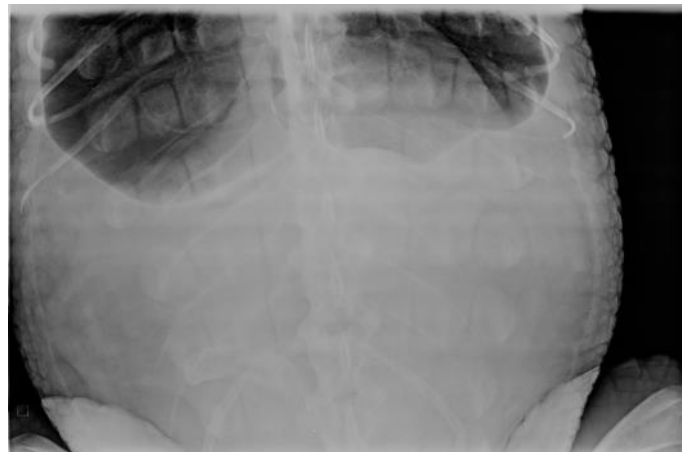
The alligator's overall physical examination was normal. Her heart and respiratory rates were 42 beats per minute and 3 breaths per minute, respectively. The only concern notable was a symmetrical swelling in the caudal aspect of the coelomic region. The area was soft on palpation. No fluid wave was balloted. There was no detectable discomfort with palpation. At this time, differential diagnoses consisted of pre-ovulation, egg-binding (pre-ovulatory or post-), organ enlargement/dysfunction, infection (abscess, granuloma), metabolic disease, and neoplasia.

Radiographs were obtained with a mobile unit and blood was taken from the post-occipital spinal venous sinus for a complete blood cell count (CBC) and biochemistry panel.^c A fine needle aspirate (FNA) was also performed following a surgical prep of the right and left ventro-latero-caudal coelomic region. The tap was negative for fluid. Radiographs showed the gastrointestinal tract to be pushed into a lateral presentation. This suggested a neoplastic mass, abscess/granuloma, organomegaly, or follicles/non-calcified eggs.

At the conclusion of the examination, the alligator was administered injections of Vitamin B12 (2,000 mcg, IM),^d Vitamin B-plex (12 ml, IM),^e ceftazidime (900 mg, IM),^f to be repeated in 72 hr pending lab work results, and famotidine (20mg, IM).^g Blood work was compared with reference values established for the species.^{1,2} The overall CBC was normal per reference values, but when compared to her values 9 months earlier, she had a 50% reduction in her heterophils and azurophils. The hematocrit (HCT) was stable at 21%, which was below the average reported. No further antibiotics were prescribed at this time. The biochemistry panel detected an elevation in her calcium values, which suggested a pre-ovulatory state, renal dysfunction, hypervitaminosis D or a paraneoplastic syndrome. The albumin was slightly lower from the year before. The uric acid and hematocrit were normal, thus placing renal dysfunction and hypervitaminosis-D lower on the differential list.

The staff tried several times each week to entice a feeding response. An internal medicine specialist was consulted for an ultrasonographic examination.^h The examination was done with restraint only, no anesthesia. No eggs were identified. The kidneys could not be observed. The spleen and liver appeared normal. No foreign bodies or obstructions were observed in the gastrointestinal tract. Fat was observed between the intestinal loops. An ultrasound guided FNA was performed on the liver and the fat. A fluid-filled structure in the caudal coelom was aspirated, and the contents appeared as urine. This was possibly the urodeum. An in-house urinalysis was normal excluding a bilirubinuria (3+), urine specific gravity 1.002, and pH 7.0. Samples were submitted to the laboratory.ⁱ Results were similar to the in-

Radiographs of chest, abdomen and hips.



house values, although the pH was reported as 8.5. Culture of the fluid was negative for bacteria. Radiographs were repeated. Clarity of the coelomic cavity was poor. No conclusions could be made. Blood work was repeated on 7/11/2018, and the CBC findings reflected a 50% reduction in heterophils from the previous results. A dramatic increase was observed in the azurophils, lymphocytes, basophils, and monocytes. The plasma protein values were steadily decreasing. The laboratory values suggested a possible inflammatory or infectious process of chronic nature. Pre-bile acids were 145.7, and estrogen <39.2 pg/ml. The alligator did not appear to be reproductively active clinically or hormonally. The HCT stayed in the 21-22% range with normal morphology of the red blood cells (RBC). Biochemistry values were stable from the first samples submitted 8 weeks prior, excluding a slight decrease in total protein, calcium, albumin, aspartate aminotransferase (AST), and an increase in lactate dehydrogenase (LDH) and creatinine phosphokinase (CPK). Mild struggling during capture was considered a contributing factor to the increase in LDH in conjunction with hepatic changes because of the increase in the CPK.

The cytology findings from the FNA of the liver revealed a large amount of peripheral blood, lipids, and cytoplasmic vacuoles within groups of hepatocytes, suggesting a vacuolar hepatopathy. Hepatic lipidosis was suspected. The adipose tissue contained lipids and fat cells. No inflammation or infectious agents were identified. The pathologist stated that the large amount of blood indicated congestion within the liver.¹

A noted reptile specialist was consulted. All radiographs, lab work and ultrasound images were forwarded to him. After review, he suspected that some unperceived stress precipitated the anorexia, leading to hepatic lipidosis (Mader, D., pers comm.). He recommended placing her on appetite stimulating medications: Capromorelin^l 150 mg, mirtazapine^k 45 mg, and metronidazole^l 750 mg into a mouse, force fed q 7d. Mirataz transdermal ointment^m 2 mg was applied topically, daily to the top of her skull using a wooden spatula attached to a pole, as well. The ointment was applied in this location because she kept her head above water the majority of the time. After 10 days and no response, the transdermal ointment was increased to 4 mg. She was then force fed a small rat. Following the feeding, her swimming activity increased, and she was more alert. S-Adenosylmethionine/silybin A+B (425 mg/35 mg)ⁿ was added for hepatic support.

Three days later she was force fed again but regurgitated 1 of the 3 rats the following day. She was force fed again 3 days later. At this time the staff noticed that a bile colored liquid was passed with the urates. A digital exam was performed, and bile colored urates were observed. She was administered a famotidine injection 20 mg SC. Blood was drawn from the post-occipital spinal venous sinus and submitted to the laboratory.^c Some hemolysis was present in the sample. Other than heterophils, the results reflected a general depression

Hematology FLUFFY WWZ

8/12/18 (Order Received)

TEST	RESULT	8/6/18	7/11/18
Hematocrit	23.0 %	11.0	22.0
WBC	14 K/ μ L	6	6.8
% Heterophils	78 %	75	26
% Het Bands	0.0 %	0.0	0.0
% Lymphocytes	1.0 %	7.0	12.0
% Monocytes	2.0 %	1.0	3.0
% Azurophils 1	5.0 %	8.0	19.0
% Eosinophils	0.0 %	2.0	2.0
% Basophils	4.0 %	7.0	38.0
Heterophils	10,920 /uL	4,500	1,768
Het Bands	0 /uL	0	0
Lymphocytes	0.14 K/ μ L	0.42	0.816
Monocytes	0.28 K/ μ L	0.06	0.204
Azurophils	2.1 K/ μ L	0.48	1.292
Eosinophils	0 K/ μ L	0.12	0.136
Basophils	0.56 K/ μ L	0.42	2.584
Thrombocytes	ADEQUATE	ADEQUATE	
Polychromasia	SLIGHT		RARE
Blood Parasites	NO PARASITES SEEN		
Plasma Protein	4.5		4.4

Remarks:

RBC MORPHOLOGY APPEARS NORMAL.
RARE MITOTIC FIGURES SEEN IN RBCS.
FEW REACTIVE AZUROPHILS PRESENT.

Chemistry

8/12/18

TEST	RESULT	8/6/18	7/11/18
Glucose	64 mg/dL	61	69
Uric Acid	1.6 mg/dL	0.7	0.6
Phosphorus	5.6 mg/dL	3.8	5.1
Calcium	11.7 mg/dL	10.1	12.2
Sodium	126 mmol/L	139	154
Potassium	5.3 mmol/L	3.9	4.9
Total Protein	4.9 g/dL	3.2	4.5
Albumin	0.7 g/dL	0.4	0.7
Globulin	4.2 g/dL	2.8	3.8
Alb:Glob Ratio	0.2	0.1	0.2
ALT	56 U/L	25	24
AST	464 U/L	231	382
ALP	61 U/L	30	36
LDH	1,564 U/L	631	527
Cholesterol	126 mg/dL	102	166
Creatine Kinase	13,668 U/L	5,448	3,786
Bile Acids	108 μ mol/L	110.9	145.7

Moderate to severe elevations in Bile Acids (>30) are consistent with hepatic dysfunction, but cannot discriminate specific liver diseases or the relative severity of liver disease. Additional diagnostics (e.g. ultrasound and/or liver biopsy) are recommended to further classify the disease process.

Phoenix Veterinary Internal Medicine Services

Russell Greene, DVM, PhD, DACVIM (Small Animal Internal Medicine), DACVIM (Bacteriology & Mycology)
 10645 N. Tatum Blvd. Ste. 200-527 • Phoenix, AZ 85028 • Tel 602-953-9541 • Fax 602-953-4713 • www.pvims.com

Owner Wildlife World Zoo **Patient** Fluffy **Date** 7/9/18
Breed Alligator **Color** White **Weight** 90 lbs
Age 14 yr **Sex** F **Veterinarian** Dr. Sharmie Johnson
Hospital and Fax # Wildlife World Zoo 623-935-7499

HISTORY

Fluffy has not been eating. Her calcium has increased, so there is a concern that she is egg bound. There is also a concern that there is a fatty liver or steatitis, because according to alligator experts, these are common conditions that can occur.

ULTRASOUND EVALUATION (Abdominal) No egg structures could be defined. I imaged all around the abdomen looking for these, including cranial to the cloaca. I could identify the bladder, but I was unable to identify any eggs. The kidneys could not be identified. I imaged dorsal near the pelvis, but was unable to identify what I thought could be the kidneys.

The liver, spleen, and bladder appeared normal.

There was no evidence of an obstruction in the GI tract. Normal fat was seen between the GI loops.

The tail was imaged. No fat was seen in the tail and the muscle appeared normal.

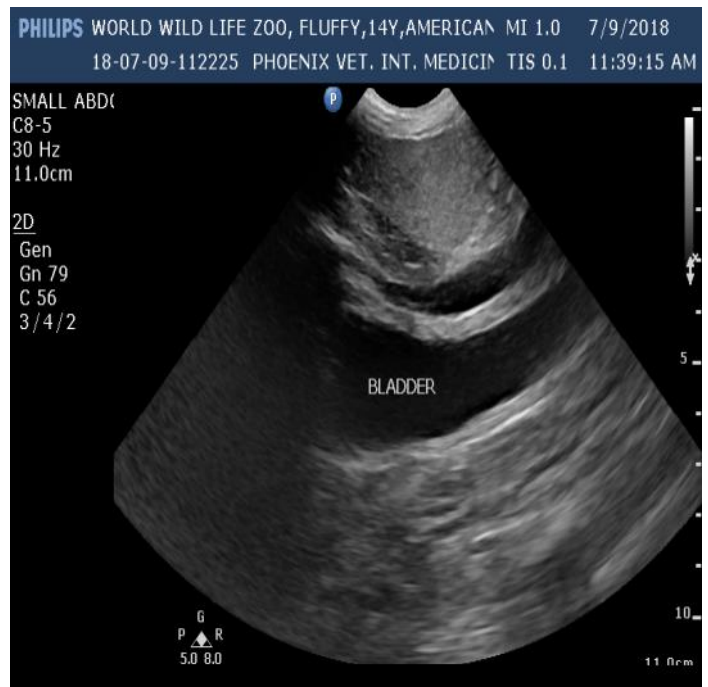
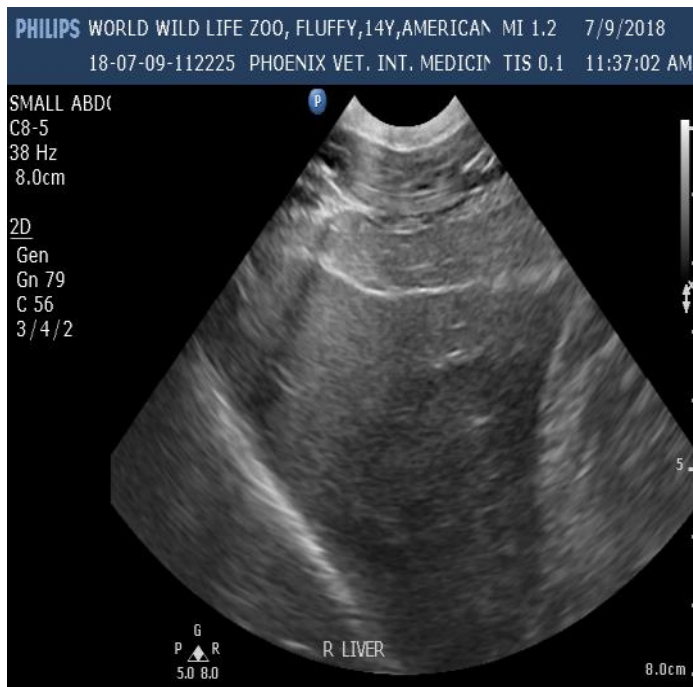
The heart walls appeared to be contracting normally. Cardiac measurements were not obtained.

PROCEDURE

Using ultrasound guidance, fine needle aspirates of the liver and fat were obtained and were submitted for cytology. Urine was collected by ultrasound-guided cystocentesis for analysis.

ASSESSMENT

The cause of the anorexia was not determined on ultrasound. No abnormalities were found in the GI tract and no egg structures were seen. Aspirations of the liver and fat were obtained, and urine was collected to try to determine the cause of the anorexia. **RECOMMENDATIONS** Blood will be submitted and radiographs will be taken today. Further recommendations can be made based on the cytology and urinalysis results, along with the blood work and radiographs.



in the white blood cell line and hematocrit, toxic heterophils were also present. Her decline in physical condition indicated a possible septic/inflammatory response or bone marrow suppression. Few nucleated red blood cells were present, indicating a non-regenerative anemia. With a 50% drop in HCT it was possible that there was internal hemolysis or an internal hemorrhagic event since albumin was also markedly reduced. The sample was contaminated with hemolymph, which undoubtedly caused some hemodilution. LDH and CPK continued to rise. There was minimal struggle with restraint and muscle wasting was evident. Pre bile acids continued to decrease, and uric acid was minimally increased. Estrogen levels at this time were <10 pg/ml.

All 3 rats were found in the exhibit the following morning. At this time she was gavage fed 100 ml of a liquid formula designed for ill carnivores.^o The following supplements were also added to the formulation: lactulose^p (12 ml), Vitamin E^q (800 IU), mirtazapine^k (45 mg), capromorelin^j (120 mg), S-Adenosylmethionine/silybin A+Bⁿ (425 mg/35 mg). She was also administered maropitant^f (40 mg SQ) for potential nausea.

The most recent blood values were re-evaluated and hemodilution with hemolymph was suspected as the cause for the present CBC and biochemical values. Blood was taken from the caudal-ventral tail vein and re-submitted to the laboratory. The azurophil count increased dramatically and showed toxic changes in their morphology. Mitotic figures were present in the red blood cells. Hepatic enzymes were increasing, and there was grave concern for a hepatic neoplasm. Marbofloxacin^s (400 mg) was added to the feeding gruel due to a potential gram -negative septicemia. The alligator's health continued to decline, and euthanasia was considered over the next few days if there was no improvement. Three days following the addition of the marbofloxacin she was observed to be breathing during morning rounds but died shortly thereafter. A post-mortem examination was immediately performed.

The skin showed petechiae and ecchymosis in general. A large volume of ascitic fluid was found within the coelom. Generalized fibrin adhesions were present. The liver was firm, pale, and had well-circumscribed masses throughout the parenchyma, which appeared grossly neoplastic. The heart appeared flaccid, and there was serous atrophy of fat. Samples were collected for histopathology.⁹ Severe hepatic lipidosis, hepatitis, cholangiocarcinoma, and cardiac mesothelioma were identified.

Discussion and Conclusions

The ultrasound findings only supported lipidosis. The cholangiocarcinoma was readily apparent grossly but was not discerned from normal appearing hepatic tissue sonographically. Neither was the papillary mesothelioma. It is possible the tissue density of the neoplasm was identical to the surrounding parenchyma.

Because of her size, the needle length and bore size used for the hepatic FNA were probably insufficient. A liver biopsy is the gold standard for diagnosis, but would have required general anesthesia. A diagnosis of hepatic lipidosis seemed plausible, and risk-benefit with anesthesia for a biopsy in the face of a diagnosis via cytology appeared risky. Advanced imaging, such as magnetic resonance imaging (MRI), would have been advantageous in this case. In retrospect, a repeat of the FNA of the coelomic cavity would have been beneficial during that time period. It is possible that a positive tap may have shown neoplastic cells in the transudate seen at necropsy. Radiographic evaluation of the coelom was non-diagnostic. The images, compared with mammals shows poor contrast between the organs, suggestive of ascites in other species. The negative tap disproved this. Poor radiographic contrast in reptiles is due to lack of distance between the organs, increased coelomic fat, lack of a diaphragm separating the 2 body cavities, and superimposition of the osteoderms in crocodylians.^{3,4}

Neoplasia in reptiles is observed with increasing frequency. Snakes are most commonly represented, while crocodylians the least.⁵ Neoplasia can affect any body system, including the gastrointestinal, which is comprised of the mouth, esophagus, stomach, intestines, liver, biliary system, and pancreas. Malignant hepatic neoplasia has been observed primarily in snakes and lizards. Oncogenic viruses are suspected in some instances. Exposure to radiation and carcinogenic toxins have the potential to cause neoplasia in reptiles as in mammals.⁵

Cholangiocarcinomas are observed in domestic animals and humans. This neoplasm has been reported in a bearded dragon (*Pogona vitticeps*) They are the most common neoplasia observed in large animals. In middle age to older horses, the main symptom prior to the onset of hepatic failure is weight loss. Hepatocellular and biliary enzymes can be elevated, especially gamma-glutamyl transpeptidase (GGT). Ultrasound examination shows a uniform-appearing mass in the liver parenchyma.⁶ This neoplasia arises from intra- and extrahepatic bile duct epithelial tissue. They are observed in older, female animals, greater than 10 years of age, except in felids where males are over-represented. Potential causes in cats and humans are chronic exposure to insecticides, such as *O*-aminoazotoluene and sulfite compounds. Trematodes have also been incriminated. The presence of bile stones and sclerosing cholangitis are also predisposing factors.⁷ Clinical findings are usually not hepatic specific. Anorexia, lethargy, weight loss, and vomiting are common. Elevations in hepatic enzymes, bile acid and bilirubin can be seen, but oftentimes they are within normal reference values due to portal hypertension, cirrhosis or other hepatic neoplasms. Reduced functional hepatic tissue is cited as the most likely explanation.⁸ This would explain the lack of hepatic enzyme activity observed in the alligator. The only increase

was observed close to death and was probably attributed to the hepatitis that was observed microscopically. The bile acids were the earliest indicator of hepatic dysfunction in this case. Normal pre- and postprandial bile acid levels in crocodylians have not been established.

Research into fecal bile acids has been done in the American alligator, and 15 bile acids have been identified.⁹ Bile acids (3 alpha hydroxyl-bile acids) have been determined to be a sensitive indicator of hepatic disease in reptiles.¹⁰ Healthy green iguanas (*Iguana iguana*) and clinically ill ones were evaluated biochemically for bile acids and histopathologically. It was determined that there is variation in the levels of bile acids depending on the duration of fasting.¹¹ All results were below 60 $\mu\text{mol/L}$ in the healthy animals, but those that were ill from hepatopathies showed levels > 70 $\mu\text{mol/L}$ in animals with lipidosis. Iguanas with cirrhosis and hepatic neoplasms were approximating 90 $\mu\text{mol/L}$, and 120 $\mu\text{mol/L}$, respectively.¹² In tortoises bile acids <60 $\mu\text{mol/L}$ were considered normal.¹³ Preprandial bile acids were obtained from a healthy female albino alligator at the zoo that is 2 years younger than the animal presented in this case. Her value was 8.5 $\mu\text{mol/L}$. Clearly, this is in the range considered normal for other reptiles based on the aforementioned research. The bile acid level of 145 $\mu\text{mol/L}$ in the affected alligator is clearly in the level for hepatic neoplasm as seen with the iguanas.

Hepatic lipidosis was also a contributing factor in this animal's demise. It is the result of rapid mobilization of peripheral body fat which overwhelms the liver's ability to process the fats for energy, leading to accumulation within the hepatocytes. Cholestasis results due to the compression of the bile caniculi. This leads to anorexia which exacerbates further fat metabolism. Obese animals that have experienced a fast are predisposed to developing this condition. Birds, cats, miniature horses, and donkeys are over-represented. Animals have gastrointestinal dysfunction from ileus leading to vomiting and diarrhea. Weight loss, jaundice, hepatomegaly, dehydration and electrolyte abnormalities are common. Hepatic enzymes can be elevated. Hyperbilirubinemia/biliverdinemia, bilirubinuria / biliverdinuria, hyperglobulinemia, and hypoalbuminemia are commonly present. Prolonged clotting factors and non-regenerative anemia are also observed. A homogeneous, hyperechoic parenchyma are seen during ultrasound examination of the liver. Vacuolar hepatopathy is a consistent finding following fine needle aspirate of the liver for cytology.¹⁴ This was observed in the alligator presented in this case.

Hepatobiliary disease in reptiles is caused by similar predisposing factors. Obese animals that have experienced a bout of anorexia develop accumulation of triglycerides within the hepatocytes.¹⁵ Biochemical evaluation of the liver is comparable to mammals. Elevations in lactate dehydrogenase (LD) and aspartate aminotransferase (AST) can be observed. These are

not hepatic specific, and can indicate muscle trauma, septicemia, or toxemia. In general AST values should be below 250 IU/L. Hypoalbuminemia, and elevations in alanine aminotransferase (ALT) and alkaline phosphatase (ALP) can also be seen.¹⁶ The alligator presented in this case was over-conditioned prior to the onset of anorexia. Body condition score (BCS) was estimated at 6/9. She had fat deposits on her neck, base of tail and femoral regions. The anorexia associated with an aggressive hepatic neoplasm most likely initiated the anorexia, that was further exacerbated by the secondary hepatic lipidosis.

The alligator also had a papillary mesothelioma that was diagnosed arising from the mesothelial cells of the ventricular epicardial tissue on histopathology. This neoplasm was not observed grossly or on ultrasound. Undoubtedly, this contributed to the deterioration of the animal. Mesotheliomas arise from the mesothelial cells that line the pleural, peritoneal and pericardial surfaces. This neoplasm is rare in animals and has been observed most commonly in bovine fetuses and young dogs. It is a congenital condition, and not believed to be associated with asbestos exposure as in humans.¹⁷ In rare instances there have been asbestos fibers found within the mesotheliomas in canine patients. Viral infections have been implicated as a causative agent in hamsters and chickens, and carcinogenic chemical exposure in squirrel monkeys and rats.¹⁸ The literature reports a case of mesothelioma in a Savannah monitor (*Varanus exanthematicus*) that presented for coelomic and pericardial effusion.

The duration of this case was 2.5 months from the start of the anorexia until her death. Inappetence was the only sign of a potential problem the end of April. Initially, she was thought to be undergoing hormonal changes due to the season, since the reproductive cycle in alligators begins in May. Even though she was housed indoors, her exhibit was orientated so that she could observe changes in the day-night cycle through 2 large windows facing west and southwest. She did not display aggression or nesting behavior. Estradiol levels were <10 pg/ml when sampled. Normal values in wild caught alligators is 300–1000 pg/ml.^{19,20} This differential was abandoned based on these observations and blood work, and pursuit of a disease entity was initiated.

In conclusion it is possible that the multitude of problems that this alligator experienced was somehow related to its albinism. Albino individuals can have immune system dysfunction that can predispose to neoplasia, particularly skin cancer due to the lack of melanin. This is an autosomal recessive genetic disease that results from an absence or defect in the tyrosinase enzyme responsible for the production of melanin.²¹ It has been observed in all vertebrates, and estimates are that 1 in 10,000 mammals and 1 in 1,764 birds are born albinos. Common conditions affecting albino individuals are ocular, auditory, and neurological problems.²² Particular individuals with Chediak-Higashi syn-

drome have defects in the immune system.²³ Mink, foxes, humans, cats, cattle, and an orca have been diagnosed with this form of albinism. These individuals have defects in their neutrophils leading to impaired lysosomal degranulation, resulting in impaired bactericidal function. A decrease in secretion of lytic secretory granules by cytotoxic T cells also occur. Neuropathy, thrombocytopenia and hepatomegaly are also frequently observed. Most of these individuals die early due to overwhelming bacterial infections.²⁴

The albino alligator featured in this case report is not the first in captivity. Most albino hatchlings in the wild die early due to exposure to ultraviolet light, resulting in severe sunburn. Several in captivity have lived normal lives if exposure to the sun was prevented. To the author's knowledge, this is the first reported case of cholangiocarcinoma and papillary mesothelioma in an American alligator.

Footnotes

^a Nebraska Classic Feline Diet-Central Nebraska Packing, Inc., PO Box 550, North Platte, Nebraska 69103-0550.

^b Sea Tabs® for Birds, Turtles, Fish & Sharks-Pacific Research Labs, Inc., 730 Saddlebrook Dr., Ramona, CA 92065.

^c IDEXX Laboratories-11034 N. 23rd Dr #100, Phoenix, AZ 85029

^d Vitamin B12 (Cyanocobalamin) Injectable Solution, 1000mcg/ml -VetOne® 3041 West Pasadena Drive, Boise, ID 83705

^e High Potency Vitamin B Complex-Sparhawk Laboratories, Inc. 12340 Santa Fe Trail Dr., Shawnee Mission, KS 66215

^f Tazicef-Pfizer Inc.- 235 E. 42nd St., NY, NY 10017

^g Teva- Carlsbad Technology 5928 Farnsworth Ct, Carlsbad, CA 92008

^h Phoenix Veterinary Internal Medicine Services-10645 N. Tatum Blvd., Ste. 200-527, Phoenix, AZ 85028

ⁱ Zoo/Exotic Pathology Service- 6020 Rutland Dr. #14, Carmichael, CA 95608

^j Entyce-Aratana Therapeutics, Inc-11400 Tomahawk Creek Prkw#340, Leawood, KS 66211

^k Mirtazapine-Actavis Inc-400 Interpace Pkwy F13, Parsippany, NJ 07054-1118

^l Metronidazole-Unichem Pharmaceuticals (USA), Inc-One Tower Center Boulevard, Suite 2200, East Brunswick, NJ 08816

^m Miratac Transdermal Ointment™-Kindred Bio-1555 Bayshore Hwy, Suite 200 Burlingame, CA 94010

ⁿ Denamarin-Nutramax Laboratories 2208 Lakeside Boulevard, Edgewood, MD 21040

^o Oxbow Carnivore Critical Care- Oxbow animal Health 11902 South 150th St., Omaha, NE 68138 USA

^p Enulose- Actavis Inc-400 Interpace Pkwy F13, Parsippany, NJ 07054-1118

^q Vitamin E-300-Neogen Vet-620 Leshar Place, Lansing, MI 48912

^r Cerenia-Zoetis 16420 Via Esprillo, San Diego, CA

^s Zeniquin-Zoetis 16420 Via Esprillo, San Diego, CA

References:

- Carpenter J, *Exotic Animal Formulary*, ed 4, Philadelphia, PA, 2012, Saunders.
- Diethelm G, Stein G, Hematologic and blood chemistry values in reptiles. In Mader DR, ed., *Reptile Medicine and Surgery*, ed 2, Missouri, Saunders, 2006, 1112.
- Lane T, Corcodilians. In Mader DR, ed., *Reptile Medicine and Surgery*, ed 2, Missouri, Saunders, 2006, 108.
- Silverman S, Diagnostic imaging. In Mader DR, ed., *Reptile Medicine and Surgery*, ed 2, Missouri, Saunders, 2006, 471.
- Garner MM, Trends in reptilian neoplasia: A diagnostician's perspective, International Veterinary Information Service (VIN), Ithaca, NY, 2004.
- Diaz-Figueroa O, Mitchell MA: Gastrointestinal anatomy and physiology. In Mader DR, ed., *Reptile Medicine and Surgery*, ed 2, Missouri, Saunders, 2006, 158-159.
- Aslan O, Cakir IK, Bekdik Z, et al, Cholangiocarcinoma of intrahepatic bile ducts with disseminated metastases in a Siamese cat: a case report, *Veterinarni Medicina*, 59 (7): 359-367, 2014.
- Aiello SE, Moses MA, eds. *The Merck Veterinary Manual*, ed 11, Merck & CO, Inc., 2016, 348-9.
- Tint GS, Bishambar D, Batta AK, et al, The fecal bile acids and sterols of *Alligator mississippiensis*. *Gastroenterology* 80: 114-19, 1981.
- Divers SJ, Cooper JE, Hepatic lipidosis. *Semin Avian Exotic Pet Med* 9(3): 153-164, 2000.
- Mcbride M, Divers SJ, Kock T, et al, Preliminary evaluation of pre- and post-prandial 3 α -hydroxy bile acids in the green iguana (*Iguana iguana*), *J Herp Med and Surg* 16 (4): 129-134, 2006.
- Knotek Z, Knotkova Z, Hrda A, et al, Plasma bile acids in reptiles, *Proc ARAV, Milwaukee* 2009, 124-27.
- Montesinos A, Martinez R, Jimenez A, Plasma bile acid concentration in tortoises: Reference values and histopathologic findings of importance for interpretation, *Proc WSAVA, Madrid*, 2002.
- Aiello SE, Moses MA, eds. *The Merck Veterinary Manual*, ed 11, Merck & CO, Inc., 2016, 346, 456, 1018, 1895, 2385.
- Donoghue S: Nutrition. In Mader DR, ed., *Reptile Medicine and Surgery*, ed 2, Missouri, Saunders, 2006, 283-4.
- Campbell T: Clinical pathology of reptiles. In Mader DR, ed., *Reptile Medicine and Surgery*, ed 2, Missouri, Saunders, 2006, 464.
- Merlo WA, Rosciani AS: Mesothelioma in domestic animals: Cytological and anatomopathological aspects, DOI: 10.5772/31830, www.intechopen.com, 2012, accessed December 31, 2019.

Wildlife World Zoo & Aquarium					
Necropsy Report Aquatic					
Common Name:	American alligator	Scientific Name:	Alligator mississippiensis		
Date of death:	8/16/2018	Date of necropsy:	8/16/2018	DOB/Age:	
BCS: 2/5	Body Condition:	Fresh	Weight:	85lb	Sex: F
Department:	AQ	Exhibit/Tank:	Alligator		
Accession#	8856	Microchip#:	Band:	Tag/Tattoo:	
Head:	Normal				
Eyes:	Normal				
Nose:	Normal				
Oral cavity:	Normal				
Skull:	Normal				
Other:					
Heart:	Generalized flaccid appearance				
Gills:					
Lung:	Fluid-filled, port-wine colored				
Other:					
Liver:	Rounded borders, swollen, large pale, well-circumscribed masses throughout parenchyma				
Kidneys:	Congested				
Spleen:	Congested				
Stomach:	Generalized erythema along mucosal region				
Intestines	Thickened walls in general. Cut-surface has a "crunch" feel				
Swim Bladder:					
Sex Organs:	inactive ovaries				
Other:	Marked fibrin adhesions throughout. Approx 500 ml of yellow ascitic fluid in coelom				
Skin:	Petechiae and ecchymosis in general. Serous atrophy in general. Edematous				
Skin Biopsy:					
Musculoskeletal:					
Fins:					
Fin Biopsy:					
Squash prep:					
Spleen:					
GI:					
Liver:					
Peripheral blood smear:					
Notes:					DVM: SJ
					Recorded NB

Kannerstein M, Churg J: Mesothelioma in man and experimental animals, *Environmental Health Perspectives* 34:31-6, 1980.

Elsy RM, Lance VA, Joanen T, et al, Acute stress suppresses plasma estradiol levels in female alligators (*Alligator mississippiensis*). *CompBiochem Physiol.* 110A(3): 649-651, 1991.

Lance VA, Reproductive cycle of the American alligator (*Alligator mississippiensis*). *Amer Zool* 29: 999-1018, 1989.

Albinism (<http://www.britannica.com/EBchecked/topic/12993/albinism>). *Encyclopedia Britannica*. Retrieved December 28, 2019.

Nasr, SR (July 15, 2008). "How albinism works". *HowStuffWorks.com*. Retrieved Dec 28, 2019.

Kaplan, J, De Domenico, I, Ward, DM. (2008). Chediak-Higashi syndrome". *Current Opinion in Hematology.* 15 (1): 22-29. Doi:10. 1097/MOH.ObO13e3282f2bcce (<https://doi.org/10.1097%2FMOH.ObO13e3282f2bcce>). PMID 18043242 (<https://www.ncbi.nlm.nih.gov/pubmed/18043242>).

Chediak-Higashi Syndrome, *Merck Manuals*. Retrieved December 28, 2019.

By Sharmie Johnson, DVM, CertAqV
Wildlife World Zoo and Aquarium
Litchfield Park, Arizona USA
vetept@wildlifeworld.com
www.wildlifeworld.com

Zoo/Exotic Pathology Service

6020 Rutland Drive #14
Carmichael, CA 95608-0515
www.zooexotic.com

Doctor: Sharmie Johnson

Clinic: Wildlife World Zoo
16501 W. Northern Avenue
Litchfield Park, AZ 85340

ISIS: -

Date: August 29, 2018

Access: V182062

Species: Reptile

Breed: Albino American Alligator

Sex: Female

Name: Fluffy

Age: 14 Years

CLINICAL INFORMATION

There is anorexia, developed the end of April. Force-feeding has occurred for the past two months. Hepatic enzymes are elevated. The liver is firm, and there is a thickened wall of the intestines. There is a well-demarcated area of the liver. The heart is flaccid with a thickened aorta and pulmonary artery. There are also frozen tissues held. The intestinal walls had a crunchy feel when cut.

MICROSCOPIC

Submitted are 38 tissue sections. Sections supporting bone have been decalcified for processing.

Brain: Examined are multiple sections of the brain. No lesion is recognized.

Heart: Examined are multiple sections through the heart. Along the epicardium of the ventricle, there is a focally extensive area of proliferative lining mesothelial cells that are supported on fibrous connective tissue. These are forming extensive papillary proliferations, some of which are very small closely placed papillary proliferations to larger proliferative changes. The great vessels of the heart are on Block G.

Liver: Examined is a section of liver. This section is supporting variable cytoplasmic vacuolization of the hepatocytes. Some are greatly enlarged hepatocytes with a single clear discrete vacuole. These are interspersed among hepatocytes that are smaller with moderate numbers of cytoplasmic vacuoles. Inflammation is also noted multifocally. This is of lymphocytes and plasma cells with smaller numbers of heterophils. In some areas, these are associated with fibrin. In a section of liver, there is effacement of the normal architecture with multiple irregular branching tubular structures. These are lined by a cuboidal cell with indistinct cytoplasmic borders and moderate amounts of eosinophilic cytoplasm with an oval cell nucleus having a stippled chromatin pattern and 1-2 basophilic nucleoli. These are supported on variable amounts of dense fibrous connective tissue, which is completely effacing the normal architecture of the underlying liver. The mitotic count is low at 0-1 per high-power field.

Coelomic cavity fat pad: No lesion recognized.

Oviduct: The oviduct is active.

Ovary: Examined are multiple ovarian follicles. There are ovarian follicles that are resorbing.

Intestines: Examined are multiple sections of the intestines in which the mucosa is moderately autolyzed.

Urinary bladder: No lesion recognized.

Skin: No lesion recognized.

Skeletal muscle: No lesion recognized.

Thyroid gland: No lesion recognized.

Spleen: Sections of the spleen are supporting extensive loss of a lymphocytic cell population. There is a proliferation of macrophages, which contain abundant intracytoplasmic granular golden-brown pigments.

Stomach: No lesion recognized.

Lung: The lung is severely congested.

Kidney: The kidney is severely congested.

Trachea: No lesion recognized.

Eye: Examined is a section through the globe of the eye. The lens fragmented during processing. Only scant amounts of the retina are identified for evaluation. No apparent lesions are noted.

Rib and bone marrow: Examined is a section through the decalcified rib as well as bone marrow. In these sections, the apparent bone marrow is lacking significant bone marrow cell population.

Tooth: No lesion recognized.

DIAGNOSIS

1) LIVER: SEVERE HEPATIC LIPIDOSIS

2) LIVER: MULTIFOCAL MODERATE SUBACUTE HEPATITIS

3) HEART: FOCAL PAPILLARY MESOTHELIOMA, WELL-DIFFERENTIATED

4) LIVER: CHOLANGIOCARCINOMA

5) SPLEEN: SEVERE LYMPHOCYTIC LOSS AND HISTIOCYTIC PROLIFERATION

COMMENT

The most significant finding is in the liver, and this is interpreted as a bile duct carcinoma.

Primary tumors of the liver, which can arise from the bile ducts or hepatocytes, are uncommonly reported in reptiles. I can find no reports of alligators with liver tumors. Lizards seem to more frequently develop tumors of the biliary system. Coelomic distension, coelomic fluid accumulation and a palpable mass approximately mid-coelom are common findings in both lizards and snakes. Biliary adenocarcinomas (cholangiocarcinomas) may appear as multiple masses in the liver and are rarely reported to metastasize.

The more normal liver is also severely altered with a hepatic lipidosis and multifocal areas of acute to subacute hepatitis.

The heart is supporting a lesions I am interpreting as a mesothelioma. I would suspect this may have contributed to some cardiac dysfunction.

I suspect that there was significant stress, and this may account for the loss of significant lymphoid cells identified in the sections of spleen.

No significant bone marrow population is noted in the section of rib; however, this may be normal given the age of the animal. It is unknown why the intestinal sections may have had a feel of crunchiness. No significant mineralization is noted of these sections.

DRURY R. REAVILL, DVM

DABVP (Avian and Reptile & Amphibian Practice)

Diplomate, American College of Veterinary Pathologists

Mycobacteriosis in a betta fish (*Betta splendens*) diagnosed after treatment with enrofloxacin

By Jenifer L. Nix, BVSc
jnix@hawaii.edu

Abstract

Atypical mycobacteriosis is a ubiquitous disease found in most species of freshwater and saltwater fish. The disease presents with a vast array of non-specific clinical signs and is usually chronic and progressive. A 1-year old male betta fish (*Betta splendens*) presented with a verrucous skin lesion at the rostral aspect of the isthmus, exophthalmia, and uniform white opacity of the left eye. The skin lesion initially appeared 2 months prior to this presentation, but had resolved within 2 weeks. Appetite and behavior were normal at the onset of clinical signs. The fish was kept in a 5-gallon filtered aquarium with a bluefin killifish (*Lucania goodei*) and Asian stone catfish (*Hara jardonii*). The entire tank was initially treated with a medicated feed containing enrofloxacin. One week after starting treatment, the killifish had suddenly died and the betta developed severe lethargy. The betta was started on a course of intramuscular enrofloxacin injections every 72 hours. It had improved significantly within minutes after the first injection, and its energy level continued to improve over the next few days. Therefore, medicated feed was resumed 72 hours after a second injection. Within 1 week after resuming the oral treatment, the catfish died, and the betta redeveloped severe lethargy and dyspnea. The parenteral course of enrofloxacin was resumed at this time. After 3 injections, the betta developed ascites and subcutaneous edema. It was given an injection of intramuscular ceftazidime 24 hours after the third injection of enrofloxacin and died 24 hours later. Sections of liver and testicle were sent for histopathology and acid-fast staining, which strongly supported a diagnosis of mycobacteriosis.



Figure 1. Verrucous skin lesion located ventrally between the gill chambers of a male *Betta splendens*.
Photo by Jenifer L. Nix, BVSc.

Introduction

Atypical *Mycobacterium* spp. are aerobic coccobacilli that are naturally found in soil and in water; more than 20 strains have been cultured in most species of freshwater and saltwater fish.^{1,13,17,19} A number of strains of *Mycobacterium* spp. are pathogenic, causing a plethora of non-specific clinical signs, such as: lethargy; anorexia; depression; emaciation; lesions of the gills; skin ulcers and hemorrhages; exophthalmia; and death.^{1,4,13,14,17,18,34} The onset of clinical disease is often chronic and progressive.¹⁷ Mycobacteriosis is commonly transmitted orally through ingestion of infected material shed from skin ulcers or intestinal excrement.¹⁷ The organisms can also be ingested in fresh and frozen foods.^{26,27}

Transovarial transmission has been documented in livebearers, and direct contact of eggs with *Mycobacterium* spp. can also occur.^{17,34} Atypical *Mycobacterium* spp. are significant to individuals working with fish, such as aquarists, veterinarians, and aquaculturists, as the organisms have zoonotic potential.¹⁷

A tentative diagnosis of piscine mycobacteriosis is made based on history and clinical signs.^{8,17} This is supported by the presence of granulomatous lesions found on various organs during necropsy and with the presence of rod-shaped acid-fast bacteria seen within granulomas on histopathology.^{1,17,34}

This case report describes mycobacteriosis in a betta fish (*Betta splendens*)

that initially presented with cutaneous and ocular lesions. Bettas are known carriers of *Mycobacterium* spp. and the organisms have been found in clinically normal animals.^{25,33} There are currently no recommended treatments for the disease, and advice is generally focused on prevention rather than cure.^{8,17}

Case Details

A 1-year old male betta fish (*Betta splendens*) was kept in a 5-gallon community tank owned by the author. The tankmates included a 1-year old male bluefin killifish (*Lucania goodei*) and a 1-year-old Asian stone cat-

fish (*Hara jardonii*, sex undetermined). Routine aquarium maintenance consisted of a 50% weekly partial water change, and ammonia, nitrite, and pH levels were measured every other week with a colorimetric test kit.^a These parameters remained consistent at 0 mg/L, 0 mg/L, and 8.2, respectively. Temperature was monitored twice daily and ranged from 27-29°C throughout the day. Daily light and dark cycles ranged from 12 hours light:12 hours dark to 16 hours light:8 hours dark. The fish were fed an alternating diet of floating pellets, insect-based crumbled feed, frozen bloodworms, frozen daphnia, and the occasional adult *Drosophila*, twice daily to satiation.

The betta had developed a number of clinical signs, starting approximately 2 months after being added to the aquarium. Initially, it presented with a 2 mm raised verrucous skin lesion at the rostral aspect of the isthmus, between the gill chambers (Figure 1). The author attempted a skin scrape biopsy of the lesion, but this was not diagnostic. The differential diagnoses that were considered included lymphocystis, a traumatic injury, a cutaneous secondary bacterial infection, or mycobacteriosis. The lesion resolved on its own within 2 weeks of initial presentation, but it returned 2 months later and the fish concurrently developed exophthalmia and a uniform opacity of the left eye.

The fish's behavior and demeanor were normal at this time. Therefore, empirical treatment of the entire aquarium with a medicated feed containing 0.5 mg/g enrofloxacin^b was attempted. The feed was prepared using a recipe in a paper by Dr. Greg Lewbart.¹⁵ Within 5 days, the betta's ocular opacity had reduced to a pencil-tip sized white opacity in the center of the eye (Figure 2).

On the seventh day after starting the medicated feed, the bluefin killifish developed an acute onset of petechiae at the base of the caudal peduncle and it became tachypneic, anorexic, and remained hovering in a stationary position near the bottom of the tank. Water parameters remained consistent as previously

described, with temperature at 27°C. Within 24 hours of this presentation, the killifish was found dead, and concurrently, the betta developed weakness and lethargy. The catfish did not show any unusual signs. At this time, ammonia, nitrite, and pH had not changed, but the temperature had dropped to 21°C due to heater failure. The betta was given an intramuscular injection of 0.02 mg of enrofloxacin and within minutes, started swimming again. An alternate heater was added to the setup, and the temperature increased to 24°C within 2 hours. Medicated feed was temporarily discontinued.

Over the next 24 hours, the betta continued to show improvement in its energy level and demeanor, and a second injection was repeated 72 hours after the first. The frequency of water changes was increased to 50% every 2 to 3 days. Within 72 hours after the second injection, medicated feed was resumed as before, and injections were discontinued.

Over the next 3 days, the betta developed worsening lethargy and began gilling at the surface near the heater. The catfish appeared normal after the medicated feed was resumed, but it was found dead and severely autolyzed within 7 days. The medicated feed was discontinued by day 7, and intramuscular injections of enrofloxacin every 72 hours were resumed. Over the next few days, the opacity in the eye continued to reduce in size until it was no longer noticeable, and the exophthalmia moderately improved. The verrucous lesion had disappeared completely within 3.5 weeks after the onset of the second presentation.

In spite of the improvements in ocular and skin condition, the betta's overall health continued to decline. The author attempted a gill biopsy 7 days after the fish had become dyspneic, but the gill tissue was severely atrophied and was difficult to sample. Within 24 hours after receiving a third dose of enrofloxacin, the fish developed ascites, subcutaneous edema, and anorexia. It was given a 2 mg intramuscular injection of ceftazidime that afternoon. The next morning, it was found dead.

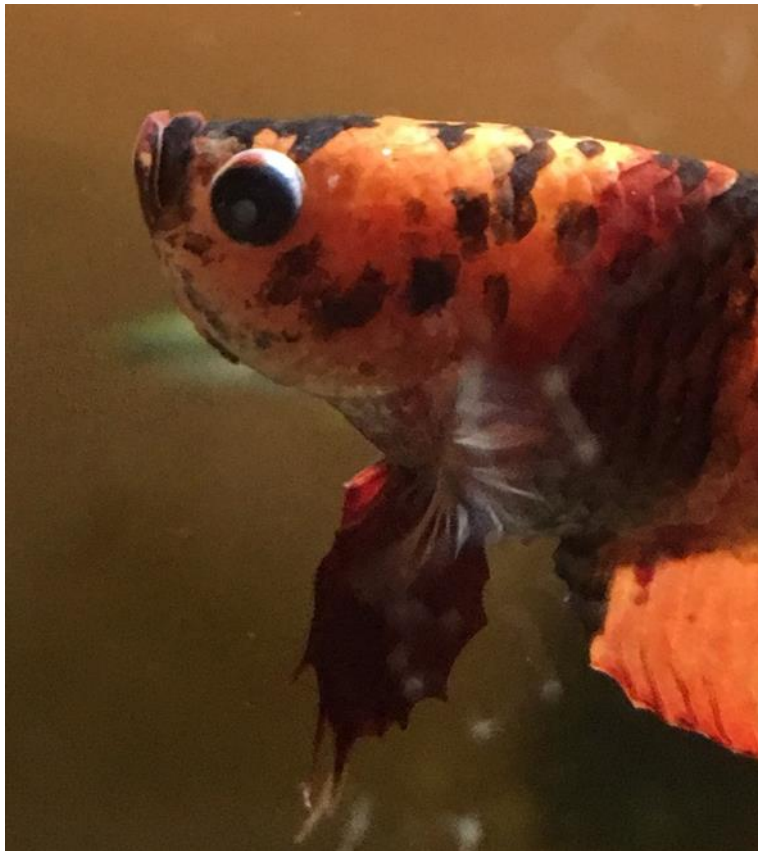


Figure 2. Pinpoint ocular opacity in a male *Betta splendens*.

Photo by Jenifer L. Nix, BVSc, 2019.

A necropsy was performed within the next hour. The tissue was severely autolyzed and it was difficult to delineate the internal organs. Samples of the liver and testicle were fixed in formalin and sent for histopathology.^c Sections of both organs showed multifocal to coalescing granulomas characterized by central cores of necrotic cell debris and an accumulation of melanomacrophages. These were surrounded by epithelial macrophages and there was scattering of lymphocytes and plasma cells. Fite's acid-fast staining confirmed the presence of rod-shaped bacteria within the cores of the granulomas, consistent with a mycobacterial infection.

Discussion and Conclusions

The preceding case describes a tentative diagnosis of mycobacteriosis in a betta fish. Isolation and identification of the organisms were not performed. However, based on history, clinical signs, and histopathological results, mycobacteriosis was the most likely diagnosis.¹⁷ Mycobacteriosis had been considered as a differential diagnosis from the onset of clinical signs, but due to the sentimental value of the fish, empirical treatment was attempted based on other possible differentials. A hospital tank was unavailable to isolate the betta, so the entire tank had been treated with a medicated feed.

Empirical use of antibiotics in fish is not advisable. Multidrug resistance has been reported in several species of bacteria, such as *Aeromonas* spp. and *Mycobacterium* spp.^{3,6,7,24,30,31,32} Many of these pathogens carry zoonotic potential^{16,17} and so the dangers of multidrug resistant strains to human health can be significant. While indiscriminate use of antimicrobials is common in the aquarium trade, veterinarians hold a responsibility of reducing antimicrobial resistance through first obtaining an accurate diagnosis, and by carefully choosing antimicrobials based on culture and sensitivity testing. Furthermore, the importance of a hospital tank cannot be overstated: not only are sick animals separated from healthy ones to prevent spread of disease, but healthy animals avoid exposure to unnecessary medications.

The question of whether or not to treat piscine mycobacteriosis remains controversial. The consensus has generally been that in the event of an outbreak, the system should be depopulated and thoroughly disinfected.^{8,17,28,34} This advice is due to several factors, including: 1) lack of pharmacokinetic studies of antimicrobials used in fish; 2) lack of registered drugs to treat mycobacteriosis in fish; 3) the potential for antimicrobial resistance; 4) the propensity for treatment to produce carriers of the disease; and 5) the zoonotic potential of the organisms.^{8,17,28,34} Nevertheless, pet fish and specimens in public aquaria are valuable animals, and in these cases, it seems reasonable that treatment could be considered.

There are currently no recommended methods of treating mycobacteriosis in fish, and attempts have

been met with variable success. In one report, striped bass (*Morone saxatilis*) that were naturally infected with *Mycobacterium marinum* had been treated with a course of rifampin in feed, but the treatment was unsuccessful.¹⁰ In another report, sea bass (*Dicentrarchus labrax*) were experimentally infected with *M. marinum* and treated with intraperitoneal injections of streptomycin and garlic extract.⁵ The fish showed a regression in granulomatous lesions of the spleen, but the organism was isolated again from the surviving fish during week 32 of the experiment.⁵ One case report describes successful treatment of Australian lung fish (*Neocratodus fosteri*) infected with *M. fortuitum*, *M. marinum*, *M. chelonae*, and *M. peregrinum*.²⁸ The fish were treated with an 8-month course of a combination of rifampicin, doxycycline, and enrofloxacin in feed.²⁸ Enrofloxacin had been the last antibiotic to be used in the protocol, and its inclusion resulted in clinical cure and eradication of the organisms.²⁸

In the present case, the betta did initially show improvements on enrofloxacin. It is possible that the antibiotic had some efficacy against *Mycobacterium* spp. The successful use in treating lung fish raises the possibility for efficacy in treating other fish species. Furthermore, enrofloxacin has been shown to be effective in treating infections caused by *M. fortuitum* in cats and dogs.^{2,9,29} This antimicrobial may therefore be a reasonable choice in treating a mycobacterial infection. Nonetheless, in this case, culture and sensitivity testing was never performed, so it is difficult to say whether or not the mycobacterial pathogens were susceptible. It is also possible that the medication had no effect on *Mycobacterium* spp., but instead, it was effective against other bacterial pathogens, or that host immunity had played a significant role in the early course of the disease. The biggest difference between the use of enrofloxacin in the lung fish and the use of it in this case was that in the lung fish, it was used in combination with other antimicrobials. The synergistic effects of the drugs and extended spectrum may be necessary due to the tendency for the mycobacterial pathogens to develop resistance.²⁸

Regardless of whether mycobacteriosis should or should not be treated in ornamental fish, as with any disease process, if an animal is not improving or is getting worse in spite of therapy, euthanasia should be strongly considered. In this case, towards the later stages of the disease, the betta had continued to deteriorate during treatment. It is possible that the use of antibiotics had slowed the progression of the disease, but this may have also prolonged suffering. This illustrates an important point: in all cases, the clinician should evaluate the animal's quality of life before attempting any treatments, and they should continuously reassess quality of life during treatment when deciding how far to proceed. While an individual animal may have sentimental value to the owner, the veterinarian holds the responsibility of helping the owner make the

best decisions for both themselves and their animal. In the case of dealing with infectious diseases with zoonotic potential, the responsibility becomes more critical: prolonging the animal's life could also compromise human health. If a clinician does decide to treat a suspected case of piscine mycobacteriosis, it is their responsibility to ensure that the owner has a working knowledge of the disease and the risks and prognosis that is involved.

Knowledge of piscine mycobacteriosis is growing, but there is still much that remains unknown. Antemortem diagnostics, approved effective treatments, and better methods of prevention would be invaluable to both the food fish and aquarium fish industries. One area which seems promising is the development of vaccines against the disease. Pasnik and Smith²² had developed a DNA vaccine for *M. marinum* that was protective in hybrid striped bass (*Morone saxatilis* x *M. chrysops*). In a later experiment, however, they discovered that the vaccine protection was short-lived.²¹ In experiments by Kato et al., the Bacillus Calmette and Guérin (BCG) attenuated vaccine against *Mycobacterium bovis* was found to provide immunity to Japanese flounder (*Paralichthys olivaceus*) and amberjack (*Seriola dumerili*).^{11,12} The protection from this vaccine may be species dependent, however. In zebrafish (*Danio rerio*), the BCG vaccine resulted in enhanced survival and lower bacterial counts when the fish were challenged with *M. marinum*, but the vaccine did not completely prevent the disease.²⁰ Rivalde et al. found that the heat inactivated *M. bovis* vaccine delivered by immersion to zebrafish resulted in significant protection.²³ However, the duration of protection was not studied. While vaccines may be an effective method of preventing mycobacterial disease in fish, further research is required before a commercial vaccine becomes available.

Mycobacteriosis is a common disease in fish and should be suspected in any animal showing nonspecific signs, such as lethargy, ocular lesions, or skin lesions. If treatment is attempted, precautions should be taken to ensure the safety of both humans and animals.

Footnotes

^a API Freshwater Master Test Kit, MARS Fish Care, 50 E. Hamilton St., Chalfont, PA 18914

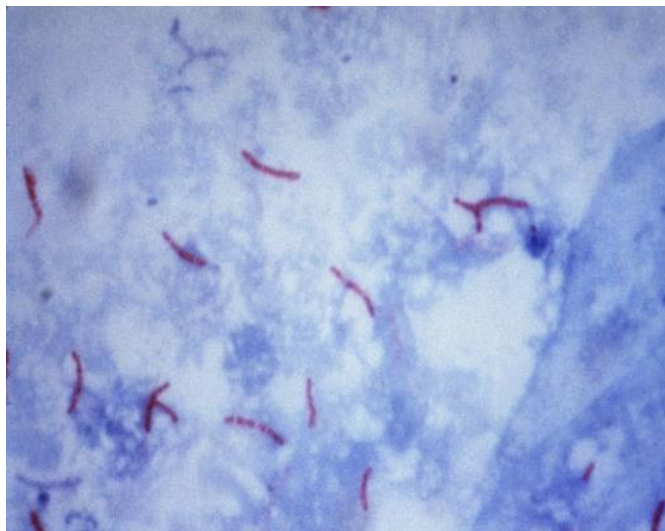
^b Enroflox 100mg/mL, Norbrook Laboratories Limited, Carnbane Industrial Estate, Newry, Northern Ireland BT356QQ

^c Zoo and Exotic Pathology Services, 6020 Rutland Dr. #14, Carmichael, CA 95608

References

1. Astrofsky KM., Schrenzel MD, Bullis RA, et al. Diagnosis and management of atypical *Mycobacteria* spp. Infections in established laboratory zebrafish (*Brachydanio rerio*) facilities. *Comp. Med.* 2000; 50(6):666-672.
2. Bercovier H, Vincent V. Mycobacterial infections in domestic and wild animals due to *Mycobacterium marinum*, *M. fortuitum*, *M. chelonae*, *M. porcinum*, *M. farcinogenes*, *M. smegmatis*, *M. scrofulaceum*, *M. xenopi*, *M. kansasii*, *M. simiae*, and *M. genavense*. *Rev. Sci. Tech. Off. Int. Epiz. (Paris)*. 2001; 20(1):265-290.
3. Bragg RR, Hildegard FAK, Huchzermeyer AK, et al. *Mycobacterium fortuitum* isolated from three species of fish in South Africa. *Onderstepoort J. Vet. Res.* 1990; 57:101-102.
4. Bruno DW., Griffiths J, Mitchell CG, et al. Pathology attributed to *Mycobacterium chelonae* infection among farmed and laboratory-infected Atlantic salmon, *Salmo salar*. *Dis. Aquat. Org.* 1998; 33(2):101-109.
5. Colorni A, Avtalion R, Knibb W, et al. Histopathology of sea bass (*Dicentrarchus labrax*) experimentally infected with *Mycobacterium marinum* and treated with streptomycin and garlic (*Allium sativum*) extract. *Aquacult.* 1998; 160(1-2):1-17.
6. Dias C, Mota V, Martinez-Murcia A, et al. Antimicrobial resistance patterns of *Aeromonas* spp. isolated from ornamental fish. *J. Aquacult. Res. Dev.* 2012; 33(3):doi:10.4172/2155-9546.1000131.
7. Dixon BA. Antibiotic resistance of bacterial fish pathogens. *J. World Aquacult. Soc.* 1994; 25(1):60-63.
8. Francis-Floyd R. Mycobacterial infections in fish. Regional Aquaculture Center (SRAC) No. 4076, November 2011.
10. Govendir M, Hansen T, Kimble B, et al. Susceptibility of rapidly growing mycobacteria isolated from cats and dogs, to ciprofloxacin, enrofloxacin, and moxifloxacin. *Vet. Microbiol.* 2011; 147(1-2):113-118.
11. Hendrick RP, McDowell T, Groff J. Mycobacteriosis in cultured striped bass from California. *J. Wildl. Dis.* 1987;23(3):391-395.
12. Kato G, Kato K, Saito K, et al. Vaccine efficacy of *Mycobacterium bovis* BCG against *Mycobacterium* sp. infection in amberjack *Seriola dumerili*. *Fish Shellfish Immunol.* 2011; 30(2):467-472.
13. Kato G., Kondo H., Aoki T, et al. BCG Vaccine confers adaptive immunity against *Mycobacterium* sp. infection in fish. *Dev. Comp. Immunol.* 2010; 34(2):133-140.
14. Keller C, Wenker C, Jermann T, et al. Piscine mycobacteriosis- involvement of bacterial species and reflection in pathology. *Schweiz. Arch. fur Tierh.* 2018; 6:385-393.
15. Lescenko, P, Matlova L, Dvorska L, et al. Mycobacterial infections in aquarium fish. *Vet. Med. (Praha)*. 2003; 48(3):71-78.
16. Lewbart GA. Medical management of disorders of freshwater tropical fish. *Comp. Cont. Educ.*

- Pract. Vet.* 1991; 13(6):969-978.
17. Lowry T, Smith SA. Aquatic zoonoses associated with food, bait, and ornamental fish. *J. Am. Vet. Med. Assoc.* 2007; 231(6):876-880.
 18. Noga EJ. 2010. Problems 45 through 57. In: *Fish Disease: Diagnosis and Treatment 2nd Edition*. Wiley Blackwell, Ames, IA, 2010:183-214.
 19. Noga EJ, Wright JF, Pasarell L. Some unusual features of mycobacteriosis in the cichlid fish *Oreochromis mossambicus*. *J. Comp. Path.* 1990; 102(3):335-344.
 20. Novotny L, Halouzka R, Matlova L, et al. Morphology and distribution of granulomatous inflammation in freshwater ornamental fish infected with mycobacteria. *J. Fish Dis.* 2010; 33(12):947-955.
 21. Oksanen KE, Myllymaki H, Ahava MJ, et al. DNA vaccination boosts *Bacillus Calmette-Guérin* protection against mycobacterial infection in zebrafish. *Dev. Comp. Immunol.* 2016; 54(1):89-96.
 22. Pasnik DJ, Smith SA. Immune and histopathologic responses of DNA vaccinated hybrid striped bass (*Morone saxatilis* x *M. chrysops*) after acute *Mycobacterium marinum* infection. *Dis. Aquat. Org.* 2006; 73:33-41.
 23. Pasnik DJ, Smith SA. Immunogenic and protective effects of a DNA vaccine for *Mycobacterium marinum* in fish. *Vet. Immunol. Immunopath.* 2005; 103(3-4):195-206.
 24. Risalde MA, López V, Contreras M, et al. Control of mycobacteriosis in zebrafish (*Danio rerio*) mucosally vaccinated with heat inactivated *Mycobacterium bovis*. *Vaccine.* 2018; 36(30):4447-4453.
 25. Schmidt AS, Bruun MS, Dalsgaard I, et al. Occurrence of antimicrobial resistance in fish pathogenic and environmental bacteria associated with four Danish rainbow trout farms. *Appl. Environ. Microbiol.* 2000; 66(11):4908-4915.
 26. Sirimalaisuwan A, Teeraruk P, Kanjanapitakchai P, et al. Detection of *Mycobacterium marinum* in clinically asymptomatic Siamese fighting fish (*Betta splendens*) from ornamental fish shops in Chiang Mai Province, Thailand. *Asian Pac. J. Trop. Dis.* 2017; 7(6):344-346.
 27. Sodchit T, Somsiri T, Chinabut S. A study of mycobacteriosis transmission in Siamese fighting fish (*Betta splendens* Regan). *Proceeding of the Seminar on Fisheries 1993, Department of Fisheries, Thailand.* 1993; 298-301.
 28. Somsiri T, Puttinawoarat S, Soontornwit S, et al. [Contamination of *Mycobacterium* spp. In live feeds.](#) *Dis. Asian Aquacult.* 2005; 5:227-235.
 29. Strike TB, Feltrer Y, Flach E, et al. Investigation and management of an outbreak of multi-species mycobacteriosis in Australian lungfish (*Neoceratodus fosteri*) including the use of tri-ple antibiotic treatment. *J. Fish. Dis.* 2017; 40:557-570.
 30. Studdart VP, Hughes KL. Treatment of opportunistic mycobacterial infections with enrofloxacin in cats. *J. Am. Vet. Med. A.* 1992; 201(9):1388-1390.
 31. Taylor PW. Communications: Multiple antimicrobial resistance in a chronic bacterial infection of koi carp. *N. Am. J. Aquacult.* 2003; 65:120-125.
 32. Uma A, Ronald BS. Drug resistance in *Mycobacterium fortuitum* isolated from goldfish, *Carassius auratus*. *Int. J. Sci. Environ. Technol.* 2016; 5(6):4411-4417.
 33. Verner-Jeffreys DW, Welch TJ, Schwart T, et al. High prevalence of multidrug-tolerant bacteria and associated antimicrobial resistance genes isolated from ornamental fish and their carriage water. *PLoSOne.* 2009; 4(12):doi:10.1371/journal.pone.0008388.
 34. Weerakhun S, Sukon P, Hatai K. *Mycobacterium marinum* and *Mycobacterium fortuitum* infections in Siamese fighting fish, *Betta splendens* (Regan) in Thailand. *Thai J. Vet. Med.* 2019; 49(2):137-145.
 35. Yanong RPE, Curtis EW, Terrell SP, et al. Atypical presentation of mycobacteriosis in a collection of frogfish (*Antennarius striatus*). *J. Zoo Wildl. Med.* 2003; 34(4):400-407.



***Mycobacterium tuberculosis* visualization using the Ziehl–Neelsen stain**

This photomicrograph reveals *Mycobacterium tuberculosis* bacteria using acid-fast Ziehl-Neelsen stain; Magnified 1000 X.

Photo courtesy of CDC/ Dr. George P. Kubica - phil.cdc.gov CDC-PHIL ID #5789

About the Author

Dr. Jenifer Nix was born and raised in the town of Normal, Illinois. She had left the mainland to study biology at the University of Hawaii at Manoa in Honolulu, earning her Bachelor of Arts in biology with honors in 2009. She then went on to study veterinary science at Massey University in Palmerston North, New Zealand. Dr. Nix experienced fish medicine for the first time during her junior year of veterinary school, when she attended a lab in which she learned how to sedate a goldfish with Aquic-S and perform a skin scrape and gill clip. She had always had an interest in exotic animal medicine, but the thought of working with aquatic animals was truly fascinating. In the final year, she was able to obtain hands-on experience in aquatics during an externship at Brookfield Zoo in Brookfield, Illinois. During the externship, she assisted with ultrasounds on pregnant dolphins and helped to take radiographs and do an ultrasound on a frogfish with buoyancy issues. This was when she decided that aquatic animals were her passion.

Dr. Nix graduated from veterinary school with distinction in 2013. She returned home to the United States shortly after graduation to take care of her mother, who was in end-stage congestive heart failure. Her mother died a few months after Dr. Nix had returned, and so Dr. Nix had taken a long sabbatical from veterinary practice. However, after her fiancé gave her a 25-gallon tropical fish tank for her birthday in 2016, she rekindled her love for fish and decided to come back to the profession, with the goal of becoming an aquatic animal veterinarian. Dr. Nix has worked in small animal and exotics practice since February 2018, and she has been working towards her aquatic veterinary certification since October 2018. This summer, she will be starting an exotic animal internship program at the Animal House of Chicago in Chicago, Illinois. Her ultimate goal is to work with fish in a zoo, aquarium, or research setting.



I'm looking at the leading cause of unhealthy crickets.
 Gordon Vadis, Cricketeer

The Bug Company, home of the world's tastiest, organic, and most nutritious line of insects! Since 1947 The Bug Company has refined its ability to produce and distribute only the healthiest live insects including Acheta Crickets, Mealworms, Super Worms, Fruit Flies, Wax Worms and more. We are proud to offer our line of bugs, which are second to none in gut-loaded quality nutrition for reptiles, turtles, birds, lizards, amphibians, fish and arachnids. Raised in temperature controlled all-natural settings, our bugs are reared on a strict diet of organic, vitamin-filled, high-quality grains and feed, making our insects the most responsible choice for creatures and pets of all kinds.

We carry a full line of tasty bugs, but our specialty and most popular product is the *Acheta domestica* cricket, otherwise known as the house cricket. Our crickets come in seven sizes, from pinheads to adults - sizes to satisfy the natural instincts of predators large and small. Our products are distributed throughout the United States and Canada to pet and birding/nature product retailers large and small. Browse the web site for more information, or to order your Crickets, Mealworms, Super Worms, Wax Worms or Fruit Flies right now, [Click Here!](http://www.ebugco.com/) <http://www.ebugco.com/>

The Bug Company

15941 Tippecanoe St. N.E.

Ham Lake, MN 55304

Phone: **1-888-777-2248**

[For general information or questions](mailto:info@ebugco.com)

info@ebugco.com

[For sales or pricing information](mailto:sales@ebugco.com)

sales@ebugco.com



Questions & Answers from the WAVMA Listserv
[WAVMA Members-L@wavma.org](mailto:WAVMA_Members-L@wavma.org)
Fish Parasites

Dear members,

This is the GI tract of a fingerling recently harvested from a pond. The fish from this pond have been slow to grow. In this picture there is a GI worm to the left. It was moving when the photograph was taken. I believe it is a type of tapeworm based on the segments. Any thoughts?



On the right, bottom corner, inside the intestines there are 2 oval-shaped eggs. The rest is zooplankton that the fish had eaten in the pond. I am trying to decide if these parasites could be what is slowing the growth of these fish.

The lack of food was the first consideration, but the intestines are full of the same type of zooplankton as found in other ponds where fish growth is adequate. The water quality has been tested along with oxygen saturation and all tests are within normal limits..

Any thoughts on treatment for these endoparasites in a flow through tank system?

Sincerely,
Sherri Kasper, DVM

Hi Sherri,

Obviously the endoparasites will prevent rapid growth, provided poor quality of feed and poor water quality have been considered and found not to be the cause.

Try using Mebendazole (500 mg/5 grams) administered at 10 grams per 10 kg of fish feed. That should help. Treat for about 3 days in the food.

Olakunle Tiamiyu, DVM, MVSc
[@tiamiyukunle69](https://twitter.com/tiamiyukunle69)
Animal Care Technical Laboratory,
Ogere Remo, Ogun State, Nigeria

Cestodes (tapeworms) in fish have a complex life cycle that involves two or more hosts. Fish can be the second intermediate host, a paratenic host, or the definitive (final) host, depending on species of tapeworm.

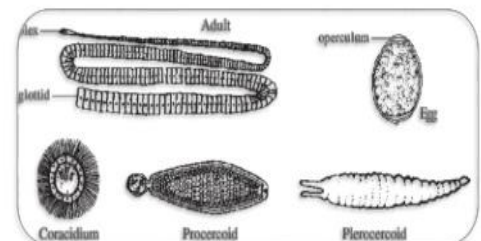
Treatment includes eliminating the first intermediate host (usually a copepod or Tubifex worm) from the diet of the fish. Treat the affected fish with 400 mg Praziquantel in 100 grams of food, fed daily for 5-7 days. Bath treatments can be used with Praziquantel 2-10 mg/L in the water for up to 24 hours. For individual pet fish, Praziquantel can be injected intramuscularly at 25 mg/kg body weight.

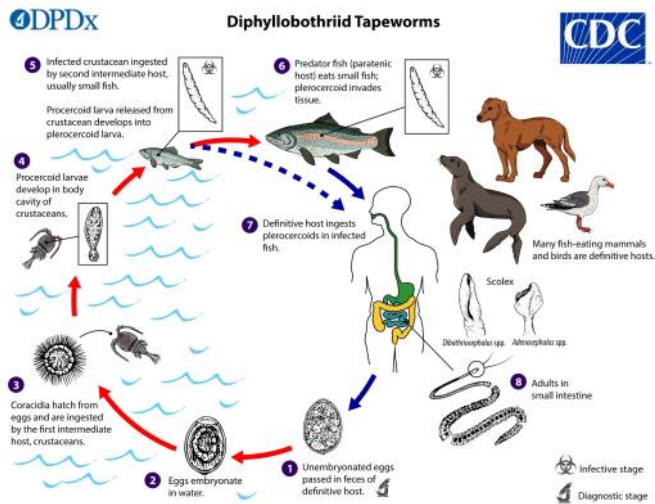
In addition to Mebendazole and Praziquantel, the old treatment of Piperazine 600 mg in 100 g of fish food can be used. Repeat all treatments in 1-2 weeks after initial dose.

Nick Saint-Erne, DVM, CertAqV
nsainterne@gmail.com

Life stages

- Unembryonated egg
- Oncospheres
- Coracidia
- Procecoid
- Plerocercoid
- Adult





Hi Everyone,

I am looking for recommendations of good reference books (with good pictures) to assist with identification of aquatic parasites in fish.

Thanks in advance.

Kind regards,

Sasha Saugh, BVSc
 Aquaglobal Veterinary Consulting
 Durban, South Africa
 Email: aquaticvet@hotmail.com; saughs@yahoo.com

Dear Sasha,

I would refer you to *Fish Diseases*, by Dr. Ed Noga, and *Fish Diseases and Disorders, Volume 1: Protozoan and Metazoan Infections*, by Dr PTK Woo. Hope these are helpful!

All the best,

Babak Shoabi Omrani
drshoabi74@gmail.com

A few other good resources are *Fish Parasites – Pathobiology and Protection*, edited by Patrick Woo and Kurt Buchmann. This book has good descriptions of a selection of common parasites, but mostly black and white images. Good color photos of some fish parasites can be found in the book *Self-Assessment Color Review of Ornamental Fish*, by Gregory A. Lewbart. Another book with good color photographs of parasites is the *Handbook of Fish Diseases* by Dieter Untergasser. BSAVA Manual of Ornamental Fish (2nd ed) edited by William H. Wildgoose has good color photographs of some common parasites.

Nick Saint-Erne, DVM, CertAqV

The Aquarium Vet, in conjunction with Barrett Christie (The Maritime Aquarium, Connecticut, USA), is delighted to announce **The Aquarium Vet E-Workshop – Parasite ID and their Management**.

The workshop will be held over two days in the first week of August 2020. Experts in the field of fish health will present on the theory and practice of making a diagnosis and then managing the problem appropriately.

Do not miss out. Book early as there will be limited seats available at the live conference.

For more details please go to:

<https://www.theaquariumvet.com/conference/>

Regards,
 Dr Rob Jones
 The Aquarium Vet
www.theaquariumvet.com
 Veterinary Advisor to AZA Marine Fish TAG
Home of the e-quarist course

OUR VISION – To Advance the Health & Welfare of Aquatic Animals in Aquariums and Zoos Globally

Here are some websites with illustrated guides to fish parasites:

<http://www.seagrant.umn.edu/fisheries/parasites>

https://www.dnr.state.mn.us/fish_diseases/index.html

<http://edis.ifas.ufl.edu/pdffiles/FA/FA11300.pdf>

<https://edis.ifas.ufl.edu/fa113>

<https://www.merckvetmanual.com/exotic-and-laboratory-animals/aquarium-fishes/parasitic-diseases-of-fish>

Aquatic Veterinary Abstracts

Compiled by David Scarfe

Fish Parasites**Guide to the Identification of Fish Protozoan and Metazoan Parasites in Stained Tissue Sections**Bruno, David & Nowak, B.F. & Elliott, Diane. (2006). *Diseases of aquatic organisms*. 70. 1-36. 10.3354/dao070001.

PMID: 16875388

DOI: 10.3354/dao070001

Dis Aquatic Organisms

2006 Jun 12;70(1-2):1-36.

Abstract

The identification of protozoan and metazoan parasites is traditionally carried out using a series of classical keys based upon the morphology of the whole organism. However, in stained tissue sections prepared for light microscopy, taxonomic features will be missing, thus making parasite identification difficult. This work highlights the characteristic features of representative parasites in tissue sections to aid identification. The parasite examples discussed are derived from species affecting finfish, and predominantly include parasites associated with disease or those commonly observed as incidental findings in disease diagnostic cases. Emphasis is on protozoan and small metazoan parasites (such as Myxosporidia) because these are the organisms most likely to be missed or misdiagnosed during gross examination. Figures are presented in colour to assist biologists and veterinarians who are required to assess host/parasite interactions by light microscopy.

Full article can be downloaded as a pdf here:

<https://www.int-res.com/articles/feature/d070p001.pdf>**Parasitology and Necropsy of Fish**E. P. Scott Weber III, VMD, MSc, Pam Govett, DVM
CompendiumVet.com, February 2009*Compendium: Continuing Education for Veterinarians*

PMID: 19288434

Abstract

Parasitic diseases are common in fish. Diagnosis can be made through gill biopsy, skin cytology, fecal examination, or necropsy. Common parasites include protozoa, helminths, and crustaceans. Determining the cause of death in a fish is important for maintaining the health of other fish in the same environment. Due to rapid autolysis, fish necropsies should be performed promptly after death. Samples should be preserved in 10% neutral buffered formalin. Squash preparations, tissue imprints, microbiology, and virology are also useful in obtaining a diagnosis.

Full article:

https://www.researchgate.net/publication/24202851_Parasitology_and_necropsy_of_fish**Parasites of Juvenile Brook Trout (*Salvelinus fontinalis*) from Hunt Creek, Michigan, USA**

Patrick M. Muzzall

Journal of Parasitology 93(2), 313-317, (April 2007).<https://doi.org/10.1645/GE-3572.11>**Abstract**

Four parasite species (*Crepidostomum cooperi*, *Cystidicoloides ephemeridarum*, *Acanthocephalus dirus*, *Salmincola edwardsii*) infected 215 juvenile brook trout (105 young-of-year; 110, 1-yr-old) from Hunt Creek, Michigan, in 2003, 2004, and 2005. Prevalences of these species in 2004 (main study year) varied from 29 to 37%. *Crepidostomum cooperi* had the highest mean intensity and mean abundance, followed by *C. ephemeridarum*. The number of fish infected with each parasite species was significantly higher in 1-yr-old fish than in young-of-year fish. Also, the mean intensities and mean abundances of *C. cooperi* and *C. ephemeridarum* and the mean abundance of *A. dirus* were significantly higher in older fish. The mean intensity of *C. cooperi* and prevalence of *A. dirus* were significantly higher in fish between creek sections. Fish length had a significant positive effect on the abundances of *C. cooperi* and *C. ephemeridarum*; parasite species richness, on the abundances of *A. dirus* and *S. edwardsii*; and parasite species richness in the 2003 and 2004 trout cohorts, respectively. *Crepidostomum cooperi*, *C. ephemeridarum*, *A. dirus*, and *S. edwardsii* commonly infect Michigan brook trout. The small number of parasite species infecting Hunt Creek brook trout is similar to the number of parasite species of brook trout from other Michigan creeks.

Helminth Parasites of South American Fishes: Current Status and Characterization as a Model for Studies of BiodiversityJ L Luque, F B Pereira, P V Alves, M E Oliva, J T Timi
J Helminthol

2017 Mar;91(2):150-164.

Epub 2016 Nov 18.

PMID: 27855726

DOI: 10.1017/S0022149X16000717

Abstract

The South American subcontinent supports one of the world's most diverse and commercially very important ichthyofauna. In this context, the study of South American fish parasites is of increased relevance in understanding their key roles in ecosystems, regulating the abundance or density of host populations, stabilizing food webs and structuring host communities. It is hard to estimate the number of fish parasites in South America. The number of fish species studied for parasites is still low (less than 10%), although the total number of host-parasite associations (HPAs) found in the present study was 3971. Monogeneans, with 835 species (1123 HPAs, 28.5%), and trematodes, with 662 species (1127 HPAs, 30.9%), are the more diverse

groups. Data gathered from the literature are useful to roughly estimate species richness of helminths from South American fish, even though there are some associated problems: the reliability of information depends on accurate species identification; the lack of knowledge about life cycles; the increasing number of discoveries of cryptic species and the geographically biased number of studies. Therefore, the closest true estimations of species diversity and distribution will rely on further studies combining both molecular and morphological approaches with ecological data such as host specificity, geographical distribution and life-cycle data. Research on biodiversity of fish parasites in South America is influenced by problems such as funding, taxonomic impediments and dispersion of research groups. Increasing collaboration, interchange and research networks in the context of globalization will enable a promising future for fish parasitology in South America.

Use of praziquantel to control platyhelminth parasites of fish

Bader, Chris & Starling, David & Jones, Douglas & Brewer, Matthew.

Journal of Vet. Pharmacology and Therapeutics

42(4) · December 2018

DOI: 10.1111/jvp.12735

Abstract

Fish are common definitive and intermediate hosts for a variety of parasitic flatworms. In unstressed wild populations, parasitic infections often go unnoticed and are perceived to represent a lesser threat to fish health. In contrast, platyhelminth parasitism of captive fish often results in decreased weight gain and increased mortality which often necessitates chemotherapeutic treatment. The presence of platyhelminth parasites in fish tissues is not only unappealing but in some cases also represents a threat to human health. In veterinary medicine, one of the most commonly used agents with anti-flatworm activity is praziquantel; yet, no praziquantel products are labeled for use in fish in the United States. Veterinarians may use praziquantel preparations approved for other vertebrate species under the Animal Medicinal Drug Use Clarification Act (AMDUCA). However, such extra-label use should be informed by scientific evidence including efficacy and tissue residue studies. Herein, we review studies testing the efficacy of praziquantel for treatment of Platyhelminthes along with an assessment of routes of administration, pharmacokinetics, and toxicity information.

Helminth Communities of Four Commercially Important Fish Species From Chetumal Bay, Mexico

M L Aguirre-Macedo 1, V M Vidal-Martínez, D González-Solís, P I Caballero

J Helminthol

2007 Mar;81(1):19-31.

PMID: 17381863

DOI: 10.1017/S0022149X0721209X

Abstract

The relative importance of ecology and evolution as factors determining species richness and composition of the helminth communities of fish is a matter of current debate. Theoretical studies use host-parasite lists, but these do not include studies on a temporal or spatial scale. Local environmental conditions and host biological characteristics are shown to influence helminth species richness and composition in four fish species (*Eugerres plumieri*, *Hexanematichthys assimilis*, *Oligoplites saurus*, and *Scomberomorus maculatus*) in Chetumal Bay, Mexico. With the exception of *H. assimilis*, the helminth communities had not been previously studied and possible associations between environmental and host biological characteristics as factors determining helminth species richness and composition using redundancy analysis (RDA) are described. Thirty-four helminth species are identified, with the highest number of species (19 total (mean = 6.3 +/- 2.1)) and the lowest (9 (4.0 +/- 1.0)) occurring in *H. assimilis* and *S. maculatus*, respectively. The larval nematodes *Contracaecum* sp. and *Pseudoterranova* sp. were not only the helminth species shared by all four host species but also were the most prevalent and abundant. Statistical associations between helminth community parameters and local ecological variables such as host habitat use, feeding habits, mobility, and time of residence in coastal lagoons are identified. Phylogeny is important because it clearly separates all four host species by their specialist parasites, although specific habitat and feeding habits also significantly influence the differentiation between the four fish species.

The Aquatic Veterinarian is meant to be read as a two-page spread (like a paper magazine!). To view it this way on your computer, open the pdf document using Adobe Acrobat or Adobe Reader, then go to the menu bar at the top of the computer screen and click on View, then Page Display, then Two Page View. That will allow you to scroll through the issue seeing the cover page by itself first, followed by two pages side by side for the rest of the issue. Doing this, you will be able to see the Centerfold picture in all its ginormous glory!


Portable Digital Microscope

The only pocket-sized microscope that delivers 1 micron resolution (400x magnification)



The ioLight microscope displays laboratory quality images onto any smart phone, tablet or computer. Beautiful images can be viewed and shared instantly by the whole team. The microscope folds to fit a jacket pocket and can be used anywhere: on farms, in classrooms or even in the jungle.

- Laboratory quality images and video displayed on smart phone, tablet or computer
- 1 micron resolution for beautiful images of cells
- x200 magnification on an iPad - zoom to x400 or more
- Folds to fit your jacket pocket - take it anywhere
- Uses standard microscope slides and cover slips
- Top and bottom illumination to light any sample



ioLight

CONTACT

✉ info@iolight.co.uk

🌐 iolight.co.uk

The Atlantic Salmon Conservation Foundation is proud to announce our upcoming series of webinars. To register, please follow the link below each webinar title. Participation in the series is free and audio access is available through your computer.

La Fondation pour la conservation du saumon atlantique est fière d'annoncer notre prochaine série de webinaires. Pour vous inscrire, suivez le lien sous chaque titre. La participation à cette série de Webinaires est gratuite et l'accès audio est disponible grâce à votre ordinateur.

2020-2021 ASCF Webinar Schedule | Horaire des webinaires de FCSA 2020 à 2021

Please note: Presentations will be in either English (EN) or French (FR), but where possible, the question and answer period will be bilingual.

Veillez noter que les webinaires seront en anglais (EN) ou en français (FR), mais dans la mesure du possible la période de question et réponse sera bilingue.

23 Sep (EN) – Myron King (MUN) – Assessing the impact of instream barriers and climate change on wild Atlantic Salmon

<https://attendee.gotowebinar.com/register/6822993425075156749>

7 Oct (FR) – Marc Trudel (MPO) – Effets de facteurs de stress multiples sur la survie en mer du saumon atlantique

<https://attendee.gotowebinar.com/register/1194496645489164044>

21 Oct (EN) – Brian Hayden (UNB) - Locked in time – can salmon scales help us understand marine mortality

<https://attendee.gotowebinar.com/register/8012958575955957260>

4 Nov (EN) – Antóin O'Sullivan (UNB) - Hydrological interconnectedness of landscapes, forests and rivers

<https://attendee.gotowebinar.com/register/6300833153981358863>

2 Dec (FR) – Carole Anne Gillis (GMRC) & Valérie Delisle-Gagnon (OBVMR) – Caractérisation et protection des aires de drainage des refuges thermiques de la rivière Matapédia

<https://attendee.gotowebinar.com/register/8328789992453321484>

6 Jan (EN) – Sam Andrews (UNB) – A review of Atlantic Salmon smolt consumption by Striped Bass

<https://attendee.gotowebinar.com/register/3765430808606893584>

22 Jan (FR) – Marie-Camille St-Amour (OBVNEBSL) & Rébecca Gagnon (OBVMR) – Projet de partenariat avec le Club quad Avignon Ouest pour la caractérisation des ponceaux à potentiel faunique

<https://attendee.gotowebinar.com/register/8864928355146819343>

3 Feb (EN) - Karelle Gilbert (UL) & Sylvian Jutras (UL) - Water and forest road networks in Quebec: issues and solutions

<https://attendee.gotowebinar.com/register/3345762613468739343>

17 Fev (FR) - André St-Hilaire (INRS) – La caractérisation et la sensibilité thermique des rivières à saumon

<https://attendee.gotowebinar.com/register/2353160899308784908>

3 Mar (EN) - Ben Whalen (KWRC) – Riparian Restoration Tool Box: A how to manual for watershed practitioners

<https://attendee.gotowebinar.com/register/7279197292405329167>



MEETINGS OF INTEREST TO AQUATIC VETERINARIANS

Veterinarians attending these meetings may be awarded veterinary CEPD credit towards annual re-licensure or re-registration to practice veterinary medicine. Individuals should check with the organizers to see if CEPD certificates are provided.

Many Veterinary Conferences being held in 2020 have been canceled or postponed. Please check websites to ensure conferences are still being held before making travel plans.

2020 WSAVA Congress has been postponed!

Future WSAVA Conferences:

45th WSAVA World Congress

Dates: 21-24 March 2021

Warsaw, Poland

[Visit the website here](#)

46th WSAVA World Congress

Dates: 13-16 November 2021

Hyderabad, India

[Visit the website here](#)

47th WSAVA World Congress

Dates: 29-31 October 2022

Lima, Peru

See: [WSAVA](#)

The 2016 WAVMA Virtual Conference

The presentations (18 webinars) from the 2016 WAVMA Virtual Conference were recorded but due to various issues have never been placed on the WAVMA website to date. They will form part of over 110 webinar recordings which will be available to members once we get the new website up and running. Exactly when that will be is still a bit up in the air, but hopefully in the next few months. A lot of detail still needs to be worked through.

CEPD credit was available if you watched the original webinars live and will be available when they go up on the WAVMA website.

Chris Walster
Website Administrator

AVMA Convention in San Diego has been cancelled for 2020

Announcing in its place:
AVMA Virtual Convention
August 20 – 22, 2020

This summer, we invite you to reconnect with your veterinary community at the first AVMA Virtual Convention, taking place August 20 – 22. Take a step back from the day-to-day work and rekindle your energy and passion for veterinary medicine—without leaving your home!

Attendees: AVMA Virtual Convention is your home for best-in-class CE taught by the profession's leading experts. Take advantage of customized CE tracks while enjoying special events and virtual networking opportunities with your peers.

[Visit the About & registration page](#) to learn more.



VMX – Veterinary Meeting and Expo

Dates: January 16-20, 2021

Location: Orlando, Florida

Venue: Orange County Convention Center

Host: NAVC

Formerly the NAVC Conference, VMX is the world's leading veterinary conference bringing together veterinary professionals across the country and around the world for 5 days of education, hands-on learning, exhibits and entertainment.

Expect to hear from the brightest professionals in the veterinary industry and explore all the veterinary CE topics you're interested in, while enjoying a winter break in sunny Orlando.

Registration is Launching Soon for VMX 2021:
<https://navc.com/best-veterinary-conferences/>

WAVMA's WebCEPD Program -
 Webinars for Global Aquatic Veterinary Education

Given by leading experts, WAVMA's real-time and recorded WebCEPD webinars are intended as educational programs on key aquatic veterinary issues and techniques to hone the knowledge and skills of aquatic veterinary students and practitioners. Currently, there are 37 recorded videos available to watch on the WAVMA.org website.

Earning CEPD Credit for Recorded Webinars

Recorded webinars can be viewed at no charge. However, to earn veterinary continuing education & professional development (CEPD) credit, you will need to complete a short knowledge & skills assessment (KSA) or quiz to ensure you have met the learning objectives. On successful completion you will receive a CEPD certificate (useful for re-licensure/registration to practice veterinary medicine, and credit towards becoming a WAVMA Certified Aquatic Veterinarian). Accessing the KSA and receiving a CEPD will cost US\$5.00 for WAVMA Student Members, \$15.00 for all other WAVMA Members, and \$25.00 for those who are not WAVMA members - click on "more info" for the recording and for KSA/CEPD information.

<https://www.wavma.org/WebCEPD>

Our most recent CEPD video:

[B-1035: Skin Deep: Microscopic Anatomy of Normal Finfish Integument](#)

Presenter:



Dr. Diane Elliott

Date Recorded:
 June 22, 2020

Duration: 1.0 hour

Career level:
 Veterinarians,
 Veterinary Scientists,
 Veterinary Students

CEPD Credits: 1.0

WAVMA Virtual Conference and AGM

The WAVMA Executive Board is working on an online conference and Annual General Meeting for the Fall 2020. Watch for more details on the WAVMA website and in the next issue of *The Aquatic Veterinarian*!

Elasmobranch Information

The electronic version of the Elasmobranch Husbandry Manual II can be downloaded free-of-charge from the Elasmobranch Husbandry website (elasmobranchhusbandry.org).

https://www.researchgate.net/publication/319762551_The_Elasmobranch_Husbandry_Manual_II_-_Recent_Advances_in_the_Care_of_Sharks_Rays_and_their_Relatives

Elasmobranch Husbandry videos are available on the Drum & Croaker (drumandcroaker.org) websites.

The website (animalprofessionals.com), provides an invaluable historical archive of the Elasmobranch meeting.

A variety of items (mugs, t-shirts, hoodies, bags, etc.) are available for purchase through WAVMA's Zazzle Store.

Items in the Zazzle store can be purchased in a variety of sizes, colors, and can even be customized to include your name, clinic name, or to include WAVMA Student Chapter information. For help with customization, please contact the [WAVMA Administrators](#).

WAVMA Decal



Decal to affix to your automobile or practice window to promote WAVMA Membership

Price*: \$8 WAVMA member

Price*: \$5 WAVMA student

Price*: \$10 Non member

<https://www.wavma.org/Shop>

The Ultimate LED Light & Sound Experience

AQUAEFFECTS



*Available in 20", 24", 36" and 48" sizes, AquaEffects 24" Model 1 and Model 2 pictured above.

Customizable LED lighting with sound effects and true UVA? Oh yeah, let's go.

With Zoo Med's NEW AquaEffects LED aluminum aquarium fixtures, you can have it all. Zoo Med's Aquaeffects Model 1 and Model 2* have high output LEDs, adjustable color channels, synchronized natural sound effects and remote controls, taking your tropical and marine tanks to the next dimension.

To learn more about the ultimate LED light and sound experience, and other fine Zoo Med products, please visit our website.



zoomed.com

