



The



quatic

eterinarian

Volume 14, Number 1
First Quarter, 2020



PREPARATION PHASE
BLACKTIP REEF SHARK - CESARIAN SECTION

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

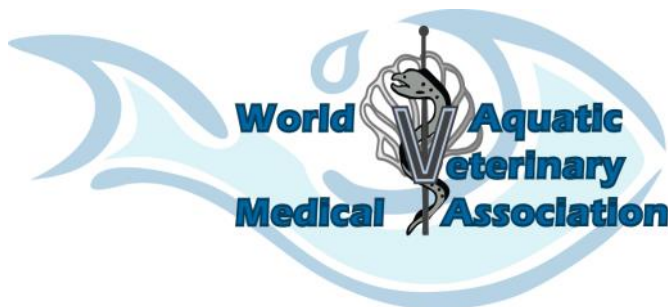
- A. To serve aquatic veterinary medicine practitioners by developing programs to support and promote our members, and the aquatic species and industries that they serve;
- B. To be an advocate for, develop guidance on, and promote the advancement of aquatic animal medicine within the veterinary profession 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)
Laura Urdes (Romania)

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
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	Grand Rounds Case	36
Executive Reports	5	Koi with Skin Lesions	36-37
President's Report	5	Aquatic Veterinary Abstracts	38
Secretary's Report	6	Frogs, The Present of the Future Protein	
Treasurer's Report	7	Source	38
Privileges & Benefits of WAVMA Membership	8	Defining and Monitoring Atlantic Salmon	
Committee Reports	8	"Health"	38
WAVMA Committees	8	Current Practices and Challenges for the Control	
Credentialing Committee	9	Of Sea Lice on Salmon Farms	38
Certified Aquatic Veterinarians	9	Fish Farms at Sea: The Ground Truth from	
Fellows Advisory Council	10	Google Earth	38
Executive Board Responsibilities	10	Legislation & Regulations	39
Meetings Committee	10	COVID-19 Information	39
Education & Student Committee	11	FDA Temporarily Relaxes Veterinary Telemedicine	
WAVMA Veterinary School Chapters	11	to Meet Animal Health Needs	39
Aquatic Animal Internships / Externships	11	Aquatic Veterinary CE & PD	41-43
Fish Veterinary Society Liaison Report	11	Sponsors	
Join A WAVMA Committee	12	The Bug Company	35
New Student Chapter—UC-Davis	12	IoLight Microscope	40
Instructions for Authors and Contributors ...	13	The Fish Vet Group.....	41
Colleague's Connection	14	ZooMed Laboratories	44
The Less Traditional Pathway of an Aquatic			
Veterinarian, By Azureen Erdman	14-17		
Featured Aquarium	18		
Arizona-Sonora Desert Museum	18-23		
Centerfold	22-23		
Gila Topminnows at the ASDM			
Case Reports	24		
Dystrophic Calcification in the Feet of a Colorado			
River Toad (<i>Incilius alvarius</i>)			
By Sharmie Johnson	24-27		
Partial Hysterectomy Following Cesarean Section			
In a Blacktip Reef Shark (<i>Carcharhinus mela-</i>			
<i>nopterus</i>) By Sharmie Johnson.....	28-34		



Colorado Pikeminnow
(*Ptychocheilus lucius*)
Arizona-Sonora Desert Museum

Photo by Randall D. Babb

Proving not all minnows are small, this one can grow to 6' (2 m) and 100 pounds (40 kg). A top carnivore in the river, it can eat mammals and birds, but tends to prefer other fish. Its torpedo shape gives it speed for the chase. Once an important food fish (known as "white salmon") and so abundant it was used as fertilizer, is now rarely seen in the Colorado River . See article on pages 18-23.



Colorado River Toad with swollen front feet. See article on pages 24-17.

Photo by Lorenzo Fuentes

Editor’s Note

In this time of global crisis, with the Coronavirus (CoVid-19) Pandemic spreading all around the world, it is important that we, as medical professionals, help to keep our communities safe. Veterinarians are involved in a wide variety of health roles that save animal lives, prevent zoonotic diseases and protect the health of animals, people and the environment. We are trained to deal with new and unexpected events.

Our President, Jena Questen, has a great article in the President’s Report (page 5) on how she never expected to lead a world wide veterinary organization. We all have more knowledge and skills than the average person, and should do our part to help other veterinarians and students in our profession and around the world. WAVMA is the premier organization for aquatic veterinary information any where in the world.

Another unexpected adventure leading to Aquatic Veterinary Medicine is expressed in our Colleague’s Connection article about Azureen Erdman (pages 14-17). She is working in an Exotic Animal only practice here in Arizona, which has allowed her to see a lot of interesting cases. She works with pets from private clients, pet stores and local zoos, including the Arizona-Sonora Desert Museum (see pages 18-23 for more about the Arizona-Sonora Desert Museum).

Our Colleagues’ Connection veterinarian from the last issue (2019, Vol 13:4), Sharmie Johnson, has continued to provide case reports for this issue. She is finishing the KSE requirements for her Aquatic Veterinarian certification, and publishing her case reports provides credits for KSEs. (See pages 24-34)

If any of our readers have case reports to include in future issues, please send them to me, along with as many photos as you have. Looking forward to getting an aquatic animal case report from YOU!

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



*Stay safe—
stay healthy!*

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>.

Cover Photo: by Lorenzo Fuentes

Preparing for Cesarean Section surgery on a blacktip reef shark.
See article by Sharmie Johnson on pages 28-34.

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.

Welcome Message from the WAVMA President

First and foremost, I would like to express how grateful and honored I am to have been elected President of this important organization for this year 2020, the start of a new decade. If you would have told me upon graduating vet school, that one day I would be elected president of the World Aquatic Veterinary Medical Association, I would have seriously wondered what sort of Pufferfish toxin was poisoning your thinking! It just goes to show you that you never know what avenue a degree in veterinary medicine might open for you, and that we must always be willing to travel the road less taken. I believe, these are the roads which have the potential to bring us the greatest rewards. Because after all, if it were easy, everyone would do it, and as aquatic animal veterinarians, we are certainly all willing to be brave in the face of the many unknowns which are associated with the unique patients we treat. When people wonder and marvel that such thing as a fish vet even exists, I like to then pile it on by asking, "How many species of dogs are there? How many of cats? Horses? ONE! Yet there are over 55,000 or so species of fish, so digest that for a moment!

From fish to invertebrates, to marine mammals, and all kinds of fascinating water dwelling creatures in between, the importance of the aquatic veterinary medicine is clear. We need people who know how to care for these unique creatures, especially in the face of environmental and population challenges, in order to keep more of these creatures and people, safe and healthy.

It is difficult to express how grateful I am to have been drawn to the field of aquatic animal medicine. I so enjoy my patients, my clients, and my colleagues, who are some of the most brilliant scientists in the world, in my humble opinion. And to express my gratitude, I promise to do my very best to lead this organization into the future, in the best way I can, to make it easier, more enjoyable, and more productive for all of us as we move into this new decade.

One of the greatest advantages and privileges that I will be able to utilize this year is the addition of a team of administrative assistants. We will work together throughout the year to streamline operation of the organization, to keep the Executive Board on task, and to help propel us into the future. My goals for the year are to keep meetings on time, develop a calendar with the admins that will help us to quickly and easily reference tasks to be completed in a timely manner, and to

see to it that our annual general meetings are planned 2-3 years in advance. It is a lot to do, along with all the other tasks that will inevitably come along. However, I am committed to helping propel WAVMA to be the number one go-to organization in the world for all things related to aquatic veterinary medicine. I believe we are well on our way to achieving that goal. Since 2015 we have certified 108 aquatic veterinarians and have 56 more in progress. I see the CertAqV program is one of our greatest accomplishments, helping to create a pathway for students interested in aquatic animal medicine to follow their dreams.

We are an organization of good people, willing to accomplish amazing things to promote aquatic veterinary medicine around the world. Hopefully soon will be

the day when everyone knows that yes there is such a thing as a fish vet. We can and will continue to grow the profession and do even more for the world's fish health, safety, and welfare, including more diagnostic testing options, more therapeutic treatment options, and more veterinarians versed in and comfortable with aquatic animal medicine.

Please feel free to email me personally at any time during the year, for thoughts, comments, and/or suggestions for ways to improve our organization. Additionally, it goes without saying that an organization is nothing but the sum of the people who devote their time to it. Not because they are being paid to do so, but because they feel like it is the right thing to do. If you value WAVMA, but have not committed to joining a committee, or attending meetings, please, this is the year

we need to hear from YOU! The future of aquatic veterinary medicine, and how quickly it spreads around the world, is up to us. Won't you please join me and commit that this year, 2020, will be the year that YOU are a most active participant in the activities of WAVMA? We need and want your input, expertise, and experience, no matter how significant, every voice matters and makes a difference.

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



Secretary's Report

The Executive Board members have been meeting regularly via teleconference so far in the first quarter and have accomplished a number of things for 2020. Chris Walster has been named the WAVMA Administrator, and Princess Cruz (a non-veterinarian) was hired as the Administrative Assistant, to assist with numerous administrative activities previously performed by WAVMA Board members.

Chris Walster suggested changing the membership year from the calendar year (December 1 to January 31) to an annual membership based on the date that members join. This would require automating the renewal system on the website. A motion for improving automation of the WAVMA website was proposed and approved by the Board. Chris Walster and Stephen Reichley will work with Gary Fairchild, our webmaster, to determine the cost and best way to accomplish this, and report back to the Board.

Treasurer Nick Saint-Erne provided an overview of the 2019 income and expenses, with suggestions for simplifying bookkeeping, accounting and other issues. Our 2019 Income was \$17,277.46 more than budgeted, and our Expenses were \$12,024.22 less than expected. Increased membership and gross income have increased bookkeeping complexity and tax filing. Simplifying membership and other income payments is needed and an accountant and new accounting software will be needed. This will be discussed at future Board meetings.

Since its inception in 2006, WAVMA has been run by volunteer veterinarians who served on committees, as Directors and Officers. This year, the WAVMA Executive Board approved a recommendation to provide complimentary membership for Board members and Committee Chairs for the year they serve in this capacity. While a \$100 membership fee is small compensation for the valuable work these people provide to WAVMA, it is a nice gesture to show appreciation for all the work that they do.

It was discussed that veterinary meetings around the world may have to be cancelled, postponed or

held virtually depending on the development on the COVID-19 epidemic. Meetings Committee Julius Tupper will develop a contingency plan to discuss at the next meeting.

The Executive Board approved the establishment of a new WAVMA Student Chapter at University of California at Davis School of Veterinary Medicine (UCDSVM).

WAVMA website updates – Chris Walster and Stephen Reichley are working with Gary Fairchild to revise the website with following possibilities:

- Current estimate \$15-20K cost
- Different people will have access to different areas for editing content
- Charging for webinars and clinical cases – revise cost & interacting with WCEA & possibly recording presentations given by members who are provided WAVMA funds to travel to meetings; will needed to be constantly updated
- Alternatives, or supplements to discussion listservs – e.g. discussion forums, RSS feeds, etc.
- Develop Wiki pages for issues, like CertAqV Program
- Data Privacy and Cookie Policies (aka GDPR) – WAVMA is obliged to

adhere to EU and other country laws and requirements

Chris Waster will set up “Data Privacy” Training for all Board members and Committee Chairs

We will have all Executive Board members complete and submit their 2020 Conflict of Interest agreement before the next Board meeting.

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

Treasurer’s Report

New Members—First Quarter 2020

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

Veterinarians

- Aubrey Tauer
- Rachel Brown
- Shelly Marquardt
- Sonya Miles
- Ian Gardner
- Terra MacDonald
- Diya Lake

Veterinarian—New Graduate

- Michelle Farkas
- Handi Usman

Vet Graduate Student, Intern or Residents

- Brett Stuck
- Anne-Carina Miebach
- Felix Valles Feliciano
- Onyx Goins

Vet Student Member (enrolled in Vet Curriculum)

- Colleen Elzinga
- Ricardo Quintana Venegas
- Maribel Escobedo
- Ryan Nel
- Andy Yu
- Victoria Baney
- Cailin Cunningham
- Amanda Dukes
- Emma Zhang
- Carson Rehn
- Alison Jeffrey
- Candice Elliott
- Heather Lane
- Mitchell Oakes
- Hannah Moore
- Samantha Scott
- Stephanie Wheatley
- Paul Thiessen
- Leandra Margolies
- Zoey Lex
- Samuel Tucker
- Madison Kucinick
- Cynthia Ocana
- Andrea Paynter
- Glenna Raycroft
- Stephanie Bronsther
- Audrey Kennedy
- Mercedes Tappy
- Ashley Felhofer
- Justin Cheung
- Kaitlyn Witlicki
- Ryan Hart

Student members—continued

- Heather Federow
- Kierra Watson
- McKayla Crouse
- Morgan Graham
- Ashley McMahon
- Nicole Muldrow
- Shea Noonan
- Madison Tolan
- Kelly Acierno
- Mengyue Wang
- Stephanie Blank
- Jazmine Pritchett
- Shantavia Hayes
- Atalani Jackson
- Hayley Healan
- Robert McGowan
- Jillian Western
- Zachary Ready
- Satarah Jackson

Affiliate Members

- Princess Cruz

Welcome to WAVMA!

Nick Saint-Erne, DVM CertAqV

WAVMA Treasurer
Treasurer@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>

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

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: Stephen Reichley, 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 CertAqV Program is administered by the WAVMA Credentialing Committee, along with the assistance of other Certified WAVMA members who serve as mentors and adjudicators.

To be credentialed by WAVMA as a Certified Aquatic Veterinarian and utilize the CertAqV honorific, individuals must be a WAVMA member, have a veterinary degree from a nationally recognized veterinary school, college or university and have demonstrated general knowledge and competency in core subject areas that are currently considered necessary to practice aquatic veterinary medicine. Students of a nationally recognized veterinary institution of higher education can register for the program, but will not be certified or entitled to utilize the CertAqV honorific until they graduate.

Individuals that desire to participate in the WAVMA CertAqV Credentialing Program are required to:

- Register for the Program (application at <https://www.wavma.org/CertAqV-Pgm>).
- Identify a mentor to assist the registrant through the Program. The potential mentors would be available WAVMA Certified Aquatic Veterinarians.
- Provide the mentor with written evidence of satisfactory completion of each of the core Knowledge, Skills and Experience (KSE) subject areas.
- Be adjudicated by the Credentialing Committee for recognition of completion of all KSE requirements after the mentor has approved the documentation.
- Have the CertAqV certification approved by the WAVMA Executive Board.

The WAVMA Certified Aquatic Veterinarian (CertAqV) program has now certified 108 aquatic veterinarians from 33 countries. Congratulations to our newest Certified Aquatic Veterinarians:

Patinan Rookkachard	Thailand
Nimrod Arad	USA
Denyse Khor	Singapore
Nuno Ribeiro	Portugal

There are an additional 56 other WAVMA members currently in the process of being certified. For more information, see the WAVMA website:

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

David Scarfe, DVM, CertAqV
2020 Credentialing Committee Chair
dscarfe@ameritech.net

Certified Aquatic Veterinarians

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



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](#).

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!

Meetings Committee

The Koi Practitioners Working Group is pleased to announce its third annual session (KoiPrax3), that will take place 22 September 2020 in Warsaw, Poland.

KoiPrax 3: "Koi Ulcer Disease and Aeromonas species: Current Clinical Presentations, Diagnostic Resources and Treatments"

Date: 22 September 2020

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

Faculty

Verena Jung-Schroers

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.



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

Education & Student Committee

ESC members virtually met for a second time in 2020, on 29th March, to define priority tasks for the year. The next ESC meeting will be held at the end of June. ESC subcommittees were re-organised earlier in 2019 and are now fully functional. Stephen Pycroft is leading the ESC WebCEPD subcommittee; Dominik von La Roche is leading the ESC Student Chapter Support subcommittee; Eva Marie Quijano Cardé is leading the ESC Students and Resources subcommittee.

The committee is updating the list of 2020 WAVMA Student Chapters details on the WAVMA website. The newest Student Chapter at the University of California-Davis has been approved by the Executive Board. We are currently working towards the establishment of new WAVMA Student Chapters at Dick Royal School of Veterinary Medicine in Edinburgh, Scotland and at the Veterinary University of Munich in Germany. Their applications are currently being finalized before evaluation by the ESC and Executive Board.

The WAVMA website has been updated with information about WAVMA-ESC [<https://www.wavma.org/media/Documents-for-download/2020%20WAVMA-ESC%20Description.pdf>] and with new Guidelines for WAVMA Student Chapters. We are delighted to announce that the WAVMA webinar series will soon start again! Prof Diane Elliott will contribute with a webinar on fish skin.

There are 20 WAVMA Student Chapters in veterinary schools around the world. If you are a veterinary student, please join your school's WAVMA chapter, or start one if your veterinary school does not have one yet! The new guidelines for veterinary school chapters are on the WAVMA website: <https://www.wavma.org/media/Documents-for-download/2020%20WAVMA%20Student%20Chapter%20Guidelines.pdf>. The guide is also being made available in Spanish and French languages. We are working on defining guidelines for keeping WAVMA Student Chapters active and on a Student Chapter Bylaws/Statute template.

WAVMA-ESC is working hard on updating the student resources available on the WAVMA website. As part of that goal, we want to have a more comprehensive list of veterinary educational opportunities. We invite WAVMA members to provide suggestions for worldwide educational opportunities, including with externships, internships, training visits etc. Please contact Eva Marie Quijano Cardé (Emq8@cornell.edu) of the Resources Subcommittee to provide useful suggestions.

Finally, I would like to invite further WAVMA members to contact me to contribute to ESC activities. Thank you,

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

Fish Veterinary Society Liaison Report

I represented WAVMA during the FVS Conference in March. It was a very good range of talks including topics of legislation, food and ornamental fish. The highlight was a talk given by Rob Jones on elasmobranchs during the second day. Rob Jones once again offered WAVMA Members discount on his e-aquarist course. This would involve WAVMA setting up a link on the website. I'm not sure of the discount but could be up to 30%. We maybe need to remind WAVMA Members that the Welfare module is currently offered free of charge and would easily satisfy the requirements of that section of the CertAqV (original email was sent out to Members-L last August by Rob). Indeed, we ought to remind members that as WAVMA Members they can access free Small Animal CEPD through WSAVA.

Of interest to the EB was a discussion about the WAVMA CertAqV program, and how it could be advanced, although nothing equivalent to diploma standard - on that the consensus seemed to be what is offered by the ANZSVS.

FVS is moving towards recording talks and would be interested in giving WAVMA Members access (which has been offered in the past). I think this would be a good reciprocal arrangement.

There was talk that FVS should combine with LASA to give an extra day on laboratory fish medicine next year in March. This was done a couple of years ago and attracted around 120 vets. Possibly there might be a second meeting in September in conjunction with the EAFP, which I understand is holding a meeting in Aberdeen.

Chris Walster BVMS M MPH CertAqV MRCVS
WAVMA Administrative Coordinator

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>.

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 TAEditor@wavma.org.

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!

New Student Chapter

The UC-Davis School of Veterinary Medicine is thrilled to have an official WAVMA student chapter. **"UCDSVM-WAVMA."** It is nested under an existing Wildlife and Aquatic Animal Medicine (WAAM) club. We look forward to utilizing all the resources afforded by WAVMA to increase opportunities for vet students in aquatic animal medicine. Although the circumstances right now make it hard to hold many of the events we were planning, we're utilizing virtual meetings both to organize and host aquatic-related talks!

Erica Chang - DVM Candidate Class of 2022
UC Davis School of Veterinary Medicine |
Aquatic Animal Health Laboratory | Researcher
Shark Anatomy & Pathology | Researcher
Pathology Club | West Coast Veterinary Pathology
Conference Coordinator
Wildlife and Aquatic Animal Medicine Club | WAVMA
Liaison
ekcchang@ucdavis.edu

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!

Below are UC-Davis WAVMA student members



TO SUPPORT FUTURE STUDENT SCHOLARSHIPS, PLEASE MAKE A DONATION TODAY TO THE SCHOLARSHIP FUND!
WWW.WAVMA.ORG/SCHOLARSHIPS

Aquatic Veterinary e-Learning
Supporting WAVMA's WebCEPD, PubCEPD, CertAqV & Clinical Cases Programs



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 veteri-

nary 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.

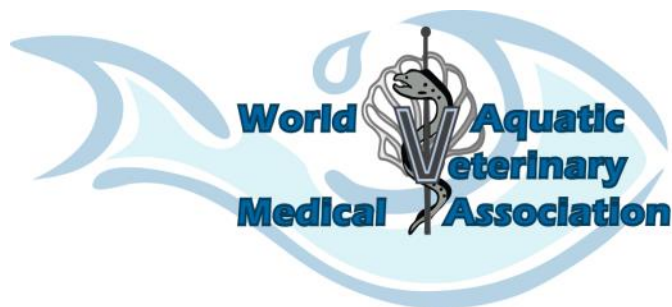
Please send articles, clinical reports, or news items to the editor by the following submission dates:

- 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](#)

**The Less Traditional Pathway
of an Aquatic Veterinarian**
By Azureen Erdman, DVM, CertAqV
Arizona Exotic Animal Hospital

When I was asked to be the featured veterinarian for the Colleague's Connection portion of this issue of *The Aquatic Veterinarian Journal*, at first I wasn't sure what to discuss. What can I offer? How to even start? Well, after some pondering, I decided to discuss my not so traditional career path and the experiences I have been offered along the way. The hope is to offer advice for those students who choose not to take the typical internship/residency route right out of school.

My love of aquatic veterinary medicine didn't start until I was given the opportunity to study at the Atlantic Veterinary College, University of Prince Edward Island, Canada. It was there that the curriculum integrated aquatic medicine lectures into almost every core subject, with opportunity to take elective courses that allowed for more pointed study and hands on experience. The classes we were provided focused mostly on aquaculture for food producing species. I have always been in the mindset to never turn down an opportunity and always say "yes." So, through my years at school, I took every opportunity to learn from our exotic companion animal department when available and from our pathology department. I took a position where I was able to study Infectious Salmon Anemia virus working with cell cultures, viral propagation, and viral identification techniques. During the fourth year some of us were given the opportunity to travel abroad to Thailand and gain training in shrimp aquaculture through Kasetsart University, Bangkok, Thailand. With each opportunity I grew more interested in the wonderful world of aquatics.

In 2015, I graduated from the Atlantic Veterinary College and stepped out into the great unknown as a newbie veterinarian. Waffling over whether to apply for internships or residencies, I decided the concept of paying off student loans was higher priority, so I entered private practice as an exotic animal general practitioner and later started working in veterinary emergency rooms, with their higher rate of pay. I really wasn't sure where my career was heading or how it was going to evolve, but decided these were good steps. I continued in general practice and emergency rooms for 4 years. Through that time frame, I kept my feet wet in clinical aquatic medicine by taking on the occasional koi pond case or by seeing tropical fish in the clinic. However, the fish cases were few and far between and I was left craving more knowledge and experience. So, I started to branch out and look for training opportunities outside of work.

If you have ever met me, you likely know that travel and exploration are a large part of my life. While traveling, I visited aquariums and fish hatcheries that happened to be near where I went. While at fish hatcheries, I often was that silly human standing there asking



a thousand and one questions trying to learn about their infrastructure and the diseases present, trying to soak up every ounce of information I could. While attending conferences, I focused on aquatic wet labs and lectures. I was given the opportunity to attend the University of Florida's two-week training course known as SeaVet. Networking through this course opened the chance to volunteer at the USGS Manatee Health Assessments in Crystal River, Florida.

Textbooks, scientific journals, and on-line resources, as well as the WAVMA list-serve became important in my aquatic medicine education. About three years out of school, I worked on my aquatic certification through WAVMA and gained those credentials. Again, never saying no to an opportunity and always keeping an open mind for when opportunities present themselves.

Currently, I am almost 5 years out of school. With a whole lot of determination and picking up emergency room shifts, mixed with still living frugally like a college student, I was able to pay off my student loans. This gave me the ability to move from a full-time general practice veterinarian position to an exotic animal internship without worrying. I did this in order to explore other aspects on our field outside of general practice.



At the Arizona Exotic Animal Hospital, we have seen a small handful of fish in the clinic, but part of the internship is to shadow senior clinicians (who are Boarded Avian and Reptile Specialists) at the Arizona-Sonoran Desert Museum (zoo and aquarium) near us. This has likely been the most enlightening part of my training as I can work with cownose rays and native teleost fish species within their collection. There has been a lot of extra hours spent researching and reading to gain knowledge and catch up with the level of knowledge needed to work in this aspect of the industry and I wouldn't change it for the world. Needless to say, with each opportunity I have encountered along the path of my career I learned a little more about my passions, my career goals, and myself in general.

By far, the most important skill you can have is networking. Go out; meet people. Reach out a hand and introduce yourself. You never know where that connection will lead. Without the amazing veterinarians who support and mentor us as we start our careers, many opportunities may never present themselves. Having had the pleasure of meeting David Scarfe in my second year of veterinary school, he was instrumental in my involvement in WAVMA and the aquatic industry as a student. He is always supportive and opened the



opportunity to meet with veterinarians in the aquatic industry to speak with them one-on-one and gain insight. While in Connecticut, Mike Corcoran became instrumental in my further interest in clinical cases and gaining WAVMA aquatic certification. He also introduced me to the internship opportunity in Arizona I have right now. During this internship, Nick Saint-Erne has played a big role in guiding my decisions on the next steps in my career as well as introducing me to aquatic medicine in a zoo setting. There are many more veterinarians, like Julius Tepper, who have answered my many case questions, provided advice, and acted as mentors and without them, I would not be the veterinarian I am today.

The field of veterinary medicine is really amazing when you look at it as a whole. We have colleagues in research, academia, private practice, zoos/aquaria, public health, conservation/field work, pathology, clinics, and the list goes on. Take every opportunity to learn about all these possible fields. Tease out where you want to go and what you want to do. Careers aren't made in a year but rather in the course of many years. With each experience you will grow. Even if there is bad mixed with good during an experience, you will often still learn something. Remember that veterinary medicine is veterinary medicine. Yes, my background has encompassed a heavy case load of what some call "air-breathers" by working in private practice and ER medicine. Yes, aquatic medicine has lots of differences in many ways, but a blood gas test (I know some of you just cringed a little just hearing those dreaded words) is a blood gas test. Diagnostics and how to work up a case will follow the same processes no matter what species you are treating. The logic behind disease spread, control, and prevention is the same across species.

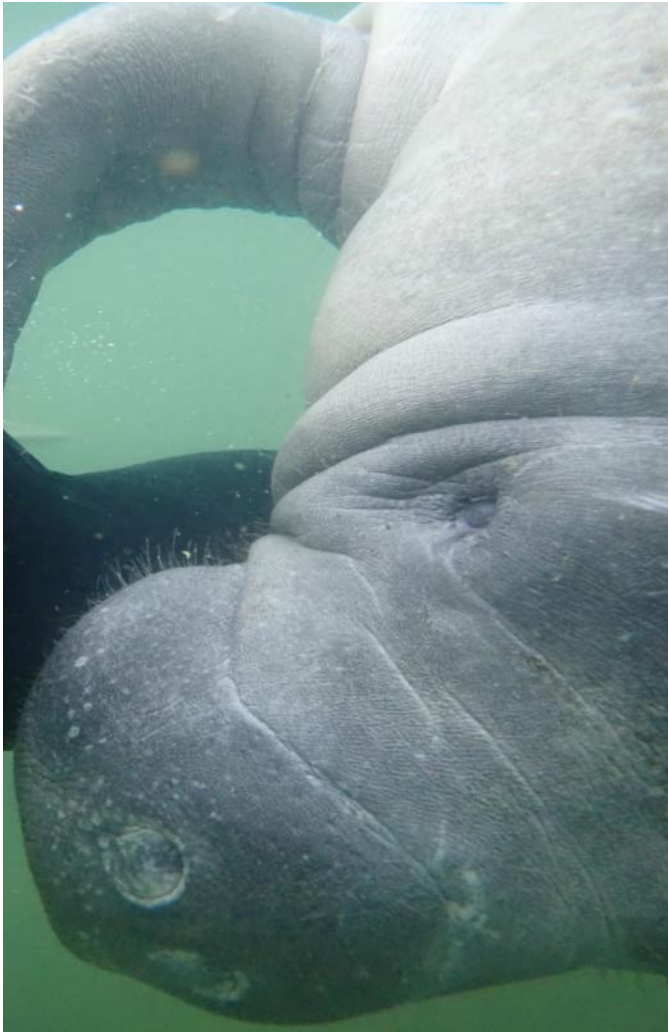


This field you chose to be a part of is full of twists and turns. Getting into the aquatic aspect of the industry can be hard. For some there isn't always the straight-road opportunities that others are given. For others it may take years of self-study and multiple jobs or learning moments working in aspects of veterinary medicine that may not be your dream job. Keep learning and keep moving forward until your career path turns into what you hoped. If I could offer students and young budding veterinarians any advice it would be to network and always keep an open mind about taking an opportunity because you never what door will open and where that door will lead.
 Best wishes!

Azureen Erdman, DVM, CertAqV
 Veterinary intern

Arizona Exotic Animal Hospital
 Mesa, AZ
 475-444-9200
az.erdman@gmail.com





Arizona-Sonora Desert Museum
Tucson, Arizona

The mission of the Arizona-Sonora Desert Museum is to inspire people to live in harmony with the natural world by fostering love, appreciation, and understanding of the Sonoran Desert. The 98-acre Desert Museum is a fusion experience: zoo, botanical garden, art gallery, natural history museum, and aquarium.

Founded in 1952, the Arizona-Sonora Desert Museum is widely recognized throughout the world as a model institution for innovative presentation and interpretation of native plants and animals featured together in ecological exhibits. The Museum is regularly listed as one of the top ten zoological parks in the world due to its unique approach in interpreting the complete natural history of a single region (in our case this is the Sonoran Desert and adjacent ecosystems). Not a "museum" in the usual sense, it is an unparalleled composite of plant, animal, and geologic collections with the goal of making the Sonoran Desert accessible, understandable, and valued.

Today, this approach can be most easily understood by noting that the Museum's living animal collection contains 4,892 specimens of 242 species. Plants number 56,000 specimens of 1,200 taxa; mineral and fossil collections include 16,853 specimens. Represented in the living collections are 110 to 120 native species considered to be of conservation concern.

The early vision of having plants and animals from the region displayed together demonstrating their interdependence as the focus of the Museum was unusual enough, but, ethnology and its interpretation continue to be strengths of the Museum with regular demonstrations, for example, by Tohono O'odham basket weavers surrounded by the native plants they use in their craft.



The Museum originally opened as a free facility, with no public tax support, but it was essential that a gate fee eventually be charged. In 1953 an admission charge of 50 cents was instituted. Today the admission charge supports the museum and zoo functions and there is still no direct tax support for the Museum.

For many years, the Museum has been involved in scientific investigations at a modest level. Research and conservation programs are expanding significantly with emphasis on studies directly related to conservation of the Sonoran Desert. This work includes the Species Survival Plan work on the Mexican gray wolf and thick-billed parrot, as well as cooperative work on the reintroduction programs for these species, and managing stud books for various taxa of endangered species. The research program, often involving outside scientists as well as staff, includes studies to discover the reason for the rapid decline of the Tarahumara frog, botanical field investigations especially in Mexico, population studies of Ironwood, and a major research program on migratory pollinators.

The ASDM occupies a crucial niche in regional conservation and research efforts. Over its history, it has played a vital role in Mexican wolf recovery; protecting Islands in the Gulf of California and Tropical Deciduous Forest in southern Sonora, Mexico; direct salvage, augmentation, and reintroduction of at-risk reptiles and amphibians; developing a better understanding of venomous reptiles and their venoms; establishing regional coordination centers for invasive species management, as well as recognizing the importance of pollinators and documenting the impacts of climate change on mountain "sky island" biota.





After several years of planning and a year of construction, the Arizona-Sonora Desert Museum's new Warden Aquarium opened in January 2013. When Tucson residents and visitors visualize the Sonoran Desert it's unlikely that images of massive rivers with six-foot minnows, or oceans teeming with whales, stingrays, eels, and thousands of invertebrates come to mind. Yet, a full understanding of the Sonoran Desert region isn't possible without recognizing the importance of the freshwater rivers that flow through it and the Sea of Cortez, which are critical to this desert's status as the *lushiest desert on earth*.

The aquarium exhibition, "Rivers to the Sea," highlights the roles of the region's rivers, including the mighty Colorado, and the Gulf of California. The 1,100 sq. ft. aquarium houses two galleries: one highlighting the region's freshwater rivers and aquatic life and the other featuring the Sea of Cortez and representative sea life. Some of the Museum's numerous conservation projects impacting many aquatic species are highlighted in the galleries.

The Freshwater Gallery explores the rivers of the Southwest following the flow of the Colorado River into the Sea of Cortez. The journey begins with a review of the watershed of the Colorado River. This mighty river traverses 1,700 miles, drops 2 miles in elevation, and drains ~12% of the U.S. It winds its way through nine states, seven in the U.S. and two in Mexico, as it seeks the mouth of the sea.

You may encounter the largest minnow in North America, the pikeminnow, as well as bonytail chub, and other fishes with humps, lumps, and bumps, that are extremely well-adapted to these riverine conditions — highly specialized for an environment that is all but gone today.

In the Freshwater Gallery, directly across from the Colorado River exhibit, visitors will experience other Sonoran Desert Rivers, including the Rio Yaqui and Rio Sonora, along with freshwater fish species that Museum staff is working to save in the wild. These include the Rio Sonoyta Pupfish, Beautiful Shiner, and others. Visitors will discover that Apache Trout are, indeed, native, but now only occur in isolated, cold-water mountain streams.

Arizona-Sonora Desert Museum
 2021 N. Kinney Rd.
 Tucson, AZ 85743
info@desertmuseum.org
<http://www.desertmuseum.org/>

Apache Trout (*Oncorhynchus gilae apache*)

The Apache trout is native to Arizona. Five other trout species have been brought into Arizona since the early 1900s, and their introduction has been a disaster for the Apache trout. They took its food and space, ate its young, and hybridized with it. As a result, the Apache trout has disappeared from 95% of its range. Today it lives in the colder and smallest streams high in the White Mountains. Efforts are underway to restore it in waters free of non-native fish.



Apache Trout

Oncorhynchus apache

Their native range is in northern Arizona at high elevations where the river water is cold from snow melt.

Native trout populations dwindled in the early 20th century due reservoir construction and the introduction of rainbow and cutthroat trout.



They were listed as 'Endangered' in 1969, but are currently only classified as 'Threatened'.



Cownose Ray Touch Pool







GILA TOPMINNOW

Poeciliopsis occidentalis occidentalis

Size: 1" (2.5 cm)

Status: Endangered

Originally abundant in the warm, shallow waters of the Gila River Basin and the lower part of the Colorado River, the Gila topminnow is now restricted to a few natural locations in Arizona. Female topminnows, which are generally larger than the males, give birth to live young.

Photograph by Nick Saint-Erne

Dystrophic Calcification in the Feet of a Colorado River Toad (*Incilius alvarius*)

By Sharmie Johnson

Wildlife World Zoo and Aquarium
 Litchfield Park, Arizona USA

vetdept@wildlifeworld.com
www.wildlifeworld.com

Abstract

A 9-yr-old adult, male Colorado River toad (*Incilius alvarius*) presented for swollen front feet. Radiographs, bloodwork and cytology from an aspirate of the affected area on the feet supported a diagnosis of calcinosis circumscripta. This is a rare condition that is thought to be the result of trauma to an affected area leading to necrosis and secondary calcium mineral deposition. Nodular swelling beneath the skin or subcuticular areas can be benign or cause lameness. Treatment involves husbandry changes, medical or surgical treatment.

Introduction

The Colorado River toad or Sonoran Desert toad (*Incilius alvarius*) is indigenous to the southwestern United States and northern Mexico. It is a semi-aquatic amphibian that is found near rivers, streams, and agricultural areas where water is present. It is a nocturnal animal that is readily adaptable to life in the desert in and around the Colorado and Gila Rivers. It is notorious due to the production of a toxin from glands in its skin that is used as a hallucinogen in Native American religious ceremonies and in the illicit drug trade. It is responsible for the poisoning of dogs through ingestion of the toxin.^{1,2}

This clinical report describes a captive Colorado River toad that developed calcinosis circumscripta in its front feet. Calcinosis circumscripta is an uncommon syndrome resulting in ectopic calcium deposition in soft tissues that have been previously traumatized. It is seen in humans, as well as domestic and exotic animals. Common sites affected include the tongue, bony prominences, and areas subjected to pressure. Tissue necrosis is a predisposing factor. Lesions are characterized by a nodular swelling in the skin or subcuticular tissues. Treatment options include husbandry changes, medical or surgical treatments.

Case Presentation

A 9-yr-old adult, male Colorado River toad (*Incilius alvarius*) presented for swollen front feet. The zoo staff noticed the swollen appendages during the routine maintenance of the enclosure.



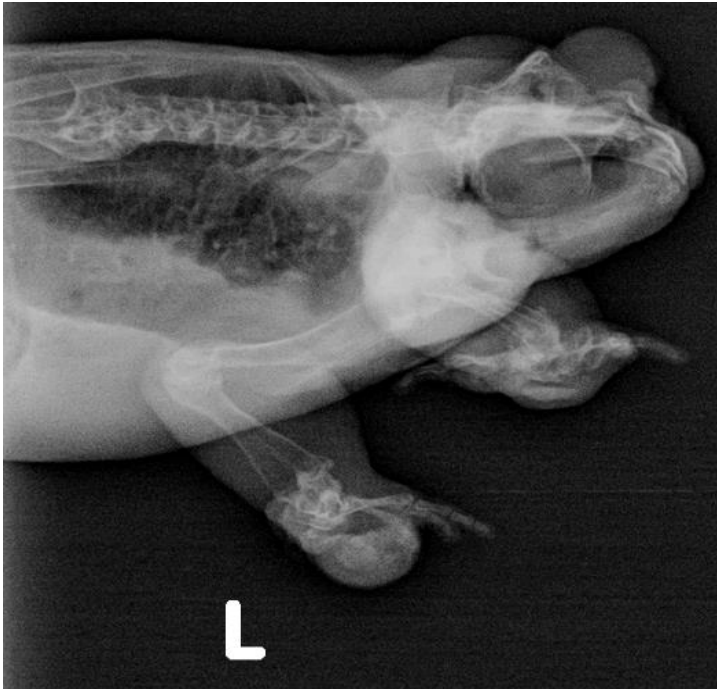
The toad is a single animal weighing 0.559 kg housed in a 151 L (40 gal) glass terrarium that measures 91.4 cm L x 45.72 W x 45.72 H (36" L x 18" W x 18" H) with a custom dual screen top. The enclosure has a coconut fiber substrate^a, with artificial plants and a shallow plastic pond. The temperature and humidity of the tank are maintained at 23.8-26.6°C (75-80°F) and 60% humidity on average. The toad is fed medium to large size crickets, adult Dubai roaches, and superworms (recent instars) three times per week. The insects are fed a fish food flake-based diet along with seasonal fruit and vegetables, and are dusted with alternating commercial supplements (calcium, multi-vitamin, amino acid and vitamin D3) based on manufacturer directions per feeding.^{b,c}

Following an evaluation of the husbandry practices and water quality, a complete physical examination was performed. The toad was bright and alert and had a body condition score of 3.5/5. During examination, both front feet were observed to be edematous along the palmar aspect. Erythema was also present, bilaterally. The feet did not appear to be painful based on tactile stimulation. The lameness score was Grade 0 during rest and ambulation. The rear feet were normal in appearance. No other abnormalities were noted.

The differential diagnoses included infection (bacterial, fungal, parasitic), organ dysfunction leading to dependent edema, lymphatic obstruction, xanthomatosis, trauma, neoplasia, or nonulcerative pododermatitis.

Radiographs were taken. No bony lesions were observed in the phalanges or the carpi. A lobulated soft tissue mass was observed in the palmar region of the left front foot. The site was disinfected with 1:10 betadine and water, and a topical anesthetic was applied.^d After the toad failed to react to tactile stimulus, a fine needle aspirate was performed of the mass using a 20g x 1" needle.^e A blood-tinged, chalky exudate

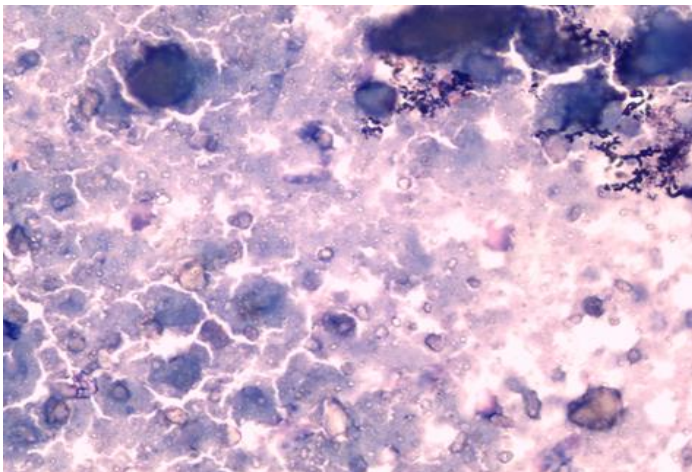




was obtained. A culture was submitted to the laboratory, and the slides were submitted for cytology.^{f,g} A doxycycline^h bath (50 mg/500 ml of distilled water for 1 hour, once daily) treatment was prescribed pending culture and cytology results. Coconut shavings were added to the shallow bathing pool, and the pool edges were lowered to be flush with the surrounding substrate to prevent abrasions and pressure on the feet.

No anaerobic bacteria were isolated, but a *Pseudomonas spp.* Bacteria was identified from the broth media. It was sensitive to several antibiotics, including doxycycline. Antibiotic baths were continued for another seven days. The erythema was relieved on the right foot but not the left.

Cytology showed nucleated red blood cells with rare heterophils. Large amounts of crystalline material were observed in the background amongst necrotic debris. Cytological interpretation was consistent



with calcinosis circumscripta with necrosis evident. No infectious agents were observed. Blood work was performed under anesthesia using tricaine methanesulfonateⁱ (0.5 gm) buffered with sodium bicarbonate (1 gm) per 3.7 L (1 gallon) of water. The toad was placed in a clear plastic induction chamber that was filled to a level consistent with the lower half of its body. Once the toad lost its righting reflex and spontaneous movement ceased, 1 ml of blood was removed via cardiocentesis using a 3 ml syringe with a 1" 25 g needle and submitted to the laboratory for a complete blood cell count (CBC) and biochemical evaluation.^j The hematologic and plasma biochemistry values for the toad were comparable to reference values from an electronic medical record database, with the exception of a decrease in the glucose levels and a slight increase in the WBC, absolute monocyte, eosinophil, basophil counts, and creatine kinase.^k

Discussion and Conclusions

To the author's knowledge this is the first case of calcinosis circumscripta in the palmar aspect of the feet in a Colorado River toad. Calcinosis circumscripta is a rare condition that has been observed in dogs, humans, non-human primates, exotic and domestic cats, horses, cattle, buffalo, rabbits, turtles, birds, and a sitatunga antelope.^{3,4,5,6,7,8} Dystrophic calcinosis is 1 of the 3 types that can manifest and presents clinically as nodules in areas of previous trauma, pressure points and boney prominences.³ The nodules contain crystalline calcium phosphate mineral that appear microscopically as round or amorphous basophilic material.^{3,4} It is similar to hydroxyapatite in bone.⁴

The toad in this case report presented early in Stage I, which is characterized by minimal granulomatous reaction. Stages II and III of the disease are characterized by moderate granulomatous reaction and presence of inflammatory cells.³ Individuals diagnosed with this type of calcinosis circumscripta have normal serum calcium and phosphorus levels. This is contrasted to metastatic calcinosis which is associated with diseases such as chronic renal failure and hypervitaminosis D resulting in hypercalcemia and hyperphosphatemia. The toad in this case had normal plasma calcium and phosphorus levels.

The third type is idiopathic, which is thought to have a genetic basis and can be associated with various immune-mediated diseases.^{3,4} In humans dystrophic calcinosis presents as localized, firm nodules beneath the skin in the hands, knees, and digits.³ The nodules in animals can be firm or fluctuant, and have been observed under the tongue, pinnae, spine, aorta, mammary glands, jejunum and footpads.⁴

The toad continues to behave and appear normal physically in all systems excluding the musculoskeletal. The swelling appears to be permanent in the palmar aspect of both front feet. Lameness is not apparent. Changes have been made in its exhibit with regards to substrate, particularly with the pond. The toad

spends approximately 90% of its time in the water. Tactile pressure from climbing onto the ledge of the pond has been eliminated by dropping the edges flush with the substrate. Cut sponges have been added to the bottom of the pond so that there is not continual pressure on the palmar aspect of the feet associated with the hard surface. This is replaced daily, soaked in hydrogen peroxide, rinsed in clean water and left in the sun to dry.

Medical and surgical treatments are feasible, but not practical, and in this case unnecessary since the animal ambulates normally without indication of discomfort. Surgical removal of the nodules is advocated if there is lameness and is the most successful treatment. In general, anurans tolerate surgery well. They are not prone to excessive blood loss, and wound closure is the same as for other vertebrates.¹⁰ The surgical removal of the nodules in this toad would be difficult, and possibly a fatal event, due to the amount of tissue requiring removal in a ventral, load-bearing site, bilaterally. A staged surgical removal or debulking per foot could be considered,⁹ however, surgical closure would be difficult, and keeping the site moist without bacterial or fungal contamination could present complications. Even with a staged procedure, there would be increased loadbearing on the opposite foot, potentially contributing to more site inflammation, necrosis and crystal deposition.

Anurans also tolerate anesthesia well. Tricaine methanesulfonate is the most common anesthetic used due to its safety profile and was the agent that was used here to facilitate venipuncture.^{9,10,11} Amphibians reach a light plane of anesthesia when they lose the righting reflex.¹⁰ This was all that was required for the blood draw. The recommended amount is 0.5g-1g/L for adult anurans.^{10,12} The anesthetic must be buffered because of the acidic and unionized state of the chemical in water.^{11,12} The head should be maintained out of the water during a procedure and during recovery.¹⁰

Blood is commonly drawn from the ventricle in all but the largest of amphibians. Blood volumes vary among the species, but it generally thought to be 10% of the body weight. Ten percent of this can be safely removed.^{10,13} Interpretation of the CBC and biochemistry values can be difficult due to variables that can affect the results, such as age, sex, season, and metabolic/hibernation state.¹⁰ Establishing baseline values for amphibians prior to disease is the best way to develop reference ranges for a facility.

Medical management has been attempted in humans but has been ineffective in some cases.⁵ Treatments have included intralesional corticosteroid injections, magnesium or aluminum hy-

Hematologic and Biochemistry Parameters

Test	Units	Patient	Reference	Mean
Hematocrit	%	23.7	2.1-47.0	30.1
WBC	K/UL	13.9	0.46-13.6	5.06
Heterophils	%	24	1.1-71.8	26.9
Lymphocytes	%	49.0	6.6-89.9	57.2
Monocytes	%	1.0	0.0-14.0	3.7
Eosinophils	%	6.0	0.0-14.0	2.6
Basophils	%	2.0	0.0-13.0	4.1
Heterophils abs.	Cells/uL	3336	30-5040	1269
Lymph. abs.	Cells/uL	6811	270-6664	2388
Mono. abs.	Cells/uL	139	Not listed	Not listed
Eos. abs.	Cells/uL	834	Not listed	Not listed
Bas. abs.	Cells/uL	278	Not listed	Not listed
Glucose	mmol/L	0.777	0.83-2.72	1.58
Uric Acid	µmol/L	7.956	0-30	5.0
Phosphorus	mmol/L	1.387	0.36-2.62	1.04
Calcium	mmol/L	1.871	1.5-3.5	2.2
Sodium	mmol/L	118	107-168	129
Potassium	mmol/L	4.0	2.0-5.5	3.9
T. Protein	g/L			
Albumin	g/L	13	2.0-29.0	15.0
Globulin	g/L	29	2.0-36.0	22.0
AST	U/L	68	7-179	45
CK	U/L	159	0-89	27
Cholesterol	mmol/L	1.81	0.70-6.45	2.78
Alk Phos	U/L	12	0-35	18

Absolute (abs.), Total Protein (T. Protein), Aspartate Aminotransferase (AST), Creatine Kinase (CK), Alkaline Phosphatase (Alk Phos).

dioxide, bisphosphates, diltiazem, ceftriaxone, sodium thiosulfate, etidronate disodium, and topical dimethylsulfoxide.^{4,5}

Lesions have been reported to spontaneously resolve if the underlying problem is addressed.⁶ The toad in this case showed a partial response to the doxycycline. There were few *Pseudomonas spp.* isolated from the broth media. There were no infectious agents and minimal inflammatory cells observed in the cytology. It is speculated that the bacteria were from the surface of the skin. The affects of the antibiotic may have been due to its anti-inflammatory properties and not antibacterial in this case.

Calcinosis circumscripta is a rare condition affecting many species of animals including amphibians. There is limited information in the literature, but this condition has been reported in 3 marine toads (*Bufo marinus*), 2 African bullfrogs (*Pyxicephalus adspersus*), and 1 Surinam toad (*Pipa sp.*).¹² No clinical history was supplied regarding these cases other than that the lesions most commonly presented in pressure sites. Of interest is that all these species are semi-aquatic. Improper substrate may be to blame since they spend time out of the water as opposed to totally aquatic species.

Calcinosis circumscripta should be considered in the differential diagnosis when an amphibian presents for nodular swelling, particularly involving the limbs or other pressure sites.

Footnotes

^a Zoo Med Eco Earth Compressed Coconut Fiber Expandable Reptile Substrate, Zoo Med Laboratories Inc., 3650 Sacramento Drive, San Luis Obispo, CA 93401

^b ReptiVite with D3, Zoo Med Laboratories Inc., 3650 Sacramento Drive, San Luis Obispo, CA 93401.

^c Repti Calcium with D3, Zoo Med Laboratories Inc., 3650 Sacramento Drive, San Luis Obispo, CA 93401.

^d Lidoject Injection (Lidocaine HCL) 2%, 100 ml, Henry Schein Animal Health 400 Metro Place N, Dublin, OH 43017.

^e Monoject Needles 20G x 1", Tyco Healthcare, 110 Kendall Park LN SW, Atlanta, GA 30336.

^f Antech Diagnostics, 8152 N 23rd Ave., Phoenix, AZ 85021.

^g ZNLabs Veterinary Diagnostics, 300 High Rise Dr., Suite 300, Louisville, KY 40213.

^h Doxycycline Hyclate Capsules USP 50 mg, Watson (Actavis Pharma Inc.), 400 Interpace Parkway#A1, Parsippany, NJ 07054.

ⁱ Tricaine methane sulfonate (MS-222), Argent Laboratories, Redmond, WA.

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

^k Zoological Information Management System (ZIMS Species360), Minneapolis, USA.

References

1. Badger D, Netherton J. *Frogs*. Shrewbury, England, Swan Hill Press. 1995:93-94
2. Well AT, Davis W. Bufo alvarius: a potent hallucinogen of animal origin. *J of Ethnopharmacology*. 1994; 41(1-2):1-8
3. Lee EM, Kim A, Lee EJ. Pathomorphological features of calcinosis circumscripta in a dog. *Lab Anim Res*. 2016; 32(1): 74-77.
4. Radi Z, Sato K. Bilateral dystrophic calcinosis circumscripta in a cynomolgus macaque (*Macaca fascicularis*). *Toxicologic Pathology*, 2010; 38: 637-641.
5. Sabater M, Carrasco DC, Huynh M, et al. Calcinosis circumscripta in the digital extensor tendon of a



Dr. Sharmie Johnson

- tawny eagle (*Aquila rapax*). *J of Av Med Surg*. 2016; 30(4): 374-377.
6. Yanai T, Noda A, Kawakami S, et al. Lingual calcinosis circumscripta in a captive sitatunga. *J Wild Dis*. 2001; 37(4):813-815.
7. Bauer K, Sander S, Steeil J, et al. Calcinosis circumscripta in a cohort of related juvenile African lions (*Panthera leo*). *J of Zoo and Wildlife Med*. 2017; 48(3): 813-817.
8. Mumba C, Squarre D, Mwase M, et al. Calcinosis circumscripta in a captive African cheetah (*Acinonyx jubatus*). *Asian Pacific J of Trop Biomed*. 2014; 4(10): 832-834.
9. Wright KM. Surgical techniques. In: Wright KM and Whitaker BR, eds. *Amphibian Medicine and Captive Husbandry*. Krieger Publishing Co., Malabar, FL, 2001:273-283.
10. Chai N, Anurans. In: Miller Re, Fowler ME, eds. *Fowler's Zoo and Wild Animal Medicine*, Vol. 8, Elsevier, St. Louis, Missouri, 2015:1-13.
11. Baitchman E and Stetter M. Amphibians. In: West G, Heard D, Caulkett, N, eds. *Zoo Animal and Wildlife Immobilization and Anesthesia*. Wiley Blackwell, Ames, IA, 2014:303-311.
12. Wright KM. Restraint techniques and euthanasia. In: Wright KM and Whitaker BR, eds. *Amphibian Medicine and Captive Husbandry*. Krieger Publishing Co., Malabar, FL, 2001:111-122.
13. Wright KM. Amphibian hematology. In: Wright KM and Whitaker BR, eds. *Amphibian Medicine and Captive Husbandry*. Krieger Publishing Co., Malabar, FL, 2001: 129-146.
14. Garner MM. Clinico-pathologic features of calcinosis circumscripta in amphibians. *Proc Asso of Reptile and Amphibian Veterinarians*. 2010.

Partial Hysterectomy Following Cesarean Section in a Blacktip Reef Shark (*Carcharhinus melanopterus*)
By Sharmie Johnson

Wildlife World Zoo and Aquarium
Litchfield Park, Arizona USA
vetdept@wildlifeworld.com
www.wildlifeworld.com

Abstract

Blacktip reef sharks (*Carcharhinus melanopterus*) are commonly displayed sharks in public aquaria. Reproductive problems have been observed in this species with regards to dystocias and pup survivability. A 9-year-old female blacktip reef shark was evaluated because of evidence of dystocia. The entwined tails from 2 fetal sharks were observed protruding approximately 15 cm (6 inches) from the female shark's cloaca. A cesarean section was required to correct the dystocia. Due to irreparable damage to the one uterine horn, a partial hysterectomy was performed. The shark recovered from the initial surgery but dehiscence of the skin incision 6 weeks later, and was euthanized due to associated septicemia from a coelomitis. This is the first reported case in the literature of a cesarean section followed by a partial hysterectomy in a captive blacktip reef shark.

Key Words:

Blacktip reef shark, hysterectomy, Cesarean section, celiotomy

Introduction

Blacktip reef sharks (*Carcharhinus melanopterus*) are commonly displayed sharks in public aquaria. They possess the expected "shark-like" characteristics that are a draw for the general public. They are easy to maintain in captivity due to their smaller size, nutritional needs, and overall demeanor. Reproductive problems have been observed in this species with regards to dystocias and pup survivability. The inability for institutions to replicate the natural pupping grounds has been the focus of much attention, based on research in wild populations throughout the world. Aquaria design to facilitate separate parturition and nursery areas is paramount to the success of captive breeding programs. The case presented here describes a dystocia and surgical procedure for correction.

Case Presentation

A 9-year-old female blacktip reef shark was evaluated because of evidence of dystocia. The entwined tails from 2 fetal sharks were observed protruding approximately 15 cm (6 inches) from the female shark's cloaca. The shark was observed to be behaving normally and did not appear distressed based on swimming posture, gill motion rate, and normal skin coloration. The behavior of the other animals was also considered normal, and none of the other sharks appeared interested in this shark's condition.

The shark is part of a 227,124 Liters (60,000 gallons) community tank that houses 5 other blacktip reef sharks (3 males, and 2 females), 1 female Oceanic whitetip reef shark (*Carcharhinus longimanus*), 1 male zebra shark (*Stegostoma fasciatum*), 5 male whitespotted bamboo sharks (*Chiloscyllium plagiosum*), and 3 male southern stingrays (*Hypanus americanus*). The exhibit tank is of circular configuration with a crushed coral substrate. Artificial coral and rockwork are incorporated in the middle of the tank. Water parameter records were reviewed and determined to be appropriate for the species kept (**Figure 1**). The sharks and rays are fed a whole fish and invertebrate diet that is supplemented with a multi-vitamins.^a They are target fed 3-5% of their body weight weekly.

Figure 1 - Water quality parameters

Temperature	25–26.6°C (77–80°F)
pH	8.11
Salinity	31 ppt (3.1%)
NH ₃	0 mg/L
NO ₂ ⁻	0 mg/L
NO ₃ ⁻	13 mg/L
DO	94%

Partial water changes of 10% are done weekly. Water turnover = 1,665 L/min (440 gal/min), ozone = 300 mV, ultraviolet sterilization = 400 watt, mechanical filtration = 6.4 meters² (21 sq. ft).

After 2 hours with no change in the shark's status and apparent degradation of the fetal shark's tails, divers were placed in the tank, and the shark was caught in a large net, and transported to the surface for examination. The shark was placed in dorsal recumbency in a stretcher to induce tonic immobility. The fetal sharks were deceased and beginning to decompose. Attempts at manual removal were unsuccessful. The female shark's cloacal tissue was hyperemic and congested. The mucosal surface was friable and beginning to slough. The shark was then placed in a shipping container and transported to the medical building for preparation for a cesarean section.

The shark weighed 13.75 kg (30.25 lb) and appeared healthy on physical examination other than the dystocia. Blood was drawn from the ventral coccygeal vein and placed in ethylenediaminetetraacetic acid (EDTA) and heparin microtubes and submitted to the laboratory for hematology and serum biochemical analysis.^b Enrofloxacin^c (70 mg, IM), dexamethasone^d (15 mg, IM), famotidine^e (7 mg, IM), and vitamin B-complex^f (3 ml, IM) were administered pre-operatively. The shark was placed back into the transport carrier containing 567 liters (150 gallons) of artificial sea water containing MS-222 tricaine methanesulfonate^g (500

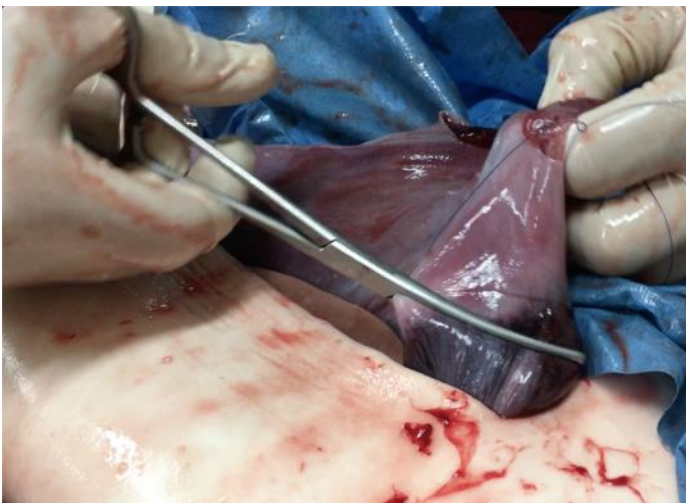
mg/L) buffered with sodium bicarbonate powder (150 g) for induction of anesthesia. A surgical plane of anesthesia was achieved, indicated by a loss of righting reflex and lack of response to painful stimulus (Stage 3, Plane 1)¹. The shark was transferred to a recirculating wet-table^h for the surgical procedure. Anesthesia was then maintained at 300 mg/L of tricaine methanesulfonate and 18 g of sodium bicarbonate. Adjustments were made in concentration based on the depth of anesthesia, which was assessed by gill movement rate (initially 4-6 per minute). Based on the stage of anesthetic plane and change in gill rate and color, a 10% reduction in the anesthetic concentration was made per change observed. Electronic monitoring was not effective and continuous intravenous access was not sustainable.

The ventral body surface was cleaned with dilute betadine followed by a final rinse of saline.¹ A ventral midline incision was made in the mid to lower one-third of the coelom, between the pectoral and pelvic fins, extending through the musculature and into the coelomic cavity exposing the uterus and deceased pups. The left horn was empty, and the right horn was exteriorized allowing for the removal of the autolyzed fetuses. The one male and one female pups were tightly adhered to each other and the uterine wall. There was minimal exudate present that was muco-purulent in character. During manipulation, the right caudo-lateral uterine wall tore and was determined to be irreparable.

A partial hysterectomy was performed and the right uterine horn was removed. Multiple ligatures^l were placed throughout the mesotubarium. The caudal-most aspect of the uterine horn was double-ligated and removed proximal to the cloacal wall. The coelomic cavity was examined and closed incorporating the body wall and associated coelomic muscles in the first layer using a simple continuous pattern.^l Ceftazidime^k (300 mg IP) was infused into the site prior to the last suture placement. The shark's gill rate was becoming slower and more erratic even with continuous dilution of the anesthetic with artificial sea water. The worsening character in respiratory rate and pattern dictated a final skin closure incorporating the subcutaneous tissue and skin in a subcuticular pattern.^l Tissue glue^l and an adhesive^m were applied to the skin incision. Skin sutures were not placed.

At the conclusion of the surgery, the shark was placed in a recovery tank with 100% unadulterated artificial sea water. A submersible pump was placed in front of her snout, and the staff carefully pushed her forward and backwards in the water. After 10 minutes, she produced spontaneous respirations and was able to maintain normal buoyancy and swimming behavior. The following day she ate a small offering of food. She was started on enrofloxacinⁿ (68 mg, PO, q24hr x 7d), famotidine^o (10 mg PO, q24 hr x 7d), and meloxicam^p (1.35 mg PO, q24hr x 3d, then 0.075 mg PO, q48hr x 3 treatments).





Review of the complete blood cell count reflected a stress leukogram characterized by a mature heterophilia (21,750 cells/ μ L; reference interval=1540-20,600 cells/ μ L). The remaining cell types and hematocrit were within established reference ranges.² Evaluation of the serum biochemical analysis revealed hyperglycemia (94 mg/dL; reference interval=29-92 mg/dL), and an elevation in creatine kinase (8613 U/L; reference interval=383-14840 U/L). A hyponatremia and associated hypochloremia were also present (199.5 mEq/L; reference interval=239-311).² Blood urea nitrogen was depressed (705 mg/dL; reference interval=1,000-1,300 mg/dL).³

The shark appeared and behaved normally following surgery. Plans were made to move her from the medical tank back to her exhibit 6 weeks post-surgery. On the day that she was to be transported, a dehiscence was detected in the mid-portion of her incision. A 3 cm (1.18 in) congested tubular mass was protruding from the incision. The shark was anesthetized as before and the surgical site was explored in the immediate region of the dehiscence. The strangulated tissue was unrecognizable. It did not appear to be intestinal but mesenteric in nature. The abnormal tissue was debrided until normal tissue was encountered. The muscular coelomic wall, subcutaneous, and subcuticular tissues at the site were debrided of granulation tissue. The skin was also debrided and closed following a coelomic flush of physiologic saline and infusion of ceftazidime (340 mg). Non-absorbable suture⁹ was placed in a cruciate pattern in the skin.



The diseased tissue and biopsies from the associated body wall were placed in buffered formalin and submitted to the laboratory.^f A culture from the coelom was submitted as well.^b Post-operatively the shark was administered ceftazidime (340 mg IM) and meloxicam (2.8 mg IM).^s No gill movement was observed after several minutes following immersion in normal salt water. Doxapram^t (7mg IV) and dexamethasone sodium phosphate^u (8mg IV) were administered into the dorsal sinus. The gills began to flare (48 per min), and she was positioned in a sling in front of a powerhead. Once fully recovered from the anesthesia, the shark would attempt swimming but would eventually fall to the bottom of the tank and remain in dorsal recumbency. Continual attempts at slinging were unsuccessful and the staff members took shifts walking her around the tank. By the third day, she was stiffening, and respirations were few and labored. A decision was made to humanely euthanize her.

Post-operative blood work revealed a white blood cell count of 24,600 cell/ μ L, reflecting a mature heterophilia (21,156 cells/ μ L). The WBC count was decreased when compared with the values obtained at the time of the first surgery (29,000 cells/ μ L). The CBC results were still within reference values, but the percentage of heterophils were increased (75% to 86%) and appeared toxic, lymphocyte, monocyte and eosinophil counts were all reduced. Only slight reductions in phosphorus 5.6 to 4.7 mg/dL; reference interval 4.2-11.1 mg/dL), potassium (3.5 to 2.9 mg/dL; reference interval 3.3-7.3 mg/dL), AST 69 to 34 U/L; reference interval 16-174 U/L), glucose (94-52 mg/dL; reference interval 29-92) and total protein (3.3 to 3.2 g/dL; reference interval 2.1-7.6 g/dL) were observed.

A gram stain from the culture submitted revealed gram-positive cocci bacteria. *Staphylococcus pasteurii* (methicillin resistant) was cultured. It was reported to be resistant to all cephalosporins. Ceftazidime was not tested. The biopsy of the prolapsed necrotic tissue was identified as epigonal organ along with ovarian stroma. There were no ovarian follicles observed in the sections. The body wall sections were ulcerated and contained mixtures of granulocytic, lymphoid and histiocytic cell types. There was excessive granulation tissue present and the pathologist stated that this was ultimately the cause of the dehiscence.

Post-mortem examination immediately followed the euthanasia. Abrasions to the skin were seen throughout the body. There was blood observed within the anterior chamber of the right eye caused by continually bumping along the side of the tank. No goiter was observed grossly. The liver was friable with petechia throughout the ventral aspect of the serosal surface. No other lesions were observed grossly.

Histopathology revealed congestion within the gill filaments. Mild, multifocal interstitial fibrosis was identified within the renal tissue. This was associated with mineralization involving oxalate crystals. The liver had expanded sinusoidal spaces filled with proteinaceous



fluid, indicating hepatic necrosis. Skeletal muscle from the caudal aspect of the body showed extensive inflammation and degeneration of the myofibers. Inflammatory cells were present. The diagnosis was extensive rhabdomyodegeneration, necrosis, and subacute cellulitis.^f

Discussion and Conclusions

Blacktip reef sharks are commonly displayed in public aquaria and private collections due partly to their small size. Adults grow to an average length of 1.8 m (6 ft) and weigh 13.60 kg (30 lbs). Their adaptability to captive care, decrease danger to staff divers, availability, and shark-like appearance also make them appealing for display. They are found naturally in shallow reefs throughout the Pacific and Indian Oceans.⁴ This species of requiem shark (see Sidebar 1) typically hunts in large groups, subsisting primarily on fish and small invertebrates.^{5,6,7} The blacktip reef shark is designated "near threatened" due to its slow reproductive cycle and overfishing.^{4,6} Reproductive efforts with this and other species of sharks is ongoing in many aquaria and research institutions. Captive breeding programs prevent removal of wild animals for display and provide much needed data regarding physiology and behavior. They also serve to provide a potential stock of animals for reintroduction into the wild.³

Sidebar 1

The term requiem shark was first used in 1896. It is possibly derived from the French word *requin* (shark). Other sources derive it from the verb *reschignier* ("to grimace while baring teeth"), or *rekigner* ("to make an ugly face")^{8,9,10} Requiem sharks belong to the Carcharhinidae family which includes 12 genera and 59 species. They inhabit warm coastal waters (fresh, brackish and marine), are migratory and viviparous. They possess familiar physical characteristics that are commonly recognized as "shark-like." They have round eyes, nictitating membranes, no naso-oral grooves, torpedo shaped with rounded snouts, and blade-like teeth. They are implicated with the majority of attacks on humans, and include tiger sharks (*Galeocerdo cuvier*), bull sharks (*Carcharhinus leucas*), the great white shark (*Carcharodon carcharias*), blacktip reef sharks, and Oceanic whitetip sharks (*Carcharhinus longimanus*).^{11,12}

Sharks reproduce by utilizing 1 of 2 types of reproductive strategies. Forty-two percent of the known elasmobranch species are oviparous (egg-laying), the remainder are viviparous (live-bearing). Only 9% of the sharks that reproduce through viviparity use placenta-trophy. Five families within the Carcharhiniformes use this strategy.^{12,14} The remainder of the elasmobranch species show variations of viviparity (see Sidebar 2). Carcharhiniform sharks possess a single right ovary, two oviducts and two uteri as adults. Initially, both ovaries are present in the juvenile state, but the left ovary atrophies as the shark matures. Compartmentalization occurs within the uterus, separating the developing fetuses from each other.^{14,15,16}

Reproductive problems, including dystocia and pup mortality are common issues associated with captivity in this species of shark and in other elasmobranchs.²¹ Research has shown that pregnant female sharks placed in connecting pools or floating cages within the main exhibit tank promote the greatest chance of pup survivability.⁴ Wild pregnant sharks migrate inland to shallow sand flats or mangrove swamps for parturition.^{16,19,20} Reduced predation is most likely the reason. The increase in pup mortality and dystocia in captive pregnant sharks is most likely associated with a lack of an appropriate pupping grounds.

Gravid sharks are insecure delivering pups in an environment with other predators and retain their pregnancies longer (over-gestation) than is physiologically safe. This potentially leads to metabolic problems with the female due to exhaustion of hepatic fat and muscle stores,¹⁸ intrauterine stress and subsequent death in the offspring. This scenario is observed in many species of animals. Fish, birds, and reptiles can become "egg-bound" due to an inappropriate environment in which to lay their eggs. Nutrition, underlying disease, over-conditioning, anatomical abnormalities, and stress are also contributing factors.^{22,23,24} The animals present in medical crisis due to long-standing anorexia, exhaustion of body stores, hepatic lipidosis, pregnancy toxemia, and dystocia.

The blacktip reef shark presented here was observed to be feeding normally into parturition. No change in diet or environment had occurred. No perceived stressful events had occurred prior to the dystocia. During the surgery, it was observed that the uterine folds that separate the fetuses into individual compartments was necrotic. The placental and para-placental sites also appeared necrotic, and the fetuses were adhered to the uterine wall. The author speculates that the gestation period extended beyond the safe period, and the pups died as a result of starvation, disease within the uterus itself, or underlying disease in the female, possibly as a result of renal dysfunction associated with the mineralization observed histologically.

The loss of the uterine folds caused the fetuses to congeal to each other. This factor along with the fetal-uterine adhesions, and combined size of the fetal

Sidebar 2

The reproductive modes of elasmobranch species are divided into two main categories based on current classification:^{13,16}

Oviparity (egg-laying)

Viviparity (live-bearing)

Aplacental yolk sac viviparity

Aplacental viviparity with uterine villi

Aplacental viviparity with oophagy (with and without intrauterine cannibalism)

Placental viviparity (placenta-trophy)

Placental viviparity is the mode of reproduction used by blacktip reef sharks and other requiem sharks. In the wild, ovulation follows breeding by approximately 1-2 months.¹⁷ Initially the embryos obtain their nutrients from individual yolk sacs, while contained within a thin envelope free-floating within the uterus, but progressively switch to maternal support through the ingestion or gill absorption of uterine secretions referred to as uterine milk or histotroph. The secretions are rich in lipids, proteins and carbohydrates.

After a few months the uterus forms folds extending from the dorsal and ventral surfaces to separate each fetus. After 4 months, as the yolk sac is depleted, it and the uterine epithelium undergo morphological changes to form a placenta. Para-placental sites also form along the wall of the uterus, and together, provide the nutrients for the developing fetuses until parturition.^{14,15,16,18} Parturition in placental viviparous species should occur within minutes to hours, however, some fetuses have been observed to be born weeks to months apart.¹⁹ The gestation period is variable and has been reported to be anywhere from 7-11 months depending on the location, with parturition occurring in the fall. Breeding is noted in the late summer at Wildlife World Zoo with parturition occurring the following year in September or October. The sharks here reproduce every other year. They have been observed to produce annually in the wild.^{19,20}

mass, led to secondary congestion of the cloacal tissue resulting in a dystocia when the female tried to expel them.

The exhibit design possibly contributed to the dystocia because the female was in the same tank as the other sharks and rays. Plans for a new tank will include a separate holding tank inter-connected to the main tank, so that individuals that are determined to be gravid can be gently persuaded to swim into them for the remainder of their gestation period. This will provide a secure location for parturition and nursery for the pups.

Veterinarians who have performed celiotomies in sharks for cesarean sections or foreign body removal have mentioned the tendency for dehiscence of the skin incision,²⁵ requiring the need to supplement the

incision site with additional sutures.²⁶ In hindsight, the author regrets that skin sutures were not placed. This occurred due to concern for the welfare of the shark and potential for an anesthetic death. The shark was under anesthesia for close to 1.5 hours due to pre-operative preparation, difficulty in cutting through the skin, the number of ligatures required in the mesotubarium, and difficulty in closing the subcuticular tissue. Multiple cutting needles were ruined during the closure due to the thick connective tissue within the dermis of the skin and the associated base of the placoid scales.²⁷ The MS-222 was diluted multiple times during the procedure. Even with very little anesthetic present in the water, the shark was still in dorsal recumbency, contributing to the anesthetic state through tonic immobility.

The effects of the oxygen within the recirculating pump may have also contributed to the anesthetic depth.¹ If presented with a choice between survivability and technique, a staged procedure could be considered within a short time following recovery. The other institutions observed dehiscence several weeks following the primary procedure. This was also observed with this shark at six weeks post-surgery.

Renal mineralization has been documented in blacktip reef sharks and other elasmobranch species.^{28,29} Soft tissue mineralization as a result of excess vitamin or minerals has been implicated. The cause in this shark was not identified. Manufacturer recommendations were followed with regards to the vitamin supplement offered.

Blacktip reef sharks use placental viviparity for reproduction. In this case the functioning right ovary and left uterine horn and associated reproductive structures were left intact. This would allow for potential breeding in the future, had the shark survived. Environmental changes, pollution, overfishing, loss of natural resources such as habitat and prey availability are impacting shark's ability to flourish. The near threatened status of blacktip reef sharks makes it prudent that research continues with this and other elasmobranch species to insure their survival. Understanding the reproductive strategies, environmental and nutritional needs in these species and others will prevent future loss of those in captivity and will facilitate a better understanding of their wild counterparts.

Photography in these two case reports is by:
Lorenzo Fuentes
Aquarist / Staff Photographer
Wildlife World Zoo, Aquarium & Safari Park
16501 W. Northern Ave.
Litchfield Park, AZ 85340
www.wildlifeworld.com

Footnotes

^a Mazuri Vita-Zu Shark/Ray Tablet, Mazuri Exotic Animal Nutrition, PO Box 66812, St. Louis, MO 63166.

^b Idexx Laboratories, 11034 N. 23rd Dr #100, Phoenix, AZ 85029

^c Baytril, 100 mg/ml, Bayer HealthCare LLC. Animal Health Division, Shawnee Mission, KS 66201

^d DexaJect, 2 mg/ml, Henry Schein Animal Health 135 Duryea Road, Melville, NY 11747.

^e Famotidine Injection, 10 mg/ml, WEST-WARD Eatontown, NJ 07724.

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

^g Tricaine methane sulfonate (MS-222), Argent Laboratories, Redmond, WA.

^h Uline Utility Cart, Uline 12575 Uline Drive, Pleasant Prairie, WI 53158.

ⁱ Baxter 0.9% Sodium Chloride Solution Injection, 500 ml Plastic Bag, Baxter International Inc., One Baxter Parkway, Deerfield, IL 60015.

^j Monocryl 3-0-Ethicon Inc- P.O. Box 151 Somerville, NJ 08876

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

^l 3M Vetbond, 3M Animal Care Products, St. Paul, MN 55144-1000.

^m Polyox powder with 2.5% enrofloxacin, Diamondback Drugs (Wedgwood Pharmacy) 7631 E. Indian School Rd, Scottsdale, AZ 85251

ⁿ Baytril tablets 68 mg, Bayer HealthCare LLC. Animal Health Division, Shawnee Mission, KS 66201o

^o Famotidine Tablets 20 mg, Teva Pharmaceuticals USA, Inc., 1090 Horsham Rd North Wales, PA 19454.

^p Metacam Oral suspension 1.5 mg/ml, Boehringer Ingelheim Animal Health USA, Inc., 3239 Satellite Blvd NW, Duluth, GA 30096.

^q Ethicon Ethilon 2/0, US Highway 22 N. Somerville, NJ 08876.

^r Zoo/Exotic Pathology Service, 6020 Rutland Dr. #14, Carmichael, CA 95608

^s Metacam Injection 5 mg/ml, Boehringer Ingelheim Animal Health USA, Inc., 3239 Satellite Blvd NW, Duluth, GA 30096.

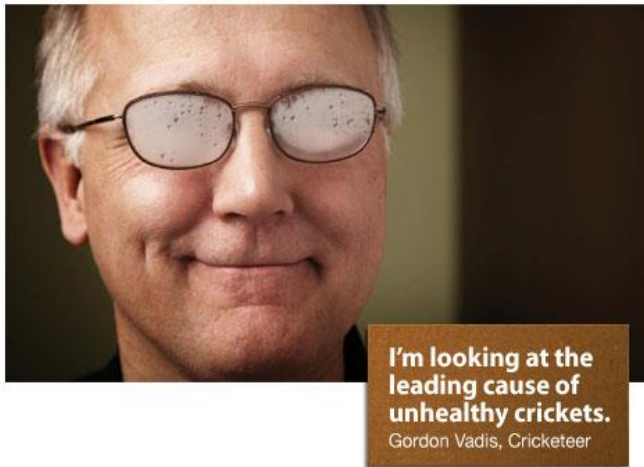
^t Dopram Injection 20 mg/ml, WEST-WARD Eatontown, NJ 07724.

^u Dexamethasone-SP, Vet One® 3041 West Pasadena Drive, ID 83705.

References

1. Stamper MA. Immobilization of Elasmobranchs. In: Smith M, Warmolts D, Thoney D, Hueter R, eds. *The Elasmobranch Husbandry Manual I: Captive Care of sharks, Rays and their Relatives*. Columbus, Ohio: Ohio Biological Survey Inc.; 2004: 281-295.
2. Zoological Information Management Software (ZIMS Species 360), Minneapolis, USA
3. Clayton L, Seeley KE. Sharks and medicine. In: Miller RE, Lamberski N, Calle P, eds. *Fowler's*

- Zoo and Wild Animal Medicine Current Therapy*. Vol. 9. St. Louis, MO: Elsevier; 2019:338-344.
4. Hibbitt JD, Rees E, Brown C. Blacktip reef shark reproduction and neonate survivorship in public aquaria. In: Smith M, Warmolts D, Thoneu D, Hueter R, Murray M, Ezcurra J, eds. *Elasmobranch Husbandry Manual II: Recent Advances in the Care of Sharks, Rays and their Relatives*. Columbus, Ohio: Ohio Biological Survey Inc.; 2017:443-450.
 5. Compagno LJV. *Sharks of the World: An Annotated and Illustrated Catalogue of Shark Species Known to Date*. Rome. Food and agricultural Organization; 1984: 487-489.
 6. Fowler SL, Cavanagh M, Camhi GH, et al. *Sharks, Rays and Chimeras: The status of the Chondrichthyan Fishes*. International Union for Conservation of Nature and Natural Resources. 2005: 296-297.
 7. Randall JE, Hoover JP. *Coastal Fishes of Oman*. University of Hawaii Press. 1995: 33.
 8. Imbs P, and Quemada B, eds., *Trésor de la langue française: Dictionnaire de la langue du XIX et du XX siècle (1789-1960)*, s.v. "requin" (Paris: CNRS /Gallimard, 1971-1994)
 9. Deshayes A, *Dictionnaire étymologique du Breton* (Douarnenez: Le Chasse-Marée, 2003), 620.
 10. Rey A, ed., *Dictionnaire historique de la langue française*, 2nd edn. (Paris: Le Robert, 1998). 3:8203-4.
 11. "Requiem shark" on Merriam-Webster.com *Dictionnaire*, Merriam-Webster, <https://www.Merriam-webster.com/dictionary/requiem%20shark>. Accessed 1 Feb. 2020.
 12. Compagno LIV. *Sharks of the world vol 4, part 2, FAO species catalogue and annotated and illustrated catalogue of shark species known to date*. Tiburon, CA. San Francisco State University; 1984.
 13. Awruch CA. Reproduction strategies. In: Farrell AP, Brauner CJ, eds. *Physiology of Elasmobranch Fishes*. Vol 34A, Elsevier; 2016:256-310.
 14. Wourms JP. Viviparity: The Maternal-fetal relationship in fishes. *Amer. Zool.*, 1981, 21:473-515.
 15. Wourms, JP. Reproduction and development in chondrichthyan fishes. *Amer. Zool.*, 1977, 17:379-410.
 16. Lyle JM. Observations on the biology of *Carcharhinus caudatus* (Whitley), *C. melanopterus* (Quoy & Gaimard) and *C. fitzroyensis* (Whitley) from Northern Australia. *Australian Journal of Marine & Freshwater Research*. 38(6): 701-710. 1987. Doi:10.1071/MF9870701
 17. Hamlett WC. Evolution and morphogenesis of the placenta in sharks. *J of Experiment Zool Supp*. 1989;2:35-52.
 18. Henningsen AD, Smale M, Garner R, et al. Reproduction, Embryonic Development, and Reproductive Physiology of Elasmobranchs. In: Smith M, Warmolts D, Thoneu D, Hueter R, eds. *The Elasmobranch Husbandry Manual I: Captive Care of sharks, Rays and their Relatives*. Columbus, Ohio: Ohio Biological Survey Inc.; 2004:227-236.
 19. Porcher IF. On the gestation period of the blackfin reef shark, *Carcharhinus melanopterus*, in waters off Moorea, French Polynesia. *Marine Biology*. 146 (6): 1207-1211. Doi:10.1007/s00227-004-1518-0 9HTTPS://DOI.10.1007%2Fs00227-004-1518-0.
 20. Stevens JD. Life history and ecology of sharks at Aldabra Atoll, Indian Ocean. *Proceedings of the Royal Society of London B*. 222 (1226), 1984. Doi:10.1098/rspb.1984.0050
 21. Cavin JM. *Elasmobranch reproductive physiology, disorders, and treatment*, American Association of Fish Veterinarians, 2015, Veterinary Information Network (VIN). <https://www.vin.com/doc/?id=7178057>. Accessed 12 Jan 2020.
 22. Pet Birds, In: Aiello, SE. *The Merck Manual*, 11th ed., Kenilworth, NJ, MERCK & CO., 2016: 1920-1923.
 23. Wildgoose, WH. Internal disorders. In: Wildgoose, WH. Ed., *BSAVA Manual of Ornamental Fish*, 2nd ed. British Small Animal Veterinary Assn. 2001:123-134.
 24. DeNardo D. Dystocias. In: Mader DR, ed. *Reptile Medicine and Surgery*, 2nd ed. St. Louis, Missouri, Elsevier; 2006:787-805.
 25. Lécua A, Herbert R, Coulier L, et al. Removal of an intracoelomic hook via laparotomy in a sandbar shark (*Carcharhinus plumbeus*). In: Smith M, Warmolts D, Thoneu D, Hueter R, Murray M, Ezcurra J, eds. *Elasmobranch Husbandry Manual II: Recent Advances in the Care of Sharks, Rays and their Relatives*. Columbus, Ohio: Ohio Biological Survey Inc.; 2017: 349-356.
 26. Gearhart SA, Croft LA, Swider DA. *Cesarean section in the whitetip reef shark (Triaenodon obesus)*, International Association of Aquatic Animal Medicine, 2014, Veterinary Information Network (VIN). <https://www.vin.com/doc/?id=6251901> Accessed 12 Jan 2020.
 27. Ashley LM, Chiasson RB. The skin. In: Ashley LM, Chiasson RB, eds. *Laboratory Anatomy of the Shark*, 5th ed. Boston, MA, WCB McGraw-Hill; 1988:5-8.
 28. Garner MM. A retrospective study of disease in elasmobranchs. *Veterinary Pathology*. Vol 50 (3):377-389. 2013. <https://doi.org/10.1177/0300985813482147>. Accessed 15/ Jan 2020.
 29. Perpiñán D, Costa T. Metastatic mineralization in blacktip reef sharks (*Carcharhinus melanopterus* (Quoy & Gaimard 1824)). *Journal of Fish Diseases* 40 (3), 2016. Doi 10.1111/jfd.12524. Accessed 12 Jan 2020.



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 and arachnids. Raised in temperature controlled and 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](#)

info@ebugco.com

[For sales or pricing information](#)

sales@ebugco.com



New Aquarium Fish Medicine Book in 2022

A new book on freshwater aquarium fish diseases is being produced by an international book publisher. We are looking for WAVMA members, especially Certified Aquatic Veterinarians, to contribute materials to use in the publication. The proposed chapters include:

Fish Welfare:

Introduction-

- A Brief History of Keeping Fish in Aquariums
- Overview of the ornamental fish industry and commercial fish propagation
- Transportation and quarantine of live fish
- Retail Fish Stores
- Ornamental fish taxonomy
- Fish Zoology, Biology, Anatomy and Physiology
- Fish immune system
- Fish stress
- Modes of fish reproduction

Ornamental Fish Keeping-

- Aquarium Set-up
- Water Quality
- Filtration Systems
- Nutrition
- Biosecurity
- Legislation and regulations concerning wild fish collection, international transportation, and endangered species
- Fish Welfare

Fish Health:

Aquatic Veterinary Medicine-

- How to practice veterinary medicine on ornamental fish
- Equipping the Veterinary Hospital to treat fish patients
- Handling and examination
- Clinical procedures
- Diagnostic tests – biopsy, radiology, sonography, endoscopy
- Fish haematology and biochemistry
- Transport of samples for laboratory analysis
- Sedation and Anaesthesia
- Surgery
- Euthanasia

Overview of Fish Diseases-

- Viral Diseases
- Bacterial Diseases
- Fungal Diseases
- Protozoan Parasites
- Other Fish Parasites
- Zoonotic Diseases
- Non-Infectious diseases
- Water quality disorders relating to fish health
- Toxins and environmental problems
- Nutritional diseases
- Neoplasia
- Reproductive and Genetic Disorders
- Disease Control and Prevention

Treatment methods-

- Administration of medications to the aquarium water
- Administering injections
- Wound management techniques in aquatic patients
- Fish vaccines
- Medications and Formulary

Glossary

Index

Chapter contributors will receive a copy of the book, multiple chapter contributors will receive further remuneration. If you are interested in collaborating on this book, please contact Nick Saint-Erne for more information, nsainterne@gmail.com.

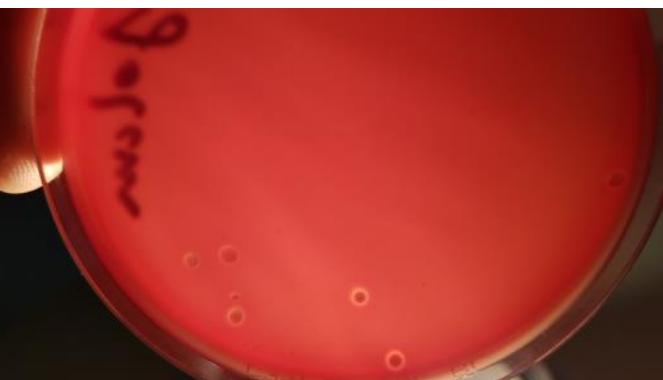
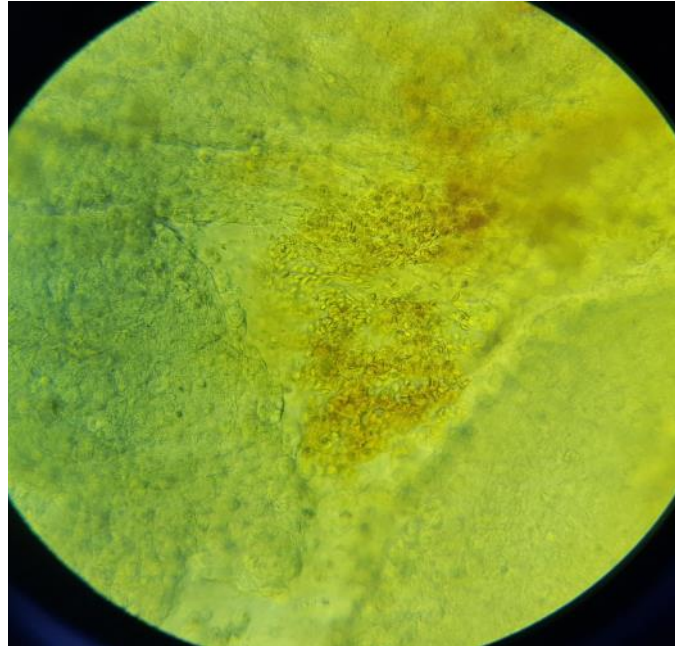
Questions & Answers from the WAVMA Listserv
[WAVMA Members-L@wavma.org](mailto:WAVMA_Members-L@wavma.org)

Koi with Skin Lesions

Hi All,

Does this ring a bell to anyone? A koi in a common koi pond shows some sort of multifocal ulcerative dermatitis, on some sites fungus is growing on top of it, or a thin layer of mucus is covering some areas. This condition is seen dorsal, lateral and ventral. Water quality is fine, parasites negative. Culture of such a spot grows some *Aeromonas*, but low growth. The Koi is acting normally and eats, other fish in the pond show no signs. In a separate but connected pond many frogs are housed. Nearly no plants are present. A biopsy has been send to the lab.

Thank you,
Tim Barbe



Subacute multifocal lesions like these are often seen on doitsu koi after a "pH crash" here on Long Island, NY. What is your total alkalinity reading for this pond?

Julius M. Tepper, DVM, CertAqV
 Fellow, World Aquatic Veterinary Medical Assn.

Hello Julius,

We measure conductivity, KH and GH here for such reasons, but no possibility that this pond suffered from pH crash now or recently. I attach the water parameters. Thanks for brainstorming with me.

Regards,
Tim B.

TIM BARBÉ
 Dierenarts
 0477 / 640 674
 huisbezoek en op afspraak

Datum: 6/8/19

WATERANALYSE *Jolem*

WAT	EENHEID	GEMETEN	NORMAAL
pH		7,50	7 - 8.5
EC	µs/cm	800	200-600
TDS	ppm	400	1/2 EC
T°	°C	17.8	2 - 28
KH	°DH	7-6	>5
GH	°DH	1-16	< 20
NH3-N	ppm	0	< 0.15
NO2	ppm	0	< 0.1
NO3	ppm	25-50	< 50
Zout	ppt	0.4	< 0.5
O2	ppm		> 6
P04	ppm	0.5-1	< 0.4

Mio *2 white koi* *huid aandoening*

Hi Tim,

I see these alterations more as an allergic reaction. Often some feed ingredients (fish oils/proteins of marine invertebrates) seem to provoke allergic reactions in the skin, especially dorsal areas and in white areas of the skin. So, this is not a typical case of food allergy but still looks to me more allergic than infectious.

Are the koi fed any goodies (shrimp/ gammarus, etc) or just standard koi food? I advise in these cases to strictly feed only a koi food with little protein (e.g., Coppens Health) and in severe cases I inject cortisone and antibiotics.

Good luck

Ralph Knüsel, Dr. med. vet.
 Fishdoc GmbH
 Schaubhus 1
 6026 Rain
 info@fishdoc.ch
 www.fishdoc.ch

Hi Tim,

Interesting to see what a biopsy reveals histologically. Has it already been assessed acid fast negative? The lesions have a morphological look of acute multifocal to coalescing ulcerative necrotising dermatitis. The lesions have a central necrotic foci but the edge looks proliferative (Granulomatous?).

I guess without looking at a live specimen it's almost granulomatous in nature. Anyway, just wanted to suggest possible necrotising dermatitis due to sporadic anoxic events. I've seen a number of dermal necrosis cases tied in with sub-lethal DO events. Histologically the skin lesions have a characteristic focal coagulative necrotic look. Would be interested to know what the histology looks like in the dermal manifestations of allergic response?

Cheers,

Dr Stephen B Pyecroft BVSc (Hons) PhD MANZCVS
 (Aquatic & Pathobiology)
 Senior Lecturer in Veterinary Pathology
 School of Animal & Veterinary Sciences
 Faculty of Science
 The University of Adelaide,
 G1B Leske Building
 Roseworthy Campus
 Roseworthy, SA 5371,
 Australia
 e-mail: stephen.pyecroft@adelaide.edu.au

Hello Stephen,

Interesting thought and after your post I made a slide from the swab that I stored, colored it with Ziehl Nielsen but found no mycobacteria. I can ask the lab to check for this as I guess that the chance to find it in there is higher.

Best regards,

Tim B.

Dear all,

Coming back to my recent post, this is the result that came back from histopathology:

The biopsy contains skin/subcutis with local extensive enlargement of the epidermis by hyperplasia and swelling of the epithelial cells. There is an abrupt transition with the normal epidermis. Epithelial cells in the lesion have frequent and strong vacuolization or a visually empty cytoplasm. Some individual apoptotic epithelial cells are seen. Multiple mitotic figures are present. Transmigration of lymphocytes and some heterophiles. On different regions at the surface, there is desquamation (erosion) seen. The dermis is hyperemic with diffuse infiltration of lymphocytes, plasma cells and histiocytes, with deposition of fibroblasts. The inflammation is extending into the subcutis.

PAS: no mycotic agents,

ZN: no acid-fast bacteria.

No infectious agents found.

Suggestive for a viral cause (pox)?

Best regards,

Tim B.

Dear Tim,

My strong suggestion to you is now even stronger for testing mucus/skin and gill tissue samples for the presence of Carp Edema Virus, the etiological agent of Koi Sleepy Disease. In advanced infections, you'll also detect it in internal organs and blood. Although CEV is currently unculturable, so the detection is still fully relying on PCR on DNA sample.

Good luck!

Bartolomeo Gorgoglione, DVM, MSc, PhD
 BartGorg@msu.edu

Dear Bart,

I've seen many CEV infections but never like this, but I have some skin biopsy left and will perform viral PCR tomorrow in my lab (CEV, KHV, SVCV). Will keep you updated.

Best regards,

Tim B.

Here's my update about the tests: I have to make the remark that the skin biopsy was formalin fixed so this could influence the result, however in the past we did tests and from there we know that formalin is not the ideal storage solution for doing DNA tests later, but here the sample has only been stored for about 2 weeks. CEV, KHV and SVCV testing came out negative. So, it is none of these viruses, or it was not the best sample for testing.

Best regards,

Tim B.

Aquatic Veterinary Abstracts

Compiled by David Scarfe

The latest issue of the *International Animal Health Journal* Volume 7, Number 1, Spring 2020 contains a few topics on aquaculture. Access them free here:

https://issuu.com/mark123/docs/2020-iahj-1-spring_web_compressed

Frogs, The Present of the Future Protein Source

Abstract

Frog farming, or raniculture, encompasses activities related to frog production, including maintenance, reproduction and breeding, as well as being part of the aquaculture industry. The objectives of raniculture can be commercial, such as human feeding (frog legs), animal feeding, or non-commercial such as repopulation with threatened species. Jose Barrio and Fabián Simón at Grenoucerie investigate why an interdisciplinary approach is needed in frog farming to replace wild-caught frogs that damage natural populations, whilst developing captive breeding programmes to ensure species survival.

Defining and Monitoring Atlantic Salmon "Health"

Abstract

Farming of Atlantic salmon is predominantly carried out in Norway, Chile, Scotland, and Canada. Biphase in nature, salmon are raised in freshwater inland sites and then typically transferred to saltwater net pens. Despite being regarded as the most industrialised aquaculture sector, bearing lower economic and biological risk than production of other aquatic species, Mark Braceland at CATC points out that Atlantic salmon culture still faces several challenges spanning engineering of culture systems to the assessment and monitoring of stock health.

Current Practices and Challenges for the Control of Sea Lice on Salmon Farms

Abstract

The salmon louse is a crustacean ectoparasite of Atlantic salmon and other marine salmonid fish. *Lepeoptheirus salmonis* is one of several parasitic copepods which cause disease in farmed fish and probably the most economically significant fish pathogen in the major salmon farming regions of the northern hemisphere, which include Norway, Faroe Islands, Scotland, Iceland and Ireland. Bill Roy at Moredun Scientific examines why sea louse epizootics are a major concern for salmon farmers due to the financial cost, impact on fish health, the risks to wild salmon and the environmental threat from sea lice medicines.

<https://www.animalhealthmedia.com/>

Fish Farms at Sea:**The Ground Truth from Google Earth**

Trujillo P, C Piroddi, J Jacquet (2012).

PLoS ONE, 7(2): 5pp.

open access publication accessible at :

<http://tinyurl.com/7edt2bg>

Abstract

In the face of global overfishing of wild-caught seafood, ocean fish farming has augmented the supply of fresh fish to western markets and become one of the fastest growing global industries. Accurate reporting of quantities of wild-caught fish has been problematic and we questioned whether similar discrepancies in data exist in statistics for farmed fish production.

In the Mediterranean Sea, ocean fish farming is prevalent and stationary cages can be seen off the coasts of 16 countries using satellite imagery available through Google Earth. Using this tool, we demonstrate here that a few trained scientists now have the capacity to verify farmed fish production data reported by the Mediterranean countries. With Google Earth, we could examine 91% of the Mediterranean coast and count 248 tuna cages (circular cages .40 m diameter) and 20,976 other fish cages within 10 km offshore, the majority of which were off Greece (49%) and Turkey (31%).

Combining satellite imagery with assumptions about cage volume, fish density, harvest rates, and seasonal capacity, we make a conservative approximation of ocean-farmed finfish production for 16 Mediterranean countries. Our overall estimate of 225,736 tons of farmed finfish (not including tuna) in the Mediterranean Sea in 2006 is only slightly more than the United Nations Food and Agriculture Organization reports. The results demonstrate the reliability of recent FAO farmed fish production statistics for the Mediterranean as well as the promise of Google Earth to collect and verify data.

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 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!

COVID-19 Information

To keep track of the current COVID-19 changes in any situation, you may check WHO's Daily Situation Reports:

<https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/>

For those epidemiological-minded members, what is interesting is that the number of confirmed cases in several countries (specifically, China, S. Korea, and Denmark) are similar to the typical bell-shaped curves seen with other recent new corona viruses (SARS and MERS) suggesting possible large-scale population immunity:

see <https://www.who.int/csr/sars/epicurve/epiindex/en/index2.html>

and

<https://www.who.int/emergencies/mers-cov/epi-1-september-2017.png?ua=1>.

**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.

Aquatic Veterinary e-Learning
 Supporting WAVMA's WebCEPD, PubCEPD,
 CertAqV & Clinical Cases Programs



**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>.

FDA Temporarily Relaxes Veterinary Telemedicine to Meet Animal Health Needs

Useful information for veterinarians in the U.S. This will also apply to aquatic veterinarians who need to establish a VCPR (veterinarian-client-patient relationship) before being able to diagnose or treat an animal. We assume that once the current COVID-19 situation stabilizes, that this will be rescinded and a veterinarian will need to actually see patient/s.

The U.S. Food and Drug Administration (FDA) is continuing to make administrative changes to provide greater flexibility as the country addresses the coronavirus pandemic. As part of the effort to provide adequate services while combatting COVID-19, the FDA has announced that it will be temporarily lifting enforcement of certain requirements to allow veterinarians to better utilize telemedicine to address animal health needs.

FDA Commissioner Stephen Hahn said that the move will allow for social distancing, while also ensuring that animals can receive the care they need from veterinary professionals. The agency intends to suspend the enforcement of certain aspects of the federal veterinarian-client-patient relationship requirements relevant to certain FDA regulations which require veterinarians to physically examine animals and to visit the location where an animal is kept in a timely manner.

Veterinarians will still need to consider any relevant state requirements, but the FDA announcement will allow for the use of telemedicine in instances previously prohibited. As an example, a veterinarian will be allowed to remotely examine and diagnose food-producing animals and authorize the use of certain medications.

For full FDA March 24, 2020 announcement, go to:

<https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-update-fda-helps-facilitate-veterinary-telemedicine-during-pandemic>



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>


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

NEW TRAINING COURSE LAUNCHING SEPTEMBER 2018

The Health and Welfare of Atlantic Salmon

Salmon farming is a multi-billion dollar global industry, making significant contributions to the economies of the world's major salmon producing countries. It is vital that fish farm operatives who are responsible for these fish are trained in all the main aspects of health and welfare, to ensure that their fish are free from disease and suffering, to enhance quality and productivity, and to comply with legislation.

The Knowledge Services Division of Benchmark Animal Health has worked closely with Fish Vet Group to produce an exciting and interactive online course covering the Health and Welfare of Atlantic Salmon.



The course includes

- Principles of fish welfare
- Feeds and feeding
- Transport
- The environment and fish welfare
- Health and veterinary health planning
- Management and husbandry practices
- Killing and flesh quality

Features and benefits

- Online course divided into bite-sized modules so you can study at your own pace
- Study on any device with internet access
- Interactive exercises and on-farm videos to create interest and test knowledge
- Questions after each module to test your understanding
- Course certificate available after successful completion of all the modules
- Optional practical sessions covering sea lice counting, gill scoring etc. to help reinforce your learning

Pricing and further details

Individual course access is £400 plus VAT.
Please contact us for prices of multiple course access.
marketing@5mpublishing.com
tel: +44(0) 1865 237733, thefishsite.com/learn



The Fish Site





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 the first half of 2020 have been canceled or postponed. Please check websites to ensure conferences are still being held before making travel plans.

American Veterinary Medical Association Conference

July 31 - August 4, 2020
San Diego, California, USA
See: AVMA

World Veterinary Day

The World Veterinary Association (WVA) and Health for Animals are proud to announce the 2020 World Veterinary Day theme: Environmental protection for improving animal and human health.

The 2020 World Veterinary Day will be held on 25th April 2020 and is an opportunity to celebrate the contributions of veterinarians to the health of animals, people and the environment.



International Association for Aquatic Animal Medicine 51st Annual Meeting & Conference

May 16-20, 2020
Tampa, Florida USA

This event will bring together nearly 350 members of the highly respected International Association for Aquatic Animal Medicine (IAAAM). Veterinarians, professors, directors, curators, researchers, and other animal health and husbandry professionals from around the world participate in these meetings. Over 50 different parks, zoos, aquariums, universities, and other related institutions throughout the United States and abroad will be represented.

Highlights of the conference will include thought-provoking plenary sessions, special scientific sessions and workshops, poster session and ample social and networking opportunities.

Go to website for more information: iaaam.org



Future WSAVA Conferences

45th WSAVA World Congress

Dates: 23-26 September 2020
Warsaw, Poland
[Visit the website here](http://www.wsaavet.org)

46th WSAVA World Congress

Dates: 13-16 November 2021
Hyderabad, India
[Visit the website here](http://www.wsaavet.org)

47th WSAVA World Congress

Dates: 29-31 October 2022
Lima, Peru
See: WSAVA

E-lasmo Conference

There is an online conference being offered by **The Aquarium Vet** during mid-April. Here is the link and a description:
<https://www.theaquariumvet.com/education/>

The Aquarium Vet is very proud to announce the first E-lasmo Conference. With the cancellation of most aquatic conferences globally this year, we have decided to provide an E-conference dedicated solely to the amazing elasmobranch group of animals.

This E-conference is brought to you by The Aquarium Vet team, a group of exclusively aquarium vets with collectively almost 50 years' experience in the public aquarium field. This E-lasmo Conference will be held online over 4 days with over 3 hours of live content per day. The course content will be a collection of detailed lectures, with some interactive Q & A sessions where you can ask questions of our presenters.

We are excited to announce that the E-lasmo Conference is free to all our current students of The Aquarium Vet E-quarist course.

For non-members there is a small charge (AUD \$47.50 = approximately USD \$30.00) for the whole conference week. The E-lasmo Conference will be held live online with ample time for Q&A and some interactive sessions.

E-Conference Schedule:

Australia Tuesday April 14 to Friday 17th
 9.00 am to noon
 UK / Europe Tuesday April 13th to Friday 16th
 Midnight to 3.00 am
 USA (west coast) Monday April 13th to Thursday 16th 4.00 pm to 7.00 pm
 USA (east coast) Monday April 13th to Thursday 16th 7.00 pm to 10.00pm

E-Conference Agenda:

Day One
 Elasmobranch Anatomy and Physiology (Dr Rob Jones)
 Elasmobranch Reproduction in Aquariums and Zoos and the Development of Assisted Reproduction Techniques (Dr Rob Jones)
 Day Two
 Anaesthesia / Sedation (Dr Rob Jones)
 Diagnostic Techniques in Elasmobranchs (Dr Rob Jones)
 Elasmobranch Nutrition (Dr Rob Jones)
 Day Three
 Elasmobranch Transport by Road and Air (Dr Luke Ross)
 Elasmobranch Diseases (Non-infectious and Infectious) (Dr Rob Jones)
 Day Four
 Elasmobranch Necropsy Technique (Dr Rob Jones)
 Cancer in Elasmobranchs (Dr Brett De Poister)
 Training of Elasmobranchs (Dr Rob Jones)
 My email is rob@theaquariumvet.com

Additional 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.

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

Free Online Aquatic Animal Nutrition Webinar April 10, 2020

Please join us for the next installment of the joint webinar series sponsored by the United States Aquaculture Society, The National Aquaculture Association and the Alabama Cooperative Extension System.

Dr. Allen Davis, Auburn University professor and aquaculture nutritionist presents "The Basics of Aquatic Animal Nutrition" on Friday, April 10th at 1:00 pm central time (USA). Register directly at:
<https://auburn.zoom.us/j/753Yk2MXJczHU91qEQ>

David Cline, Ph.D.
 Past President United States Aquaculture Society
 Email: clinedj@auburn.edu

Website: www.alearn.info see education section

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.

