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The



quatic

eterinarian



WHO ARE WE

MISSION

The Mission of the 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.

To fulfill this Mission, the World Aquatic Veterinary Medical Association has established the following:

Objectives

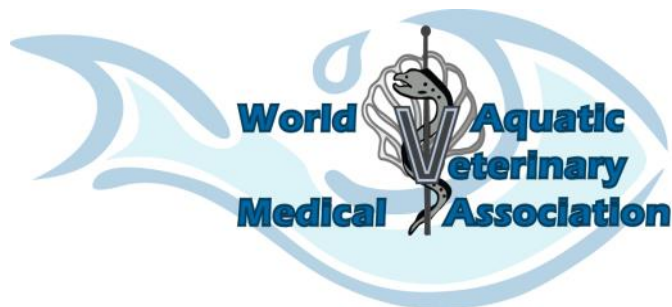
1. To serve aquatic veterinary medicine practitioners of many disciplines and backgrounds by developing programs to support and sustain members, and the aquatic species industries that they serve.
2. To identify, foster and strengthen professional interactions among aquatic medical practitioners and other organizations around the world.
3. To be an advocate for, develop guidance on, and promote the advancement of the science, ethics, and professional aspects of aquatic animal medicine within the veterinary profession and a wider audience.
4. To optimally position and advance the discipline of aquatic veterinary medicine, and support the practice of aquatic veterinary medicine in all countries.

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.

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Editorial 4
 Editor’s Note 4
 Advertising Rates 4

Executive Reports 5-8
 President’s Report 5
 Secretary’s Report 6
 2023 Executive Board 7
 New WAVMA Members 8
 Executive Board Responsibilities 8

Conference Reports
 WAVMA Conference and AGM Report9-15
 47th WSAVA Congress in Lima, Peru 16-17
 71st IVSA Congress, São Paulo, Brazil 24-25
 11th International Aquarium Congress 34-37

Committee Reports17-30
 John L. Pitts Aquatic Education Committee .. 17
 Join a WAVMA Committee 18
 WAVMA Committees 18
 Meetings Committee 19
 Fellows Advisory Council 19
 WAVMA Fellows 19
 Credentialing Committee 20
 Certified Aquatic Veterinarians20-21
 WAVMA Student Chapters 22
 WAVMA Student Chapter Report:
 Michigan State University College of
 Veterinary Medicine23
 John L. Pitts Aquatic Education Award Reports:
 Jill Western, DVM26-27
 Pablo Morón-Elorza 28-29
 Emi Retter 30

Centerfold
 Sea nettles at the Nausicaá Aquarium, France
 Photos by Komsin Sahatrakul.....32-33

Aquarium Report
 Nausicaá Aquarium, France
 by Komsin Sahatrakul..... 32-37

Research and Case Reports
 Determination of Edwardsiella tarda Median
 Lethal Dose (LD50) in Nile tilapia38-42
 Microplastics, by Greta Van De Sompel 43-45
 Cephalic Sarcoma with Metastasis in an Adult
 Swell Shark 46-50

Aquatic Vet News
 FAI Launches World’s First Tilapia Welfare App.. 50

Grand Rounds Case
 Protozoal parasites in an ornate cowfish 51

Literature Review
 New Book: Fundamentals of Aquatic Veterinary
 Medicine52-53

Aquatic Veterinary CE & PD 54-66
 AQUAVET 2023 Information 54
 38th World Veterinary Association Congress.. 55
 International Aquarium Congress 55
 Project Piaba 56

Sponsors
 WAVMA Shop19
 AquaDocs Podcasts 25
 The Bug Company 53
 API Mars Fish Care 57
 ZooMed Laboratories 62

The Aquatic Veterinarian 2022 Index 58-59
Topical Comprehensive Index 60-61

Cover Photo by Komsin Sahatrakul:

*Take a peek into the Nausicaá Aquarium,
Boulogne-sur-Mer, France.*

See article on pages 32-37.



Get The Fuller Picture From WAVMA WebCEPD Online Webinars

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

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

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

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

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

Editor’s Note

WAVMA is back in action! After two years of virtual conferences and AGMs, we had a live/webcast event in Pretoria, South Africa in early December. What a great meeting, planned by our president Gillian Taylor. See report on pages 9-15. The photo below is me presenting one of my lectures at the conference. There are also reports on other conferences attended by WAVMA members: the 47th WSAVA Congress in Lima, Peru (pages 16-17), and the 71st IVSA Congress, São Paulo, Brazil (pages 24-25) and the 11th International Aquarium Congress (pages 34-37).

The Pitts Aquatic Education Awards Committee (page 17) is excepting applications for 2023, and we have three student reports from the 2022 awardees (pages 26-30).

In this issue we also present three research and clinical case reports (pages 38-50). Please continue to submit your research or case reports for future publications. We need to help spread the word about clinical experiences with aquatic animals.

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



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



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

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

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



The Aquatic Veterinarian

The Quarterly Magazine of the World Aquatic Veterinary Medical Association

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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 can place a free 1/8 page (business card size) advertisement in the TAV. Contact TAVeditor@wavma.org for information on advertising and payment options.

President's Report

Dear WAVMA friends and colleagues,
Wishing you a wonderful 2023!

As I step back from WAVMA Presidency, handing over the baton to my friend and colleague, Bart Gorgoglione, I'm immensely grateful for the time and opportunity I was given to lead this eminent organization, and to have had space to give it my African mark.

I had a vision to connect WAVMA and Africa in a stronger way, and I think we have made great progress in achieving that, with the WAVMA conference in Pretoria really showcasing the personal investment in collaboration, and a thirst for networking and knowledge.

I was immensely humbled with the effort and time people gave, with delegates and speakers flying in from all over the world to attend in person, colleagues in Africa flying down to SA, dealing with all kinds of challenges like visa delays, cancelled flights, going to the wrong venue (Neale) yet appearing at the podium with a smile and great presentation.

You all made the conference great: farmers, vets, our first vet-tech attendees locally, industry support, our fantastic sponsors, our local S.A. Tourism board, fellow EB members, and students.
Ubuntu - I am because we are.

We have African momentum now... and that will continue. In all your corners of the world, in all your amazing varied areas of aquatic veterinary medicine, may you continue to thrive and grow, may you be visionary in your outlook and make a difference.

I thank my amazing EB 2022 team for the support and all the good work you have done in growing and developing our organization. I hope I gave you the "lekker - good," I know I gave you the "vasbyt - hang-in-there," and above all I hope I brought and will always continue to bring the "gees - spirit." I wish the new 2023 EB all success and an amazing year.

Let's support the team: colleagues volunteer where you are able. We need many hands to keep this organization strong, and bring new vision and impact.
Cheers (but I'm still around),

Kind regards,

Dr Gillian Taylor
WAVMA President 2022
President@wavma.org

*Photo on right:
Gillian Taylor
presenting at the
WAVMA Confer-
ence in Pretoria,
South Africa.*

*Photo below:
Gillian presenting
a prize at the
WAVMA
Conference,
December 2022.*



Secretary's Report

Dear WAVMA members,

We have come to the end of 2022 under the guidance of Dr. Gillian Taylor. It has been a bitter-sweet year, which saw the world opening up again, thus giving us the opportunity to meet face to face at Veterinary Conferences. Despite this, WAVMA remained consistent in providing its members with WebCEPD through its online portals. We are indeed thankful to those who made presentations in this forum and shared their experience and expertise in aquatic veterinary medicine with their colleagues. The CertAqV program remains the most popular service that is being offered to our members and we are thankful to the chair of the Credentialing Committee, Dr. Matthijs Metselaar. Apart from those veterinarians who were awarded this year for the first time, or renewed their certificate, the committee started the Vet Tech/Vet Nurse version of the program. This is an important step that is well received by our members who fall in this category. With this development, the work of the committee will intensify and therefore the automation of most of the process will become more crucial when it comes on stream.

The WAVMA Annual Congress and AGM was held in South Africa from December 3-7, 2022. This event was offered in a hybrid format, allowing all members and interested persons to participate. It was a success with several presentations touching aquaculture, pet fish and fisheries. It was tailored to suit the needs of the region and was a fitting way to end the tenure of Dr. Gillian Taylor as President. At the AGM, several presentations were made by members of the board. One of the recommendations presented to the forum by incoming President Dr. Bartolomeo Gorgoglione was to expand the number of Directors-at-Large on the Board. This recommendation was approved by the outgoing Executive Board and formed part of the recent electoral process held to elect the new Board for the year 2023.

To this end, I wish to thank all those who presented themselves to serve on the Executive Board for the year 2023 and to the members who exercised their right to cast ballots for the candidates of their choice. I take this opportunity to appeal to the rest of the membership to get involved in leadership, which could also be at the level of any of the committees that we have (Communication, Credentialing, Education and Students, Meetings, Membership). We congratulate those who have been elected to serve under the leadership of Dr. Bartolomeo Gorgoglione in 2023 and wish them well. We do look forward to learning of the great accomplishments that they will be able to achieve.

WAVMA continues its work on the global scene at the World Small Animal Veterinary Association's 47th Congress held in Lima Peru from the 29th to 31st, October, 2022. An aquatic veterinary medicine stream was



held, which has been an annual feature of the event that is co-sponsored by WAVMA. Additionally, I gave talks as an invited speaker in the One Health stream. WAVMA will continue to use these fronts to advance the cause of aquatic veterinary medicine globally.

Throughout the year, the Communications Committee, Meetings Committee, Credentialing Committee, Education and Student's Committee and WAVMA Fellows have collectively assisted in the smooth functioning of the organization under the guidance of the Board. These committees have been quite vibrant, accomplishing much during the year. Apart from serving on a Committee, one way that you can contribute is by publishing in WAVMA's Quarterly Journal, *The Aquatic Veterinarian*, which is a great avenue to let others know what you have been doing and the interesting cases that you may have worked on.

It was a pleasure serving as secretary under Dr. Gillian Taylor in 2022 and I believe that I hand over these responsibilities to the incoming Secretary, Claudia Venegas Morales, while the organization is in good health. It was indeed an honour serving you.

Devon Dublin, PhD, DMVZ, MSc. CertAqV
WAVMA Secretary
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Kushiro, Hokkaido
285-0814 Japan
Secretary@wavma.org

WAVMA EXECUTIVE BOARD 2023

Congratulations to the new members of WAVMA's Executive Board for 2023, pictured below. This year, we have expanded the number of Regional Directors from four to seven, to better include the voices and concerns of all areas of the world. There are members from nine different countries on the board, helping us to be truly a world-wide association.



WAVMA Executive Board



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President
United States



Gillian Taylor
Past President
South Africa



Matthijs Metselaar
President Elect
United Kingdom



Wes Baumgartner
Treasurer
United States



Claudia Venegas Morales
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Thailand



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United Kingdom



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Director for Middle East
Turkey



Nelly Isyagi
Director for Africa
Kenya



Paola Barato
Director for Latin America and Caribbean
Colombia

New WAVMA Members - 4th Quarter 2022

Members are the lifeblood of any organization!
 Please welcome our new members:

Full Members

- Sarah Pellett
- Brak Moczygemba
- Shraddha Cantara
- Amir Mohammed
- John Mastrobuono
- Deidra Shuck-Lee
- Christine Huynh
- Sunita Awate
- Sherri Russell
- Cobus Raath
- Gianluca Deli
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- Elisabeth Range
- Marcos Godoy
- Julia Lucas
- Justin Rosenberg
- Mark Powell
- Otis Miller
- Andrew Tornell
- Alexandria Oswell
- Juan-Ting Liu
- Mary Ceccolini

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- Yoandy Coca
- Emily Smith
- Tyson Jenkins
- Ashley Whitehead
- Samantha Fowler
- Alexandra Koutras
- Eren Aksu
- Kendra Davis
- Shelby Monnin
- John Retzlaff
- Monica Esquivel-Zarate
- Ariana Cortez
- Boon Han Teo
- Laura Benecke
- Heriberto Franco
- Carrie George
- Anna Mulkeen
- Lauren Humphrey
- Ruskin Cave
- Deanna Guynup
- Victoria Priester
- Kathryn Lewis
- Racquel Edjoc
- Shannon Lloyd
- Daniel Capasso
- Raegan Hetrick
- Satarah Jackson
- Devon Anderson
- Jussa-Pekka Virtanen
- Victoria Duffy
- Kaitlin Fitzpatrick
- Shirley Ramesh
- Cole Lim
- Andrea Lim
- Tasha Warren

Executive Board Responsibilities

The WAVMA Executive Board consists of the President, Immediate-Past President, President-Elect, Secretary, Treasurer and Directors. The Executive Board will provide oversight and approve all fiscal and administrative activities of WAVMA and its committees, programs and services in accord with the Bylaws, and facilitates the development and implementation of WAVMA programs.

The President will: Schedule, draft agendas and preside over the Executive Board meetings; Monitor and facilitate implementation of all active WAVMA and Committee programs, services and other initiatives; serve on the Budget Committee; Provide an update of WAVMA activities for the association’s quarterly publication; Work with the Meetings Committee to finalize and implement the WAVMA Annual General Meeting; Preside over the WAVMA Annual General Meeting.

The President-Elect will: Assume the President’s responsibilities in the absence of the President; Serve as a member of the Budget Committee; Identify at least one new WAVMA program or initiative to implement during his/her 3-year tenure; Assist in facilitating and implementing active WAVMA programs and initiatives during his/her 3- year tenure;

The Immediate Past-President will: Assume the President’s responsibilities in the absence of the President and President-Elect; Assist the President-Elect and other Board members in developing or implementing new or existing WAVMA initiatives and programs.

The Secretary will: Serve as the primary WAVMA point of contact for the public; Inform members of WAVMA programs & initiatives; Assist the developments and distribution of WAVMA official correspondence; Serve as Chair of the Communications Committee;

The Treasurer will: Maintain all WAVMA bank accounts and bookkeeping, receive all payments, and pay all approved expenses; Chair the Budget Committee and facilitate the development of an annual budget

Directors will: Represent individual WAVMA member’s general interests in their geographical regions.

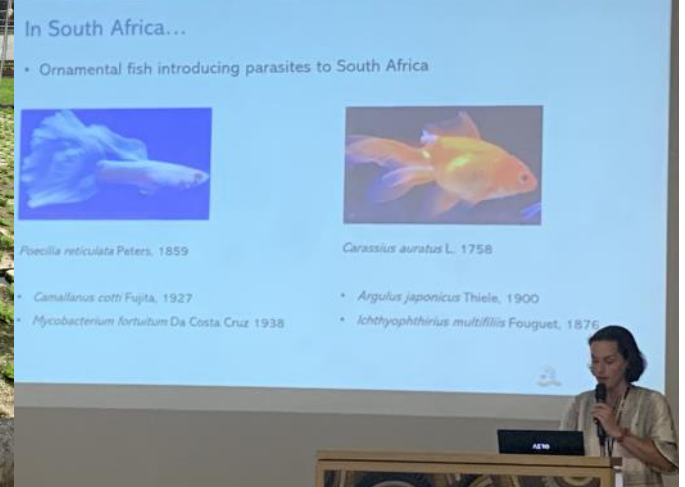
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WAVMA Conference and Annual Meeting Report
Julius Tepper and Nick Saint-Erne

The WAVMA Conference and Annual General Meeting, held in Pretoria, South Africa, provided four days of lectures by in-person speakers and also by video for those who were unable to attend. Evening events allowed interaction with aquatic veterinarians, government agency representatives, and fish farmers. On Thursday, we were taken on a tour to an aquaponics farm that raises Tilapia and lettuces.

The Annual General Meeting allowed the Executive Board members to discuss the current WAVMA programs and outline a plan for next year. Current President Gillian Taylor did a great job in planning and executing the WAVMA Conference.



WAVMA Conference and AGM

Date: 3 December 2022 - Farmer's Day

Faculty of Veterinary Sciences Onderstepoort

Stephen Reichley, Roy Yanong and Julius Tepper helped with the farmer's workshop discussions and wetlab aimed at helping fish farmers with health-related issues. This is a photo of the vet school area where the aquatic courses are given.



Photo below is inside the aquatic department's fish holding and research area. Seen here is Gillian Taylor discussing cases with several vet students involved with fish care at the facility.



Dr. Gillian Taylor about to start the necropsy demonstration on a tilapia.



One of the tanks set up for feeding control experiments. Hundreds of tilapia fry are seen here.



Farmers in the lecture area listening to the fish health discussion.



Stephen Reichley and Roy Yanong talking with the farmers during lunch.



Conference Day 1: Sunday, 4 December 2022
Future Africa Campus, University of Pretoria

A view of the delegates seated at the main conference lecture hall.



Nick Saint-Erne lecturing at the conference.



Gillian Taylor speaking at the opening of the AGM



WAVMA AGM: Monday, 5 December 2022

Nick, Stephen and Roy at the annual dinner.



Julius Tepper enjoying dinner conversation with delegates from across Africa and the world



Table decorations created by local artists.



Beautifully presented and delicious dinner.

**Conference Day 4: Wednesday, 7 December 2022
FinLeaf Aquaponics Farm Tour**

The trip to the fish farm north of the conference venue saw storm clouds and rain approach.



Views of the FinLeaf lettuce production.



And Tilapia pools.



Wednesday's visit to FinLeaf Aquaponics farm was a two-hour bus trip north of Pretoria.

Gillian Taylor and Roy Yanong enjoy a lighter moment at the farm.

Raceways teeming with tilapia are seen behind them.



Rock hyrax or “dassies” as they are known locally, resemble groundhogs, but with raccoon-like faces. Although they are herbivores, they are not rodents at all, but more closely related to the elephant. They are seen commonly on campus.

An excellent South African red wine



The Voortrekker Monument is located just South of Pretoria. It is a monument and museum commemorating the pioneering days of the 1830s, when the Dutch, English and Africans struggled to settle the land.

Beautiful red bishop bird seen at the conference venue. Other wildlife was plentiful around the campus.



WAVMA Conference and Annual Meeting Photos

A great time was had at the social events at the WAVMA Conference at the Future Africa Campus of the University of Pretoria in South Africa, the first week of December 2022. There were several social events, including an African drumming circle, African themed dinner, and the Annual General Meeting Dinner.

It was a great opportunity to see old friends, make new ones, and discourse with colleagues from around the world. There were also several vendor booths set up for the conference.





**WAVMA's Presence
 at the 47th WSAVA
 Congress
 in Lima, Peru
 by Julius Tepper
 & Devon Dublin**



This autumn between October 29-31, 2022 the World Small Animal Veterinary Association (WSAVA) held its 47th Congress in Lima, Peru, known as the "City of the Kings." This city encompasses a mixture of cultures showcased by its cathedrals, squares, and museums housing a majestic past. Peru is ancient, ancestral, cultural and touristic with a mixture of nature including the Pacific Ocean and the tropical Andean mountains. Outside of the talks that were offered, attendees had the option of visiting the deepest canyons on earth and the oldest civilization in America: Macchu Picchu.

It is in this awesome environment that WAVMA presented lectures in aquatic veterinary medicine. This is an annual and traditional feature of the WSAVA congress that we are proud of. Small animal vets tend to be focused on dogs, cats, rabbits, and to some extent exotics. Aquatic medicine is still scratching the surface where they are concerned. Many of these veterinarians, however, are having clients show up with fish and the lectures given on "Integrating ornamental fish medicine into a small animal practice" and "Selected cases from pet fish veterinary practice" given by Dr. Julius Tepper were certainly useful in this regard to boost the confidence of such veterinarians.



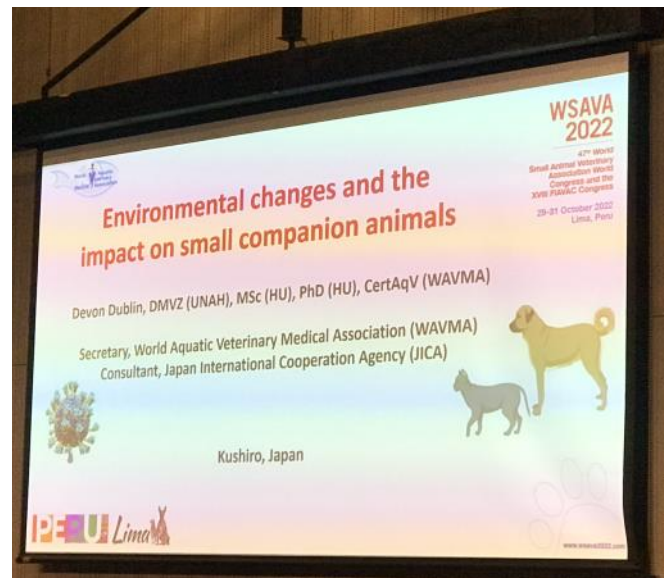
Dr. Julius Tepper (above) and Dr. Ladislav Novotny (right) giving their lectures.



Dr. Devon Dublin chaired the stream and ensured that a vibrant and healthy exchange was sustained between the speakers and attendees. Dr. Dublin was also an invited speaker in the One Health stream where he spoke on the "Environmental changes and the impact on small companion animals". Aquatic Veterinarians are well poised to contribute significantly to the scene of One Health due in part to the great environmental focus that comes into play with water quality.

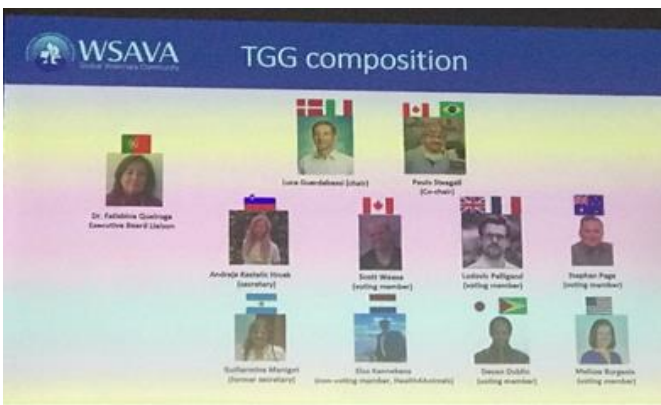


For those that are somewhat involved in aquatics and needed some more in-depth lectures, Dr. Ladislav Novotny of the Czech Republic spoke on "Respiratory diseases in fish" and "Mycobacterial infection in fish". The stream was graced with the presence of attendees with a keen interest in fish, many of whom stayed for all the lectures.





Dr. Dublin's work on the Therapeutics Guidance Group (Photos below) of WSAVA was also highlighted at a special session held by that committee entitled "Shaping the Future - Drug availability and accessibility of veterinary medicines - a global issue?" As a result, WAVMA was showcased on several fronts in a region where we need to expand our reach. WAVMA will continue to partner with WSAVA to bring the issues related to Aquatic veterinary medicine to global audiences.



John L. Pitts Aquatic Education Awards

Applications are currently open for the 2023 John L. Pitts Aquatic Veterinary Education Award. The purpose of the awards are to provide an opportunity for recipients to explore a career in aquatic veterinary medicine. Veterinary students and recent graduates (within 2 years of March 2023) are eligible to apply for activities that take place between October 1, 2022 and February 1, 2024. Applicants who are interested in aquatic medicine but have previously had limited ability or opportunity to get involved are encouraged to apply. Awards (typically \$250-\$1,000) may be used towards offsetting personal costs for your externship or other aquatic veterinary education activity.

The application form and additional information is available at: <http://www.wavma.org/scholarships>

Applications for the 2023 Program will close on March 01, 2023. Recipients will be notified around May 1st, 2023

Questions?

Please contact PittsEduAwards-Admin@wavma.org

Our 2022 John L. Pitts Scholars are:

- Maria-Antonia Minea; University of Agriculture and Veterinary Medicine (Romania)
- Alok Dhakal; Tribhuvan University (Nepal)
- Greta Doden; Oklahoma State University (USA)
- Bree Karns; Colorado State University (USA)
- Pablo Morón-Elorza; Complutense University of Madrid-Oceanográfica of Valencia (Spain)
- Emily Retter-Tucker; North Carolina State University (USA)
- Hery Ríos-Guzmán; Cornell University (USA)
- Jillian Western; Blue Pearl Tampa (USA)

John A. Griffioen, DVM

Pitts Education Awards Committee Chair

Associate Veterinarian

Fort Worth Zoo, Fort Worth, TX

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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 veterinarians, veterinary students or veterinary nurses, to join us on the committees. 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 12. Contact our Secretary or the committee chair for more information about the committee and the dates of the next meeting (also done via web conference). All are Welcome!

Join a WAVMA Committee today!

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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 Secretary.

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: Wes Baumgartner, 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: Morag Clinton, 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: Matthijs Metselaar CertAqV-Admin@wavma.org

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 members and the organization.

Chair: Chris Walster, Administrators@WAVMA.org

Education & Student Committee

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

Chair: Bartolomeo Gorgoglione, BartGorg@msu.edu

Fellows Advisory Council

A WAVMA Fellow is someone who has conferred on them the honorific: *WAVMA Distinguished Fellow*. The Fellows Advisory Council is composed of WAVMA Distinguished Fellows who are current WAVMA members and who wish to contribute to the development of WAVMA. The Chair of the Fellows Committee will be the Fellows Representative to the Executive Board.

The Fellows Nomination Subcommittee (FNS) is a subcommittee of FC and evaluates applications for the WAVMA Distinguished Fellow and forwards a recommendation for a WAVMA Distinguished Fellow to the EB. The 2022 Distinguished Fellow was announced at the Annual General Meeting in South Africa, the first week of December 2022.

Current Distinguished Fellows are:

- Peter Merrill (2012)
- Ronald Roberts (2012)
- David Scarfe (2012)
- Julius Tepper (2012)
- Christopher Walster (2012)
- Grace Karreman (2013)
- Marian McLoughlin (2013)
- Dusan Palic (2013)
- Mohamed Faisal (2016)
- Nicholas Saint-Erne (2017)
- Richmond Loh (2018)
- Laura Urdes (2019)
- Devon Dublin (2020)
- Gregory Lewbart (2021)
- Matt Metselaar (2022)

Laura Urdes, PhD DVM CertAqV
 Fellows Advisory Council Chair

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. Adjust the size on your screen so you can see both pages side by side.

Make sure that the first page is viewed by itself. 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 in all its ginormous glory!

Meeting Committee

Following from my last report in September, the meetings scheduled for 2022 were continued with the World Small Animal Veterinary Association Congress, held in Lima, Peru from Oct. 29-31, 2022. As a co-sponsor of this annual event, WAVMA had a dedicated schedule of aquatic talks presented by Ladislav Novotny and myself. This is always a pleasurable event to participate in, as it is often attended by both seasoned practitioners and novice pet fish veterinarians. Format tends to be casual and friendly, and questions range from basic day-one advice to lively discussions on treatments and procedure protocols.

To end the meetings calendar for 2022, the WAVMA Conference and Annual General Meeting, including KoiPrax4, were held in Pretoria, South Africa the first week of December 2022. This was an exciting event, with both local and international speakers and attendees. To read more about this event, see the article by Nick Saint-Erne and myself in this issue of TAV.

Finally, it is my pleasure to report that once again, we have succeeded in ending the year with the Meetings Committee under budget.

Julius M. Tepper, DVM, CertAqV
 Meetings Committee Chair

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 (including shirts, mugs, caps) are available
 at the WAVMA Store. Get yours today!



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Credentialing Committee

Firstly, I like to thank you for yet another great year. A year of many successes. We have expanded the committee with a few new members, welcome again. We have reviewed and approved 58 candidates, the same as last year. We have successfully debated and approved a new certificate for vet nurses. Great news indeed.

We are in the final stages of testing the new approval system that will make approval and communication around the subject much easier. It will considerably reduce the admin on my side and improve the record keeping. We hope to start to implement this early next year.

The first two Certified Aquatic Veterinary Nurse / Technicians were awarded by the EB on 26th December 2022. Two more are currently going through the assessment process.

Awardees:

- Alianna Munakata, CertAqVNT currently working at The Unusual Pet. Vets, Frankston, Victoria, Australia (www.unusualpetvets.com.au)
- Tiffany Pope CertAqVNT currently teaching at Texas A&M University - Kingsville (www.tamuk.edu)

These are the first two trialists to be awarded and the CertAqVNT will hopefully go live sometime in January once the web page has been set up.

Check www.WAVMA.org for further information, or if you are a WAVMA member, you can contact:

administrators@wavma.org, who can provide you with the current documentation (Handbook, draft CertAqVNT KSE). When the web page goes live WAVMA Members will also be able to access a Resource page, assisting those wishing to complete the CertAqVNT.

For CertAqV Program Description [Click here](#) to download, or go to WAVMA.org/CertAqV-Pgm.

Individuals who desire to participate in the WAVMA CertAqV Credentialing Program will first need to register and pay the US\$250 administrative fee. When registering you will select a mentor to assist and guide you through the requirements. After you have registered, you will receive an e-mail on how to download a document to record where you have obtained sufficient KSEs (knowledge, skills and experience/education) in each of the 9 modules or subject areas. You have one year to complete these, once registered.

When your mentor is satisfied you have sufficient KSE credits, he/she will then request the WAVMA Credentialing Committee to evaluate these. Once the Committee and the WAVMA Executive Board have evaluated these and are satisfied you meet all requirements, you will be notified and mailed a certificate suitable for framing and display.

If you have questions about the Certification process, please send me an email.

Dr. Matthijs Metselaar DVM PhD CertAqV MRCVS
Credentialing Committee Chair
CertAqV-Admin@wavma.org

Certified Aquatic Veterinarians

Jessica Allen	USA
Sara Alves	USA
Chelsea Anderson	USA
June Ang	Singapore
Nimrod Arad	USA
Brenda Arras	USA
Farah Gonul Aydin	Turkey
Romualdo Balagapo	Philippines
Sarah Balik	USA
Marcello Balzaratti	Italy
Jo Bannister	Australia
Madison Barnes	St. Kitts & Nevis
Michelle Barnett	USA
Christa Barrett	USA
Heather Barron	USA
Giana Bastos-Gomes	Hong Kong
Julia Bauer	Germany
Mariah Beck	USA
Trista Becker	USA
Jenice Bell	USA
Heather Bjornebo	USA
James Bogan	USA
Pierre-Marie Boitard	France
Serena Brenner	USA
Erika Brigante	St. Kitts & Nevis
Tessa Brown	USA
Faith Burgos	USA
Todd Cecil	USA
Bryony Chetwynd-Glover	UK
Prakan Chiarahkhongman	Thailand
Dana Clark	USA
Annie Clift	USA
Dondrae Coble	USA
Michael Corcoran	USA
Emily Cornwell	USA
Galaxia Cortes-Hinojosa	Chile
Rebecca Crawford	St. Kitts & Nevis
Rubén López Crespo	Mexico
Charles Cummings	USA
Nadav Davidovich	Israel
Manuel De la Riva Fraga	Spain
Darren Docherty	UK
Simon Doherty	UK
Christina Dover	USA
Devon Dublin	Japan
Freeland Dunker	USA
Michael Dutton	USA
Jacqueline Elliott	USA
Ashley Emanuele	USA
Azureen Erdman	USA
Maribel Escobedo	Mexico
Antonella Fabrisin	Italy
Mohamed Faisal	USA
Erika First	USA
Lindsay Francis	USA
Ari Fustukjian	USA
Cherissa Garcia	United Arab Emirates
Erika Gibson	USA
Danielle Godard	USA
Christopher Good	USA
Bartolomeo Gorgoglione	USA
Krystan Grant	USA
John Griffioen	USA
Miguel Grilo	Portugal
Stephanie Grimmett	UK
Katharina Hagen-Frei	Switzerland
Alex Hall	USA
Katharine Haussman	USA

Orachun Hayakijkosol	Australia
Eileen Henderson	USA
Chelsea Hester	USA
Nora Hickey	USA
Karlee Hirakis	Australia
Kelsey Hoag	USA
Emma Houck	USA
John Howe	USA
Aivee Huynh	Australia
Kerryn Illes	New Zealand
Adrien Izquierdo	USA
Leslie Jarrell	USA
Jimmy Johnson	USA
Kelsey Johnson	USA
Sharmie Johnson	USA
Kasper Jorgensen	Denmark
Brian Joseph	Canada
Hali Jungers	USA
Parinda Kamchum	Thailand
Kyle Kansman	USA
Fritz Karbe	Germany
Sherri Kasper	USA
Elizabeth Kaufman	Israel
Denyse Khor	Singapore
Amy Kizer	USA
Jessica Koppien-Fox	USA
Jack Kottwitz	USA
Laura Krogman	USA
Lana Krol	USA
Marie Kubiak	UK
Diya Lake	Mauritius
Krista Ann Lee	USA
Veronica LePage	Canada
Elizabeth Leuchte Rising	USA
Sarah Lietzke	USA
Jan Linkenhoker	USA
Eric Littman	USA
Richard Lloyd	UK
Richmond Loh	Australia
Alfonso Lopez	Singapore
Ruben Arturo Lopez Crespo	Mexico
Jordi Lopez Ramon	Spain
Amber Lum	USA
Adolf Maas	USA
Raphael Malbrue	USA
Paul Manensis	Canada
David Marancik	Grenada
Victoria Maroun	USA
Laura Martinelli	USA
Robert Martinez	USA
Alexandra Mason	USA
Colin McDermott	USA
Alicia McLaughlin	USA
Celia Megdal	USA
Larissa Menke	USA
Matthijs Metselaar	UK
Sonja Miles	UK
Tim Miller-Morgan	USA
Haitham Mohammed	Egypt
Alissa Mones	USA
Danny Morick	Israel
Charlene Morotti	USA
Lucie Nedved	Australia
Ross Neethling	UK
Jenifer Nix	USA
Sally Nofs	USA
Ladislav Novotny	Czech
Massimo Orioles	Italy
Alec Ortiz Colosi	USA

Dušan Palić	Germany
Brian Palmeiro	USA
Veronica Pardini	USA
Christine Parker-Graham	USA
Lily Parkinson	USA
Chris Payne	USA
Melanie Peel	USA
Ayanna Phillips	Trinidad & Tobago
Ashley Powell	USA
Jena Questen	USA
Eva Quijano Cardé	USA
Janis Raines	USA
Atisara Rangsichol	Thailand
Zachary Ready	USA
Aimee Reed	USA
Stephen Reichley	USA
Nuno Ribeiro	Portugal
Julianne Richard	USA
Camille Richie	USA
Michelle Rivard	USA
Rifky Rizkiantino	Indonesia
Patinan Rookkachard	United Arab Emirates
Komsin Sahatrakul	Singapore
Nick Saint-Erne	USA
Sonja Saksida	Canada
Jessie Sanders	USA
Sasha Saugh	South Africa
David Scarfe	USA
Neha Shah	India
Khalid Shahin	UK
Galit Sharon	Israel
John Shelley	USA
Chris Shirkey	USA
Constance Silbernagel	USA
Melissa Singletary	USA
Esteban Soto	USA
Brandon Spolander	South Africa
Elizabeth St. Germaine	USA
Brittany Stevens	USA
Chairat Sumgorthong	Thailand
Win Surachetpong	Thailand
Tanatporn Tantiveerakul	Thailand
Gillian Taylor	South Africa
Alissa Tepedino	USA
Julius Tepper	USA
Sharon Tiberio	USA
Miranda Torkelson	USA
Norrapat Towanabut	Thailand
Alexandra Troiano	USA
Laura Urdes	Romania
Julian Vaillard Cerdio	Mexico
Greta Van de Sompel	Belgium
Claudia Venegas	Chile
Zachary Waddington	Canada
Sarah Wahlstrom	USA
Chris Walster	UK
Scott Weber	USA
Marcus Webster	USA
Trista Welsh	USA
Michael Wenninger	USA
Peter Werkman*	Holland
Laura Whalen	USA
David Wilbur	USA
Sarah Wilson	USA
Howard Wong	Hong Kong
Sarah Wright	USA
Taylor Yaw	USA
Irene Yen	USA

WAVMA Student Chapters

To initiate a new Student Chapter, download the [WAVMA Student Chapter Guidelines](#)
 A Spanish version of the Student Chapter Guidelines can be [downloaded from the WAVMA website](#).

Examples of available Student Chapters programs:

- Assistance in organizing and promoting Chapter programs and activities.
- MiniGrants of up to \$500 USD are available to assist official WAVMA Student Chapters with conducting activities intended to engage students in opportunities related to aquatic veterinary medicine. Download [the Flyer here](#) and [the application form here](#).
- Access to recorded webinars and live web-based presentations from experts around the world.
- Low annual WAVMA Student Membership (\$25)
- 50% Chapter member's dues may be available to support Chapter-organized activities. [Get more information here](#) and a [Spanish version here](#).
- Reduced rate (50% off) WAVMA Full Membership the year after graduation.
- [John L. Pitts Aquatic Veterinary Education Awards Program](#)
- Access to the latest editions of WAVMA's quarterly journal, [The Aquatic Veterinarian](#).
- Access to WAVMA member-only webpages.
- Aquatic veterinary externship and job listings.
- Participation in the WAVMA Certified Aquatic Veterinarian (CertAqV) Program.
- Access to WAVMA e-mail listservs, including Members-L, and Student-L.

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

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

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

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WAVMA Student Chapters

University of Pretoria, Onderstepoort [Faculty of Veterinary Science](#), South Africa (established 2017)

Murdoch University, [School of Veterinary & Life Sciences](#), Australia (established 2014)

University of Sydney, [School of Veterinary Science](#), Australia (established 2014)

Auburn University, [College of Veterinary Medicine](#), USA (established 2013)

Colorado State University, [College of Veterinary Medicine & Biomedical Sciences](#), USA (est. 2019)

Cornell University, [College of Veterinary Medicine](#), USA (established 2019)

Michigan State University, [College of veterinary Medicine](#), USA (established 2021)

Mississippi State University, [College of Veterinary Medicine](#), USA (established 2014)

The Ohio State University, [College of Veterinary Medicine](#), USA (established 2018)

Oregon State University, [College of Veterinary Medicine](#), USA (established 2017)

Ross University, [School of Veterinary Medicine](#), St. Kitts & Nevis, West Indies (established 2015)

St. George's University, [School of Veterinary Medicine](#), Granada, West Indies (established 2018)

Tuskegee University, [School of Veterinary Medicine](#), USA (established 2012)

University of California, [Davis School of Veterinary Medicine](#), (Established 2020)

University of Georgia, [College of Veterinary Medicine](#), USA (established 2015)

University of Illinois, [College of Veterinary Medicine](#), USA (established 2018)

University of Pennsylvania, [School of Veterinary Medicine](#), USA (established 2020)

Western University of Health Sciences, [College of Veterinary Medicine](#), USA (established 2014)

University of Edinburgh, [Royal \(Dick\) School of Veterinary Studies](#), Scotland UK (established 2020)

University of London, [Royal Veterinary College](#), England UK (established 2021)

Ankara University, Faculty of Veterinary Medicine, Turkey (established 2022)

Makerere University College of Veterinary Medicine Animal Resources and Biosecurity (established 2022)

St. Matthew's University School of Veterinary Medicine West Bay, Cayman Islands (established 2022)

Student Chapter Report

Luke VanBlois

MSU College of Veterinary Medicine Class of 2024
 WAVMA student chapter – Vice-President

Michigan State University College of Veterinary Medicine's WAVMA student chapter traveled to the Shedd Aquarium in Chicago, Illinois, on September 24, 2022. This behind-the-scenes tour was made possible by the gratuitous funding of the WAVMA Student Chapter Mini-Grant, awarded to the club in 2022. This mini grant provided funding for the cost of admission for all of the students, travel (fuel and parking), and one meal.

The six students who attended were Tessa Peerbolte (Student Chapter President), Luke VanBlois (Student Chapter Vice President/Treasurer), Robyn Hawley (Student Chapter Secretary), Hunter Wojtas, Khelsea Bahr, and Melissa Vaughn. Our day began by exploring the Caribbean Reef and Amazon Rising exhibits for about an hour before meeting Dr. Zach Ready, the aquatic veterinarian on staff.

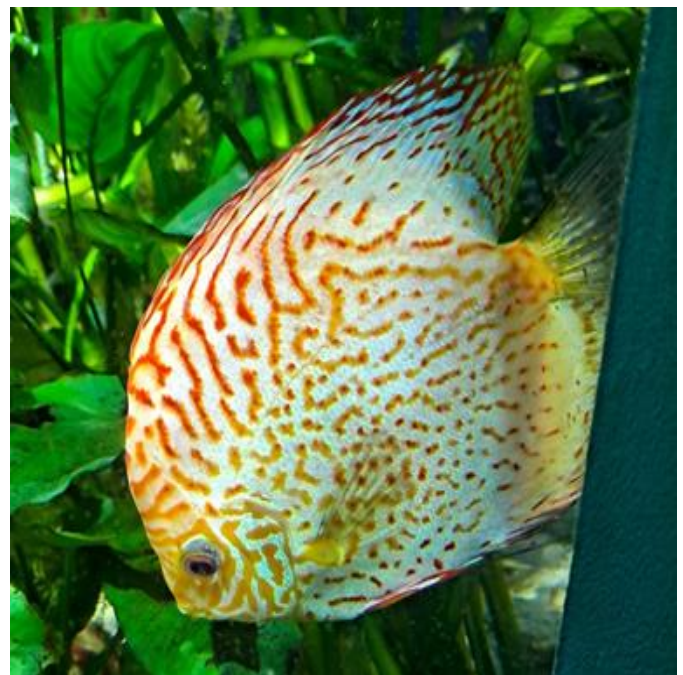


The tour with Dr. Ready began by visiting the microbiome lab. There, he informed us about the importance of stimulating the immune systems of aquatic mammals. To achieve this goal, the mammals are exposed to “dirty” water from fish exhibits. Next, the team saw the water quality lab and learned the importance of monitoring and managing ammonia in the aquarium setting. Dr. Ready provided a tour of the hospital and kindly answered many questions. Discussion topics included his journey in aquatic medicine and the residency program that led him to Shedd Aquarium. The most interesting thing we learned was that endoscopy is commonly used in both the Pacific white-sided dolphins and beluga whales. Dr. Ready discussed a case regarding a



beluga whale that had consumed a pacifier which had been thrown into its exhibit. The pacifier was successfully retrieved by endoscopy.

Following the behind-the-scenes tour, the group enjoyed lunch, visited the rest of the aquarium, and attended a dolphin show, during which Dr. Ready was observed scanning one of the female's ovaries via ultrasound. Collectively, hundreds of pictures were taken, and many new species were learned about. The opportunity created excitement and interest in aquatic veterinary medicine! The MSU Student Chapter is extremely grateful for the funding provided by WAVMA's mini-grant program and all the knowledge gained during this trip.



**WAVMA Aquatic Session
at the 71st IVSA Congress,
São Paulo, Brazil
by Laura Urdes & Devon Dublin**



This summer, July 17-27, the International Student Veterinary Association (IVSA) held its 71st Congress, in the city of São Paulo, Brazil, a cosmopolitan, melting-pot city that is home to the largest Arab, Italian, Japanese, and Portuguese diasporas. The theme, “*All working as one: overcoming difficulties with perseverance,*” was chosen to highlight the importance of collective effort to confront global challenges, with a special focus on the COVID-19 pandemic as a point of reference. This event was the first in person IVSA scientific meeting since the COVID-19 pandemic began, and it was meant to celebrate the easing of the restrictions, while remembering the losses and struggles suffered during the outbreak, as well as learning how to help build the future veterinarian career cognizant of the fact that other pandemics can occur.

The logo of the Congress, the hyacinth macaw (*Anodorhynchus hyacinthinus*), was chosen due to its colors matching the Brazilian flag (blue, yellow and green) and because this bird, found throughout Brazil, is a symbol of the preservation of biodiversity in the country. The Congress was held at the Faculty of Veterinary Medicine and Animal Science, University of São Paulo (USP), in the “University City” campus (Photos 1, 2). USP is one of the four largest public universities of the state government, and considered the country’s most important public university.



With over 120 student delegates from 33 countries and 30 invited speakers from 11 countries, the IVSA Congress was a marathon of joyful social events combined with

topic-focused lectures and Panel discussions, open to delegates and other Congress participants. The World Aquatic Veterinary Medical Association (WAVMA) supported the event as is a tradition and graced the occasion with two speakers: Dr. Laura Urdes and Dr Devon Dublin.

Dr. Urdes was placed in the stream of “Advances in Animal Welfare” where she gave a presentation entitled “Welfare and Sentience in Aquatic Invertebrates” (Photo 3). Dr. Dublin was placed in the stream of “Importance of the Veterinarian in Pandemics: Example of COVID-19”, in which he gave a presentation entitled “COVID-19 and Aquatic Animal Medicine” (Photo 4, bottom of page). There was a panel discussion held for each of the streams where frank and dynamic exchanges were facilitated between the speakers and the delegates (Next page, Photo 5).



There were opportunities to enjoy the local cuisine and interact between speakers and delegates (Next page, photos 6, 7). Of particular interest was the *Cultural Evening* and *Open Bar Club*, where members were invited to wear traditional outfits from their country of origin, and to share cultural aspects from each of the participant countries. As in every IVSA Congress and symposia, there were also *Dad Live and Silent Auctions* (IVSA DAD) supported by the Development Fund, where students were able to donate items from their own country for the live and silent auctions.





Photo 5. Group picture of participants of the stream of "Importance of the Veterinarian in Pandemics: Example of COVID-19"



Photo 6. A night out with (from left to right): Alexander Starke (University of Leipzig), Devon Dublin (WAVMA), Laura Urdes (WAVMA), Shadia Berjaoui (Istituto Zooprofilattico Sperimentale dell'Abruzzo e Molise) and Fabio C. P. (USP).

Another attractive social event was the International Stands, where each delegation from each country was able to share information about their country and about the opportunities for externships, internships and exchanges. Participants were invited to bring pictures, pamphlets and other items that might represent their country, thus boosting cultural and traditional exchanges among participants.



Photo 7. Coffee with IVSA students and guest speakers at the USP's Canteen : Extreme left Sharun Khan, (Indian Veterinary Research Institute); third from left Donald Broom, (University of Cambridge); fifth left Laura Urdes (WAVMA); sixth left Devon Dublin (WAVMA); far right Shadia Berjaoui (Istituto Zooprofilattico Sperimentale dell'Abruzzo e Molise), with IVSA students.

WAVMA is excited to partner with Aquadocs Podcast



Looking for new and on-the-go ways to learn about aquatic medicine? Check out Aquadocs podcast hosted by Michelle Greenfield where aquatic animal health experts share their research, clinical cases, stories, and more.

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Follow us on Instagram and Facebook @aquadocspodcast



**John L. Pitts Aquatic Education Award Report
What I Learned in Fish School Is...
Jill Western, DVM**

In the summer of 2022, I was fortunate to participate in AQUAVET® I, an aquatic veterinary medicine course for both current veterinary students and veterinarians. Throughout vet school, early January was always highlighted on my calendar as the time to apply to the course. Each year, I would try to improve my resume and application essay, attempting to convey how I felt about aquatic medicine. It wasn't until the past cycle year that I realized what I was lacking – putting my passion for aquatic medicine into accurate words (without using the word 'passion' or any of its derivatives), and the experience to back it up. With improvements in both areas and a letter of recommendation, I was accepted into the program.

During our first day, we had some insight into the rigor and mental fortitude that we would need over the next twenty-eight days. Immediately after moving in, we were briefed on the history of AQUAVET®, reviewed mandatory lab safety procedures, and started lectures on marine invertebrate phyla. Classes and labs consumed most of the time in our day – starting at 8 am and concluding to around 8:30 pm during the week, and 8 am to 4:30 or 5 pm on Saturdays, for four weeks. The material covered in AQUAVET® I ranges from the medicine and surgery of invertebrates to marine mammals. Additionally, aquarium management, aquaculture, and water quality were included.

The labs were one of the highlights of the course for me. We were able to necropsy several species, including fish, sea turtles, seabirds, seals, bivalves, horseshoe crabs, and lobsters. For each of these labs, we were able to practice clinical techniques, such as physical exams and venipuncture techniques. I was most surprised by how to collect a hemolymph sample from a clam, and that this clinical skill can prove valuable. Another lab that surprised me was the invertebrate dissection lab. I had never given much thought to what the inside of a horseshoe crab looked like, but the brain structure was fascinating to me.



Photo 2. The brain of a horseshoe crab.

However, one lab stands out above the rest. Fish surgery lab, just like many of my classmates, was my favorite lab. Although I had performed an enucleation on a fish before, this was my first splenectomy in any species. It was also very valuable to learn how to set up a mobile anesthetic cart for fish surgery, in a way that you can finely control anesthetic depth. How do you evaluate a fish's anesthetic plane? Unsurprisingly, it's the respiratory rate and changes in respiratory rate, just like in mammalian patients. This lab demonstrated the similarities between mammalian medicine and fish medicine, as well as the practicality of mobile fish surgery.

One important block of time that proved invaluable was our marine mammal discussion with a panel of veterinarians from the field, whose expertise included managed care animals as well as rehabilitated animals. It was important to get their perspective on controversial subjects that are intertwined with aquatic medicine and see how their individual opinions slightly differed but had the same overall message. Additionally, it was important to get my classmates' perspectives on these subjects, as their opinions also differed but had common themes. This session also demonstrated how easily an open discussion is with well-established experts in the field, and I think it did a great job conveying how welcoming the profession is overall.

Toward the end of the course, we were able to take field trips to several aquatic facilities around New England. My favorite of these trips was the Long Island Aquarium. During our visit, we were able to perform physical exams on African penguins from the aquarium population as well as physical exams on the loggerhead sea turtles and harbor seals in rehabilitation. Up until this trip, I had always categorized aquariums separately from rehabilitation facilities. Despite the majority of, if not all, aquariums being involved in conservation, I maintained this categorization until this

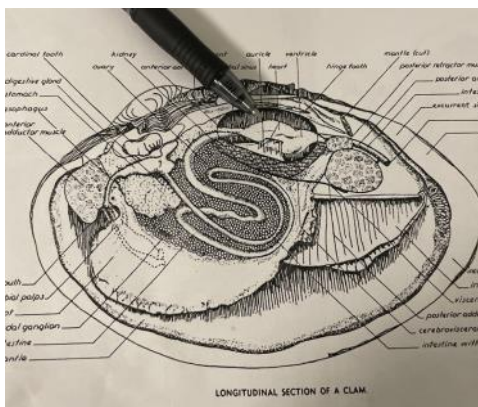


Photo 1.
Hemolymph collection site in a clam.



trip. If the same veterinarians treated both sets of patients, how could they really be such separate facilities?

Another component of this course that I found valuable was the required student seminars. Through these student-taught topics, I was able to better understand my classmates' interests and backgrounds. As for my international classmates, it was fascinating to see how aquatic medicine fits into the culture of their homeland and how they will apply their newfound knowledge when they return home. I'm excited to see what they will accomplish in their careers and for their countries!

A less-advertised benefit of AQUAVET® is the networking opportunities it provides. Not only do you form a bond with veterinary students with the same interests as you, but you also get the opportunity to meet the biggest names in aquatic medicine from all over the globe. Now, I know whom I will need to contact with questions as I grow in my career, as well as how to contact them. Additionally, I know what projects they are working on, and where to direct other students and veterinarians inquiring about how to get involved in a particular facet of aquatic medicine. I look forward to seeing these people again when conferences are face-to-face again.

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>.

*Photo 3.
 Fish surgery lab team with their respective organs removed during surgery:
 from left to right: Jill Western (me) with spleen, Ivy Sudduth with an eye, Sam Oakey with an eye, Kristi Kaleel with gonads, and Dr. Jessie Sanders, our surgery lab instructor.*

From the hands-on experience to the networking opportunities, I cannot recommend AQUAVET® enough for veterinary students and current veterinarians interested in pursuing aquatic medicine. The knowledge I've obtained and the connections I've made from the course will follow me throughout my career. It's another experience I've had that makes me so grateful to have stumbled into aquatic medicine. Looking forward to participating in AQUAVET® II in the future!

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John L. Pitts Aquatic Education Award Report
Pablo Morón-Elorza

INTRODUCTION:

My name is Pablo Morón-Elorza, I am a 27-year-old Veterinarian, and I am currently enrolled in a PhD in Veterinary Medicine program entitled "Advances in Elasmobranch Medicine: Pharmacokinetics of Meloxicam and Clinical Contributions to Shark and Skate Blood Analysis." In June 2022, I presented a proposal for the John L. Pitts Aquatic Veterinary Education Award to help me support the research projects included in my PhD during this year. In September 2022, I was told that I had been selected to receive financial support in the amount of \$500. The following report is a description of the work developed and the results obtained during the last year.

DESCRIPTION OF THE RESEARCH WORK:

The Doctoral Thesis is carried out in the Department of Pharmacology and Toxicology of the Faculty of Veterinary Medicine from the Complutense University of Madrid, together with the Department of Veterinary Medicine of the Oceanogràfic of Valencia. The objective of this Doctoral Thesis is to provide new information that increases the existing knowledge regarding the clinical and therapeutic management of elasmobranchs. This project is intended to provide results than can improve dosing regimens and optimize pharmacotherapeutic protocols of the anti-inflammatory drug meloxicam in sharks and skates. Furthermore, this Thesis also aims to increase the understanding and interpretation of the main hematological, biochemical, and plasma protein electrophoresis parameters in this group of animals. For the development of this work two model species have been used: the Nursehound Shark (*Scyliorhinus stellaris*), and the Undulate Skate (*Raja undulata*). These two species were selected because they are present in Spanish coastal waters, they are medium sized which allow a safe and easy handling, and both are present in most European public aquariums.

To achieve the proposed objectives, the experimental part of the Thesis that involved handling and sampling of elasmobranchs was carried out mostly in collaboration with the Oceanogràfic of Valencia. During the PhD program, multiple collaborations were also developed with different Spanish aquariums. Sampling was carried out in the following: Aquarium Finisterrae (Coruña), Bioparc Aquarium (Gijón), Cantabrian Maritime Museum (Santander), Acuario de Sevilla (Seville) and Poema del Mar Aquarium (Las Palmas de Gran Canaria).

We are currently working on writing the Doctoral Thesis Manuscript, which it is intended to be presented as a compendium of published works and defended at the Complutense University of Madrid in March-April 2023.

RESULTS OBTAINED:

To facilitate the interpretation and evaluation of the results achieved during 2022, the scientific activities conducted within the PhD have been divided into two sections: scientific publications and participation in conferences.

SCIENTIFIC PUBLICATIONS PRODUCED DURING THE LAST YEAR AND INCLUDED IN THE DOCTORAL THESIS WORK:

Article 1. Morón-Elorza P, Rojo-Solís C, Álvaro-Álvarez T, Valls-Torres M, García-Párraga D, Encinas T. (2022) Pharmacokinetic studies in elasmobranchs: Meloxicam administered at 0.5 mg/kg using intravenous, intramuscular and oral routes to nursehound sharks (*Scyliorhinus stellaris*). *Front Vet Sci* 9. [Q1 I₂=0.72 SJR Vet Sci 2021; Q1 (D1) I₂=3.47 JCR Vet.Sci 2021] <https://doi.org/10.3389/FVETS.2022.845555>

Article 2. Morón-Elorza P, Rojo-Solís C, Álvaro-Álvarez T, Valls-Torres M, García-Párraga D, Encinas T. (2022). Pharmacokinetics of meloxicam after single 1.5 mg/kg intramuscular administration to nursehound sharks (*Scyliorhinus stellaris*) and its effects on hematology and plasma biochemistry. *J Zoo Wild Med* 53 (2):393-401 [Q2 I₂=0.34 SJR Vet Sci 2021; Q4 I₂=0.806 JCR Vet Sci 2021], <https://doi.org/10.1638/2021-0144>

Article 3. Morón-Elorza P, Cañizares-Cooz D, Rojo-Solis C, Álvaro-Álvarez T, Valls-Torres M, García-Párraga D, Encinas T. (2022) Pharmacokinetics of the Anti-Inflammatory Drug Meloxicam after Single 1.5 mg/kg Intramuscular Administration to Undulate Skates (*Raja undulata*). *Vet Sci*, 9, 216. [Q1 I₂=0.52 SJR Vet Sci 2021; Q2 I₂=2,518 JCR Vet Sci 2021]. <https://doi.org/10.3390/vetsci9050216>

Article 4. Morón-Elorza P, Rojo-Solis C, Álvaro-Álvarez T, Valls-Torres M, García-Párraga D, Encinas T. (2022). Pharmacokinetics of meloxicam after multiple 1.5 mg/kg administration to nursehound sharks (*Scyliorhinus stellaris*). [Under review for publication in VAA Q1 I₂=0.58 SJR 2021 Vet Sci; Q2 I₂=1,763 JCR Vet Sci 2021].

Article 5. Morón-Elorza P, Steyrer C, Rojo-Solís C, Álvaro-Álvarez T, Valls-Torres M, Encinas T, Garcia-Parraga D. (2022). Hematology and Plasma Biochemistry Reference Values of Juvenile Undulate Rays (*Raja undulata*) Under Human Care. *J Zoo Wild Med* 53(3):504-514 [Q2 0.34 SJR 2021 Vet Sci; Q4 I₂=0.806 JCR Vet Sci 2021]. <https://doi.org/10.1638/2021-0140>

Article 6. Morón-Elorza P, Rojo-Solis C, Steyrer C, Álvaro-Álvarez T, Valls-Torres M, Encinas T, Garcia-Parraga D. (2022). Hematology and Plasma Chemistry Reference Values in Nursehound Sharks (*Scyliorhinus stellaris*) Maintained Under Human Care. *Frontiers Vet Sci* [Q1 I₂=0.72 SJR 2021 Vet Sci; Q1 (D1) I₂=3.47 JCR Vet.Sci 2021]. <https://doi.org/10.3389/fvets.2022.909834>



Article 7. Morón-Elorza P, Rojo-Solis C, Steyrer C, Álvaro-Álvarez T, Valls-Torres M, Encinas T, García-Parraga D. (2022). Increasing the Data on Elasmobranch Plasma Protein Capillary Zone Electrophoresis: Electrophoretogram Description and Reference Values in the Undulate Skate (*Raja undulata*) and the Nursehound Shark (*Scyliorhinus stellaris*) Maintained Under Human Care. *BMC Vet Res* 18, 380 [Q1 II=0.61 SJR Vet Sci 2021; Q1 II=2.792 JCR Vet Sci 2021]. <https://doi.org/10.1186/s12917-022-03478-z>.

PARTICIPATION IN NATIONAL AND INTERNATIONAL CONFERENCES DURING THE LAST YEAR:

October 17–22, 2022 – Participation with a poster at the International Conference “Sharks international”. Valencia Spain. Poster: Morón-Elorza P, Rojo-Solis C, Steyrer, C, Encinas T, Álvaro-Álvarez T, Valls-Torres M, Encinas T, García-Párraga D. Capillary Zone Plasma Protein Electrophoresis Analysis in Nursehound Sharks (*Scyliorhinus stellaris*) Maintained Under Human Care.

May 24–28, 2022 – Participation as a speaker at the International Conference “The Zoo and Wildlife Conference (EAZWV)” Emmen, The Netherlands. Lecture: Morón-Elorza P, Steyrer C, Rojo-Solis C, Encinas T, Álvaro-Álvarez T, Valls-Torres M, García-Párraga D. Blood cell morphology and hematology reference interval determination in nursehound sharks (*Scyliorhinus stellaris*) under human care.

May 16–26, 2022 – Participation as a speaker at the “International Association of Aquatic Animal Medicine (IAAAM)” Online. Lecture: Morón-Elorza P, Rojo-Solis C, Álvaro-Álvarez T, Valls-Torres M, García-Párraga D, Encinas T. Increasing the Dosage: Pharmacokinetics of Meloxicam after Single Administration of 1.5 mg/kg PO and IM in Nursehound Sharks (*Scyliorhinus stellaris*).

May 31–April 2, 2022 – Participation with a poster at the International Conference “II International Meeting on Zoo Research, Conservation and Biodiversity.

“Serengeti-Park” Hodenhagen, Germany. Poster: Morón-Elorza P, Steyrer, C, Rojo-Solis C, Encinas T, Álvaro-Álvarez T, Valls-Torres M, García-Párraga D. Determination of Juvenile Hematological Reference Intervals in the Undulate Skate (*Raja undulata*) under human care.

February 17, 2022 – Presentation entitled “Fish Medicine” at the Veterinary Conference of Master D Madrid (Spain).

CONCLUSIONS:

To conclude, I consider that being selected for the 2022 John L. Pitts Aquatic Veterinary Education Awards Program has been great help to enhance the work of my Doctoral Thesis during the last months. This award allowed me to enrich both the research and the divulgation activities included in my PhD, maximizing my possibilities to assist international conferences, gain valuable experience and share our work. For all this, I thank the World Aquatic Veterinary Medical Association and the John L. Pitts Aquatic Veterinary Education Awards Program.

*Figure 1. Above Left: Meloxicam IM administration to an adult Nursehound Shark (*Scyliorhinus stellaris*) during one of the pharmacokinetic studies included in the PhD. Quarantine facilities of the Oceanogràfic of Valencia Aquarium (Valencia, Spain).*

*Figure 2. Below: Adult Nursehound Shark (*Scyliorhinus stellaris*) maintained at “Puerto” exhibit, Oceanogràfic of Valencia Aquarium (Valencia, Spain).*



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John L. Pitts Aquatic Education Award Report
Emi Retter
NCSU CVM, Class of 2023

Thanks to the generous financial assistance of the John L. Pitts Aquatic Veterinary Education Award, I was able to complete a four-week externship at the Shedd Aquarium in Chicago, Illinois, in September 2022. I had the pleasure of learning from Drs. Matt O'Connor, Karisa Tang, Bill Van Bonn, and one of the current zoological medicine residents at the University of Illinois. The typical day varied greatly, and included wellness exams, quarantine exams, diagnostics, animal training, pathology, and surgery.

The best part about externing at Shedd was the diversity of species – I was able to participate in the care of teleosts, elasmobranchs, reptiles, amphibians, birds, and marine mammals. One of my most memorable patients was a silver carp with a head wound. I did my PhD research on silver carp in Illinois, and this fish is generally disliked in the United States due to its invasive nature and disruptive jumping behavior. I never would have imagined having a silver carp as a patient, let alone providing it with such a high standard of veterinary care! It was a “full circle” moment in my career, and I definitely appreciated the opportunity to participate in that case.



Photo 1.
Silver and bighead carps
from Shedd's collection.



Photo 2.
Venipuncture on a blue-tongued skink.

Other memorable patients include a baby bonnet-head shark that received a blood transfusion, the continuous parade of geriatric (and dramatic) penguins, and a three-month-old California sea lion that arrived at Shedd during my externship. The latter inspired my student presentation topic for the externship: neonatal care and hand-rearing of pinnipeds. As a self-proclaimed “fish person,” I was surprised at how much I enjoyed working with the marine mammals during this experience. Every day at Shedd was interesting!

While I learned a lot about medicine during this externship, I also learned a lot about the “soft skills” of veterinary medicine, such as how to manage aquarist/keeper expectations for a beloved patient, the importance of building trust with a team, and the role of the veterinarian in promoting changes in animal care. The veterinary team at Shedd works well with each other as well as with the rest of the aquarium staff, and it shows in the standard of care that they are able to provide to their animals. In my future career as an aquatic animal veterinarian, I aspire to treat both people and animals with the same kind of respect I observed at Shedd Aquarium.

I am honored to have received this award and would like to extend gratitude to WAVMA and the John L. Pitts Scholarship Committee for selecting me as a recipient.

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2023 John L. Pitts Aquatic Veterinary Education Awards Program



For Veterinary Students & Recent Graduates

This Program was established in 2010 to honor the contributions of **John Leland Pitts, DVM (1941-2009)** in advancing the discipline of aquatic veterinary medicine and his dedication to helping veterinary students and recent veterinary graduates navigate their way into highly rewarding careers in aquatic medicine.

The John L. Pitts Aquatic Veterinary Education Awards Program is pleased to offer financial support to veterinary students or recent graduates of recognized veterinary schools. The purpose of the awards are to provide an opportunity for recipients to explore a career in aquatic veterinary medicine. These activities or projects **must be completed between October 1, 2022, and February 1, 2024**. Current veterinary students and veterinarians who have graduated in the past 24 months are eligible for awards.

Applicants who are interested in aquatic medicine but have previously had limited ability or opportunity to get involved are **encouraged to apply**.

Awards (typically \$250-\$1,000) may be used towards offsetting personal costs for:

- Travel, accommodation, and/or registration at aquatic veterinary conferences, symposia and other continuing education and professional development (CEPD) meetings; including on-line CEPD
- Travel, accommodation, and other activities directly associated with externships or clinical experiences that expose individuals to aquatic veterinary medicine
- Equipment and supplies needed for aquatic veterinary research projects not funded by other sources



Individuals who receive an award must provide a written report after completing their activity for publication in *The Aquatic Veterinarian* and are encouraged to give a presentation about their experience to other veterinary students.

Applications

Applications will be accepted from veterinary students currently enrolled or recent graduates (within the past 24 months of the application deadline) of any veterinary school or college worldwide that awards a degree allowing the person to practice veterinary medicine. Incomplete applications and applications from previous recipients will not be considered. **Applications must be completed in English.**

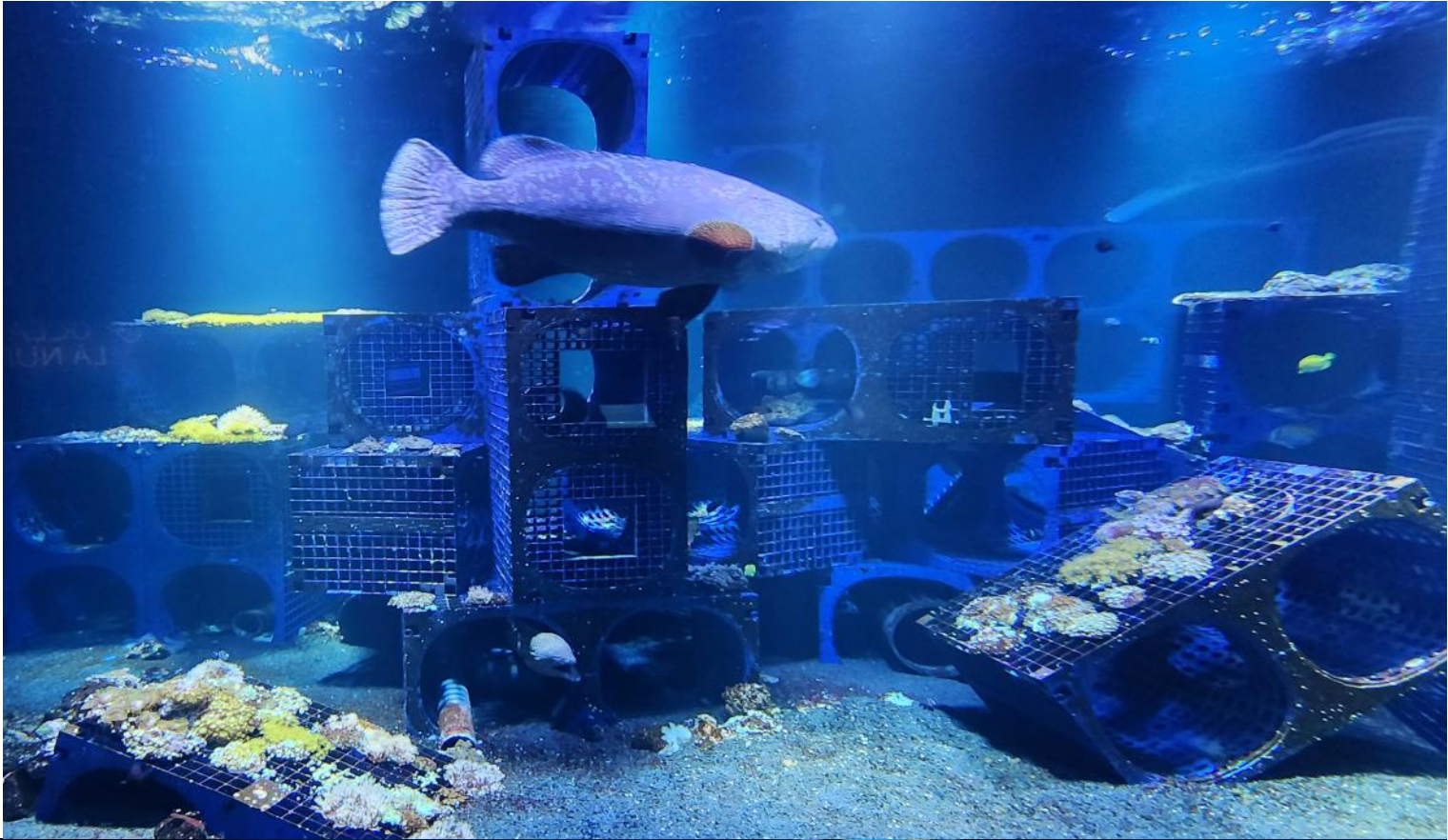
Applications will open **January 09, 2023** and the application form and additional information will be available at <http://www.wavma.org/scholarships>

Applications for the 2023 Program will close on March 01, 2023



Recipients will be notified around May 1st, 2023

Questions? Please contact PittsEduAwards-Admin@wavma.org



Display tanks of giant groupers and sea nettles at the Nausicaá Aquarium.
Photos by Komsin Sahatrakul, DVM, CertAqV



International Aquarium Congress (IAC2022)
Nausicaá, France

Komsin Sahatrakul,
DVM (Hons), CertAqV
Certified Aquatic Veterinarian (Singapore)



The 11th International Aquarium Congress (IAC) was held this year from 30 October to 4 November 2022 at the Nausicaá - Centre National de la Mer in Boulogne-sur-Mer, France. There were over 250 public aquarium professionals from all over the world attending the conference. With the support of the International Aquarium Network (IAN), the International Aquarium Congress is held every 3-4 years. The previous IAC took place in Fukushima, Japan in 2018. Due to unprecedented circumstances of the COVID-19 pandemic, we were unable to meet for over two years, and so, just like every other international conference, the IAC had to be postponed. As the border restrictions started to ease, IAC was able to occur in Boulogne-sur-Mer in November 2022 as a hybrid conference, both physical and virtual, which corresponds with the current situation.

More than 250 public aquarium enthusiasts from around the world attended the conference and brought together a wide range of topics to discuss how public aquariums can actively contribute to protecting our blue planet's ocean resources. Public aquariums are undoubtedly a crucial part of this sector, as they serve as a vital link between science and society, thus providing a unique opportunity to engage with nature in a meaningful way. Hence, they play a vital role in providing information about conservation, biodiversity, and the threats posed by man-made climate change, including bringing awareness to the public about actions that are taken.

Photos 1 and 2: *Dr. Alistair Dove from Georgia Aquarium presented the Stegostoma tigrinum Augmentation and Recovery (StAR) project, which takes a bold approach to conservation of the Zebra Shark (previous photo). Tom Verhoeven from De Jong Marine life discussed about marine ornamental fish culture in the future as a sustainable practice (below)*



The four-day conference was a great opportunity for participants to discuss a wide range of initiatives, best practices, and recent developments within the field. Over 80 presentations were delivered, and 200 public aquariums from five continents agreed on these three key points:

- Raising public awareness and mobilizing their audiences
- Commitment to the United Nations' sustainable development objectives through the Decade of Ocean Sciences
- Establishing educational and scientific programs

Participants were also allowed to visit the aquarium on their own during the conference. There are two trails for aquarium walking: Journey on the high seas, and Shore and mankind. Furthermore, participants also had the opportunity to participate in a variety of free activities, such as a behind-the-scenes tour, a spectacular augmented reality experience with GRAND LARGE at High Seas tank, a guided tour of the Boulogne-sur-Mer old town, and a visit to the fish market and fish auction.



Photo 3: Congress participants are offered exclusive tours behind the scenes at the aquarium.



Photos 7 and 8: Giant Manta Ray (above); This is an awe-inspiring exhibition in which you can immerse yourself in the deep blue sea by discovering through an incredible window (below).



Photos 4 and 5 (above): During our visit, the aquarium staff provided us with both knowledge and fun as we toured their facility.



Nausicaá aquarium is located in Boulogne-sur-Mer, just 2½ hours north of Paris. There are over 58,000 creatures, representing more than 1,600 species of aquatic animals. It was opened in 1991 and has welcomed over 19 million visitors since then. The aquarium is already one of the largest in the world and Europe’s biggest aquarium, and is continuing their development, adding to the facility’s size and length, which they began constructing in 2018, to complete its extension. Phase one has completed and is now operational, while phase two will open in the first half of 2025, after being postponed due to the COVID-19 pandemic.



Photos 9 and 10: Display of small sea creatures (above) and giant groupers (below).



Photo 6: Featuring a stunning viewing panel measuring 20 x 5 meters (100 square meters), High Seas habitat, is home to 40 species of sea creatures, including sandbar sharks, sardines, spinefoots, and of course, the giant oceanic manta ray.





Photos 11, 12, 13: A vibrant and beautiful coral tank.



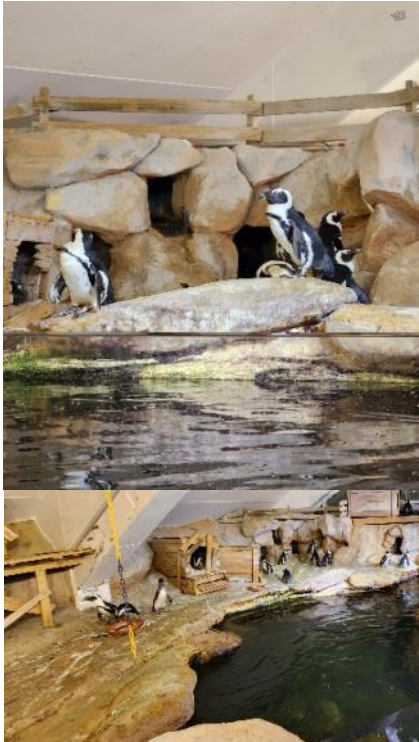
Photos 14 and 15: Touch pool tank (above and below).



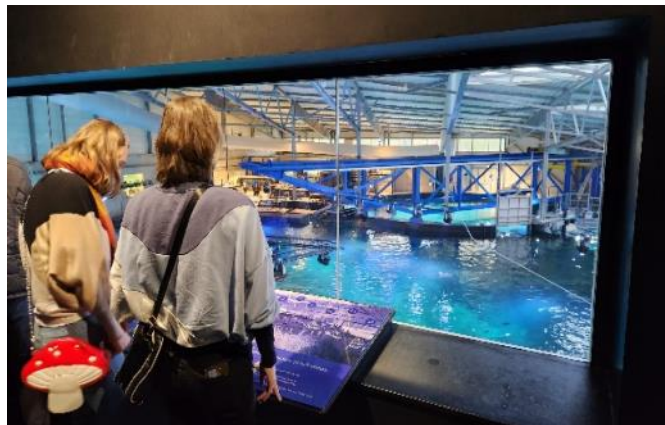
Photo 16: Freshwater exhibit (below).



Nausicaá Aquarium has done a fantastic job of displaying each habitat in a very appealing way. There have been a lot of technological advances used in the making of Nausicaá that have made it not only more than just a public aquarium, but an exciting, educational, and scientific attraction all at the same time.



Photos 17 and 18:
African penguin
display



Photos 19 and 20:
From the window, visitors can view the back of the house and the filtration system. Staff members were feeding sharks and manta rays on the image below.



Photos 21 and 22: At the end of the visit, audiences will encounter 'the Eye of the Climate' exhibition, which displays and raises awareness of climate change.



Finally, at the end of the conference, the participants enjoyed the opportunity to dine in front of Nausicaa's enormous High Seas tank during the post-conference Gala dinner. Certainly, both in terms of the food as well as the ambience of the dinner, it was a fantastic night. Nevertheless, attendees enjoyed the Mariachi band's performance, highlighting Mexico's upcoming hosting of the next IAC.



Photos 23, 24, 25: The gorgeous exhibit High Seas is the backdrop for the gala dinner.



À votre santé!

There is nothing better than good wine and a perfect lamb shank for dinner.



Determination of *Edwardsiella tarda* Median Lethal Dose (LD₅₀) in Nile tilapia (*Oreochromis niloticus*)

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Abstract

Edwardsiella tarda is a severe fish pathogenic bacteria circulating in both cultured and wild fish species, with a broad host range and geographical distribution. The experimental infection of Nile tilapia with *Edwardsiella tarda* was conducted to determine its Median Lethal Dose (LD₅₀). Fifty (50) live fish of 75 gram body weight were acclimatized and divided into 5 equal groups of 10 fish. Each group was randomly assigned to treatments of 10⁶, 10⁷, 10⁸, 10⁹ cfu/ml dilutions or control (PBS). Previously isolated laboratory stock of *Edwardsiella tarda* KOCT4¹, was intraperitoneally injected into each fish in the test groups respectively, while PBS was used for the control group. The calculated LD₅₀ value was 1.6x10⁸ and the infected fish showed hemorrhages, skin ulcers, swollen abdomen, vertical hanging and loss of pigment. Results from this study will be very useful for further pathogenicity studies and facilitation of vaccine development.

Key words

Edwardsiella tarda
Median Lethal Dose (LD₅₀)
Nile tilapia
Mortality

Introduction

Fish production has increased globally over the last several years with supply increasing at an average annual rate of 3.2 percent, outpacing world population growth at 1.6 percent (FAO, 2014). In 2016, production was estimated at about 171 million tons while world per capita apparent fish consumption increased from an average of 9.9 kg in the 1960s to 20.2 kg in 2016 (FAO, 2018). As a valuable source of animal protein, minerals and vitamins that are essential requirements in human diets, fish occupies a unique position in the agriculture sub-sector in the world economy with immense contribution to the

food and nutritional security, employment and national revenues (AU-IBAR, 2016). Aquaculture has the potential to make significant contributions to food, nutritional security and income generation. To meet the growing demand for food fish, there has been an effort to increase fish production through intensive farming in ponds and cages, especially on Lake Victoria in Uganda.

Due to increased intensification and rapid development of aquaculture in East Africa, the risk of fish diseases and disease outbreaks has also increased. Aquatic animal disease outbreaks impact aquaculture investments at farm and national levels, in terms of costs associated with disease management and reduced levels of production and returns (FAO, 2000). Bacteria are the most common pathogens of cultured warm water fish, and cause major losses to the freshwater aquaculture industry in the world. They are also the most prevalent cause of morbidity and mortality among wild fish populations. Out of the most annihilating bacteria, motile Aeromonads and *Edwardsiella sp.* are the most significant. *Edwardsiella tarda* is one of the commonly found pathogens causing diseases that lead to mass mortalities in various populations and age groups of fish (Mohanty and Sahoo, 2007).

Cases of aquatic disease leading to mortality rates of 60% have been reported in hatcheries and grow-out systems in Uganda (Akoll and Mwanja, 2012). Evidence from a number of studies shows that disease incidences in the aquaculture and fisheries industry have the capacity of causing huge economic loss, as occurred in Asian countries where massive expansion in the aquaculture industry preceded fish health capabilities, which cost the industry heavily (AU-IBAR, 2016).

Edwardsiella tarda is a Gram-negative, short, rod-shaped, facultative anaerobic bacterial organism of about 2–3 µm in length and 1 µm in diameter (Woo and Bruno, 2010). Generally they are motile, while isolates from red sea bream and yellowtail are non-motile (Matsuyama *et al.*, 2005). According to Ishihara and Kusuda, (1982), *E. tarda* can survive at 0–4% sodium chloride, pH 4.0–10.0, and 14–45°C. Its biochemical characteristics are catalase positive, cytochrome oxidase negative, indole and hydrogen sulfide production, glucose fermentation, and reduction of nitrate to nitrite (Woo and Bruno, 2010).

Edwardsiella tarda has been isolated in many fish farms in East Africa in both symptomatic and asymptomatic fish (Walakira *et al.*, 2014; Wamala *et al.*, 2018). *E. tarda* is known to affect economically important fish species, including Japanese eel (*Anguilla japonica*), red sea bream (*Pagrus major*), yellowtail (*Seriola quinqueradiata*), channel catfish (*Ictalurus punctatus*), and turbot (*Scophthalmus maximus*) worldwide (Yasunaga *et al.*, 1982; Nougayrede *et al.*, 1994). *Edwardsiellosis* has also led to serious economic losses in the production of olive flounder (Japanese flounder; *Paralichthys olivaceus*), the most important fish species in South

Korean aquaculture, with production valued at 489.7 billion Korean Won (40 922 MT), which corresponds to 56.5% of total fisheries production in 2010 (Bang *et al.*, 1992; KOSTAT, 2011). Despite several previous prevalence studies on *E. tarda*, its pathogenic count that amounts to LD₅₀ in Nile tilapia is somewhat unclear as it varies in different studies and has not been studied in Uganda. This study therefore estimated the LD₅₀ as the virulence evaluation for this bacterium in Nile tilapia in Uganda.

Study Design

The study was entirely experimental and Completely Randomized experimental Design (CRD) was used (random selection and random assignment to treatment and control groups). However, fish samples for the experiment were collected purposively as the target was on the source/farm with no history or signs and symptoms of parasites and diseases.

Sample size

The Resource Equation Method based on law of diminishing return (Charan and Biswas, 2013) was used to determine the sample size. This method was used as an option to the power analysis method, which requires standard deviation and effect size that must be gotten from similar previous studies or pilot studies of the same nature.

Sample size = Number of individual animals targeted in each group - Number of groups intended

Treatments

Fifty (50) live fish (75 g body weight) were collected from Aquaculture Research and Development Center of National Fisheries Resources Research Institute (ARDC-NaFIRRI) and transported in an open tank with aeration to Makerere University College of Veterinary Medicine, Animal Resources and Biosecurity for experimentation. Samples were divided into 5 equal groups of 10 fish, each group was randomly assigned to treatments of 10⁶, 10⁷, 10⁸ and 10⁹ cfu/ml dilutions with one overall control group. Before treatment, the fish were acclimatized for a period of two weeks in dechlorinated municipal water in 60 Liter plastic tanks, a quarter of the water was changed twice daily. All the fish were fed on 30% CP feed (2 mm pellets) at a rate of 3% body weight, except one day prior to and after inoculation or handling. Dissolved oxygen was maintained by continuous aeration and pH and temperature were monitored on a daily basis using a pH/Temperature meter throughout the experimental period.

Edwardsiella tarda KOCT4' was cultured in Tryptic Soy Broth and incubated at room temperature (25-27°C) for 24 hours, the concentration of the stock culture 1.5x10⁹ cfu/ml was determined by drop plate counting. The stock culture was subjected to serial 10-fold dilution to obtain 10⁹, 10⁸, 10⁷, 10⁶ cfu/ml solutions and used immediately. Fish were intraperitoneally (intracelomically) exposed by injection (using 25 gauge

needles on 1 ml syringes) with 0.1 ml bacterial suspensions in their respective dilution groups and 0.1 ml PBS for the control, after anesthesia with MS-222 at 100 mg/l. The experiment was monitored for a period of four weeks for mortalities and clinical signs.

Freshly dead fish were removed from tanks and recorded on a daily basis, when present. Freshly dead/moribund fish from each group were dissected and their liver, spleen, gut, gills and head kidney inoculated on Tryptic Soy Agar by stamp plating to confirm the presence of *E. tarda*.

LD₅₀ was calculated following the Reed and Muench (1938) method:

$$LD_{50} = \frac{[(\text{Mortality at dilution next above 50\%}) - 50\%]}{[(\text{Mortality next above 50\%}) - (\text{Mortality next below 50\%})]}$$

Data Analysis

Data on mortalities was entered, cleaned in Microsoft Excel and exported to SPSS for analysis by non-parametric Independent-Samples Kruskal-Wallis test, with 95% level of confidence to detect the effect of treatment.

Results

The first death in the experiment was recorded in 10⁷ dilution four days post infection (Table 1) and the first manifested clinical signs were hemorrhages on the skin and caudal fin. Pathological lesions in internal organs included tiny black spots in the liver and the kidney. The clinical signs observed were generally much more severe in fish infected with dilutions 10⁸ and 10⁹ regardless of number of days post infection than in other dilutions.

On the fifth day, the second mortality was recorded in 10⁶ dilution followed by one mortality in 10⁹, the last dilution to have first mortality was 10⁸ at day seven post infection (Table 1). The highest mortality (3 fish) in a single day was recorded in 10⁹ at day eleven post infection. No mortality was recorded in the control group throughout the experimental period. At day nine and day thirteen, no mortality was recorded in any of the dilutions. The LD₅₀ value was determined at the 14th day and the calculated value was 1.6x10⁸.

The experiment was further monitored up to day 28 post infection and after day fourteen, no mortality was recorded for four consecutive days in all dilutions until day nineteen in 10⁸ (Table 2). At twenty days post infection, all the fish in 10⁹ dilution had died and in 10⁸ the last fish died on day twenty two. By the end of the twenty-eight days of the experiment, four fish and seven fish survived in dilutions 10⁷ and 10⁶, respectively (Table 2). All the fish in the control survived.

E. tarda was recovered from dead fish after stamp plating the liver, kidney, gills, spleen and the intestines on nutrient agar plates and sub culturing on TSA plates. Small round raised whitish-cream colonies developed after 18-24 hours of incubation at room tem-

perature (25-27°C). The mean water temperature and pH throughout the experiment was $22\pm 1.6^\circ\text{C}$ and 7 ± 0.6 , respectively. There was no significant difference in percentage mortality of treatment among different concentrations, $p = 0.406$.

Table 1: Daily and total cumulative mortalities, percentages 14 days post infection

Dilution	Total Number of fish	Number of mortalities per day (Days 1-14)														Total mortality	Percentage mortality
		1	2	3	4	5	6	7	8	9	10	11	12	13	14		
1.5×10^6	10	0	0	0	0	1	0	1	0	0	0	0	0	0	0	2	20
1.5×10^7	10	0	0	0	1	0	0	0	1	0	0	2	0	0	0	4	40
1.5×10^8	10	0	0	0	0	0	0	1	2	0	0	2	0	0	0	5	50
1.5×10^9	10	0	0	0	0	0	1	0	0	0	2	3	1	0	1	8	80
PBS	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2: Daily and total cumulative mortalities, percentages 15th-28th day post infection

Dilution	Total Number of fish	Number of mortalities per day (15 th -28 th day)														Total mortality	Total Percentage mortality
		15	16	17	18	19	20	21	22	23	24	25	26	27	28		
1.5×10^6	10	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	30
1.5×10^7	10	0	0	0	0	0	0	1	0	0	0	1	0	0	0	2	60
1.5×10^8	10	1	0	0	0	1	1	1	1	0	0	0	0	0	0	5	100
1.5×10^9	10	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	100
PBS	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Discussion

The median lethal dose of bacterium is the assessment of the virulence which is determined by a number of mechanisms. The median lethal dose of *E. tarda* in Nile tilapia obtained in this study was found to be 1.6×10^9 cfu/ml at day 14 post infection. This revealed that the *E. tarda* strain KOCT4' was moderately virulent according to the degree of virulence as described by Pu *et al.* (2007). These results are similar to previous reports by both Baxa *et al.* (1990) and Mostafa *et al.* (2008) where *E. tarda* LD50 were determined at 7.9×10^8 cfu/ml and 2.8×10^8 cfu/ml with similar clinical signs and symptoms exhibited by the experimental fish at 5-7 days and 7-15 days post infection.

However, results in this study differ from LD50 values previously determined in a number of other studies. Abraham *et al.* (2015) calculated the value of LD50 to be 1.68×10^7 cfu/ml in a twenty-two days experiment. Also, Pridgeon *et al.* (2014) reported an LD50 value of *E. tarda* isolates from Southern flounder in Nile tilapia at 1.1×10^7 cfu/ml when Nile tilapia were exposed by intraperitoneal injection. Variations in median lethal dose values could probably be due to differences in the involved strains. Variations in strains of Nile tilapia used in these experiments could have led to differences in response to the infection and development of immunity against the pathogen over time. Furthermore, environmental conditions under which the experiments

were conducted may have influenced the virulence and pathogenicity of *E. tarda* (Leung *et al.*, 2012) following optimization strategies.

Infected fish clinically presented with hemorrhages, ulcers, swollen abdomen, vertical hanging, and loss of pigment. These observations are similar to what was reported earlier, although varied in LD₅₀ values. Differences in the days at which the fish died and the number of fish that survived as the days of the experiment increased suggests the differences in the development of immunity in individual fish's body against the pathogen, which could include response to stress by other fish in the same tank among others (Leung *et al.*, 2012). Fish that survived in pathogen concentrations of 10⁶ and 10⁷ until day 20 of the experiment could have fully developed immunity against *E. tarda*. This is supported by the fact that there were neither clinical signs nor pathological features of the disease in fish after 20 days of the experiment, which suggests that the pathogen can be found as well in fish that appear asymptomatic.

The ability of a pathogen to cause a disease depends on a number of factors and processes that interact and result into the disease (Park *et al.*, 2012; Roberts, 2012). Different clinical signs of the disease are attributed to different virulence factors of a particular pathogen. A number of virulence factors are known to facilitate the pathogenicity of *E. tarda*, the major factors are reported to be a Type III secretion system (T3SS), and a Type VI secretion system (T6SS), which are essential for the survival, replication and virulence of the bacteria in the host's body (Nakamura *et al.*, 2013; Xie *et al.*, 2014). They produce different effectors that exploit the host's environment. T3SS secretes needle complex proteins that make the pathogen able to avoid killing by phagocytes.

Edwardsiella tarda also has a range of regulatory systems that can react to environmental changes such as pH, temperature, osmolarity, presence of antimicrobial peptides and nutritional value changes or shortages that contribute to its survival in the host (Leung *et al.*, 2012; Mendez *et al.*, 2012; Park *et al.*, 2012). The initiation and expression of the pathogen's virulence factors depend on these environmental factors (Leung *et al.*, 2012). Ullah and Arai (1983b) demonstrated that *E. tarda* has exo-enzymes with haemolysins and dermatoxins activities which confer pathogenicity on the bacteria, and they have been associated with clinical signs like hemorrhages, ulcers and depigmentation in infected fish. These clinical signs were among those that were observed in this study, this together with the confirmed re-isolation of *E. tarda* from the kidney, liver, spleen and intestines of dead fish confirms that the development of the disease clinical signs and mortalities were due to the inoculated *E. tarda*.

Results of this study show that *E. tarda* is a virulent pathogen and could have been more virulent by enhancement through prior inoculation and re-isolation before using it for the main study. However, further

studies need to be done to clearly understand its pathogenesis in different species of fish using different doses and more exposure days. The results can also be used to carry out further studies on the ultimate effect of the pathogen on the general health of fish and the extent of damage to the economics of the farm, as well as the predisposing environmental conditions and fish husbandry practices.

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Conflict of interest

All the authors have no conflict of interest inline with publication of this paper

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WAVMA Student Chapter member Ryan presenting bouquet of thanks to President Gillian Taylor at the WAVMA Conference in South Africa.

Microplastics

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In March 2022, the Blue Growth Research Lab discovered microplastics in the human blood for the first time. How has this come so far? And what is more, what can we do to prevent further damage? In 2019, microplastics were identified as tiny pieces of plastics with a maximum size of 5 mm. There are two kinds of microplastics. The first sort of microplastics are the ones that are intentionally added to daily-life products, such as shampoo, toothpaste, face masks, etc. The second kind of microplastics are parts of bigger shaped plastics, for-example shopping bags, that erode into tiny fragments. The microplastics don't perish, but stay in the environment for many years (Bollain Pastor & Vicente Agulló, 2019).

Microplastics are everywhere in our daily lives. They are released from the plastic bottles we drink out of. The amount of plastic depends on the brand of the bottle (Song *et al.*, 2021). Fitting clothes can liberate tiny plastics which can be inhaled (Zhang *et al.*, 2020). Unintentionally, humans ingest and inhale 0.1 to 0.5 grams of microplastics via these ways (Senathirajah *et al.*, 2021).

Whereas microplastics themselves are a threat, they also tend to carry other contaminants with them, such as insecticides, toxins, microbes, viruses, and chemicals that adhere to them. This can possibly contribute to drug resistance (Hirt & Body-Malapel, 2020). It can even have an adverse effect on gut microbiota, which is very important in the health of both humans and animals. Further research must be done to examine the danger of chemicals being released from the microplastics in the body (Adamovsky *et al.*, 2021). High concentrations of microplastics can trigger hypersensitivity, detected by the increase of cytokines and histamines in human blood (Hwang *et al.*, 2019).

Not only humans are suffering the damage of the microplastics, the ocean also gets overloaded with floating and sinking microplastics. The waste in the ocean is estimated to be 150 million tonnes (Chandran *et al.*, 2020). The microplastics are hardly recognisable because they get overloaded with algae, which makes them look like natural fragments. This leads to marine organisms mistaking these microplastics for food. Their size and the annex of algae makes them look edible (Desforges *et al.*, 2015). The microplastics enter the organism by being eaten, or by being sucked in with water while breathing (Li *et al.*, 2021). This way, fish meal made from affected fish gets contaminated with microplastics, too (Wang *et al.*, 2022).

Oysters are filter feeders, filtering massive amounts of water through their gills. This is how they get infested with plastics that can interfere with their reproduction and offspring (Li *et al.*, 2021; Sussarellu *et al.*, 2016). The average contamination is 0.72 particles per individual (Keisling *et al.*, 2020). The amount varies in

the bays due to temperature, water circulation, and the nearby population (Lozano-Hernández *et al.*, 2021). The risk to the human health from eating oysters depends on whether the ingested microplastics are infused with chemicals, and by the size and form of the ingested microplastics. If the ingested microplastics are contaminated with chemicals, they can have an adverse effect to the oyster's health. They can lower micro-closure time or lower the growth rate. This is only due to the chemicals, which wouldn't be in the oysters if they weren't contaminating the microplastics (Bringer *et al.*, 2021). There is no proven harmful effect of eating oysters that ingested microplastics without chemicals (Smith *et al.*, 2018). Oysters can egest microplastics, but some of them do not, depending on size and form. The bigger the microplastic, the sooner it gets egested (Ward *et al.*, 2019).

Shrimps ingest microplastics from their food. The microplastics enter via the mouth, passing through to the stomach and only the smaller parts end up in the midgut gland. The hepatopancreas is not affected thanks to protection through the pyloric filter. The microplastics can stay for a long time in the stomach, but the duration of this stay doesn't affect the shrimp (Korez *et al.*, 2020). The microplastics loaded with chemicals can induce an immune reaction and react with the microbes, resulting in death of the shrimp (Hsieh *et al.*, 2021). Normally, the microplastics enter the intestines and they are excreted. The shape of the microplastic doesn't affect egestion in shrimp. In uptake of microplastics, only the size matters (Klein *et al.*, 2021). Large microplastics are kept apart and are egested. Small microplastics enter the gastro-intestinal system, resulting in oxidative stress (Saborowski *et al.*, 2022). The effect on humans when eating shrimp is very low because the head and intestines are thrown away (Lusher *et al.*, 2017).

Fish reject the microplastics with mucus. The rejective behaviour is selective and less prone to selection when there is food around the source (Ding *et al.*, 2021). Not all plastics are ejected, as they have been found in intestines and gills (Azevedo-Santos *et al.*, 2019). The amount is about 0.72 mg per individual (Thiele *et al.*, 2021).

Microplastics bruises the intestines. They affect respiration, development, metabolic process, and the immune system. Altogether, they cause trauma and dysbacteriosis (Qiao *et al.*, 2019). Dysbacteriosis modulates the immune system, which can reduce good physical condition and thus limit daily living (Fackelmann & Sommer, 2019). In real life, the burden is aggravated due to hazardous additions, sticking to the microplastics (Adamovsky *et al.*, 2021).

The answer to getting microplastics out of the seas and oceans remains unsolved, as the particles are so microscopic, they escape filtering and end up in the ecosystem. In Europe, there is an intention of prohibiting microplastics that are added to products. An effort will be made to use biodegradable plastics (Fältström

& Anderberg, 2020). Biodegradable plastics can be enzymatically recycled to no waste (Roohi *et al.*, 2017). In contrast with the non-degradable plastics, the alternative is expensive, which is what keeps people from using it (Yaguchi *et al.*, 2020). Once aware of the health risks, people can get motivated to use less plastics in their daily lives, creating a better environment for themselves and for the marine world (Garcia-Vazquez & Garcia-Ael, 2021).

Not everything is known about microplastics. Yet, the evolution to cope with alternatives is promising, but far from ideal.

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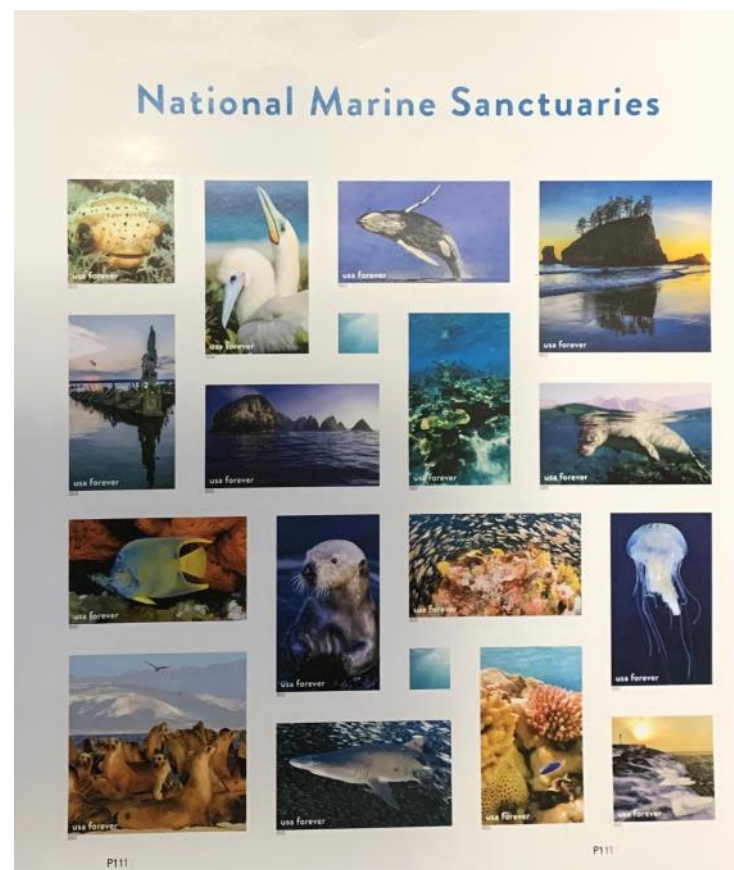
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2022 Stamps issued by the United States Postal Service commemorating preserving sea life in the National Marine Sanctuaries along the coasts of the USA.



Cephalic Sarcoma with Metastasis in an Adult Swell Shark (*Cephaloscyllium ventriosum*)Miceala M. Shocklee^{1,2}, Brittany N. Stevens^{2,3}, Michael M. Garner⁴, Lance M. Adams^{2,5}¹VCA West Los Angeles Animal Hospital, Los Angeles, California 90025, USA; ²Aquarium of the Pacific, Long Beach, California 90802, USA; ³California Science Center, Los Angeles, California 90026, USA; ⁴Northwest ZooPath, Monroe, Washington 98272, USA; ⁵Cabrillo Marine Aquarium, San Pedro, California 90731, USA**Key Words** – neoplasia, spindle cell sarcoma, elasmobranch, swell shark, neuroembryonal tumor**ABSTRACT**

In 2017, an adult female swell shark (*Cephaloscyllium ventriosum*) presented for rupture of the left globe that was initially treated with conservative medical management but ultimately required enucleation. Inflammatory changes to the surgical site were noted over the next three years, but the shark remained overall clinically well. In 2020, the swell shark developed loss of righting reflex and abnormal body posture. The neurological signs progressed despite treatment, and the shark was euthanized.

At necropsy, multiple masses were found throughout the body. Most notable was one mass extending from the remaining left orbital tissue along the optic nerve that encompassed the left cerebral hemisphere. Histologic analysis identified the brain lesion as a poorly differentiated spindle cell sarcoma present in the meninges and neuropil of the brainstem and midbrain. Metastases were identified in the musculature and skin of the right body wall, the gills, and an olfactory mucous membrane. Histologic findings most closely resembled a malignant meningioma. To the authors' knowledge, this is the first reported instance of a primary malignant sarcoma of eye or central nervous system with metastatic spread in an elasmobranch.

INTRODUCTION

There are an increasing number of reports of neoplasia in sharks, but the incidence of recorded metastatic neoplasia in elasmobranchs is comparatively scarce.¹⁻³ Accessing and assessing elasmobranchs for subtle physical and behavioral changes can have greater logistical challenges than with terrestrial species, making the antemortem diagnosis and subsequent treatment of neoplasia at any stage comparatively more difficult.

In this case report, the authors herein describe an adult female swell shark that presented initially with ocular and later with neurological signs that were attributed to a primary cephalic or ocular sarcoma with metastasis.

CASE PRESENTATION

In June of 2017, an adult female swell shark (*Cephaloscyllium ventriosum*) at the Cabrillo Marine Aquarium presented for left-sided corneal perforation resulting in left globe rupture with peri-orbital and scleral swelling and inflammation. The shark was otherwise clinically healthy. Initially, conservative medical management was elected and an ongoing course of enrofloxacin (Bayer Corporation, Leverkusen, Germany; 10 mg/kg PO in the feed every 2-3 days) was implemented. At recheck in August of 2017, the corneal lesion appeared thickened and opaque with scarring. The eye appeared grossly irregular in shape, but no ongoing exudate, discharge, or other gross signs of infection were noted. Conservative medical management was continued. At recheck in October of 2017, ongoing left corneal scarring was observed, but the remaining ocular tissues protruded from the orbit. The ocular tissue palpated as firm with no regions of flocculence. As the swell shark was eating well and behaving normally at that time, antibiotic treatment was discontinued.

The shark remained clinically well and the left ocular lesion was static until October of 2018, when the shark presented for changes to the protruding ocular tissue, which appeared proliferative and edematous. Palpation, external examination, and focused ultrasound did not reveal any areas of abscessation or any fluid-filled tracts. Another course of enrofloxacin (Bayer Corporation, Leverkusen, Germany; 10 mg/kg PO in the feed every 2-3 days for three weeks) was prescribed, and it was recommended to enucleate the eye if swelling and edema did not resolve.

At recheck in April of 2019, the ocular lesion was notably enlarged with firm white tissue that was suspected to represent granulomatous scarring of the eye and surrounding orbit. Due to incomplete healing of the lesion with medical management, surgical intervention was elected. In May of 2019, the swell shark underwent routine enucleation of the remaining left-sided ocular tissue, scar tissue, and orbital muscle and fat. The shark was sedated with 90 mg/L buffered tricaine methanesulfonate (MS-222) (Western Chemicals Inc., Ferndale, WA, USA) prior to the procedure.

Enucleation was performed in a routine fashion, with one ligation placed around the optic nerve and vessels with 2-0 polydioxanone (Monosorb). Hemostatic ligation was used to control the smaller bleeding vessels. The orbital space was closed with two mattress sutures using 2-0 Monosorb. The orbital margins were apposed in a simple interrupted pattern using 2-0 Monosorb. Post-operatively, a single injection of ceftiofur (Zoetis, Kalamazoo, MI; 200 mg/mL; 6.6 mg/kg IM once) was administered, and the shark was prescribed meloxicam (Dechra, Northwich, UK; 5 mg/mL; 0.5 mg/kg IM every 3-5 days for two weeks) and enrofloxacin (Bayer Corporation, Leverkusen, Germany; 10 mg/kg PO in feed every 2-3 days for 3 weeks).

In late May of 2019, prior to any suture removal, surgical site dehiscence occurred, so the swell shark was again anesthetized with 90 mg/L MS-222, and the surgical site was debrided and reclosed in a simple interrupted fashion using 2-0 Monosorb. Antibiotic regime was changed to oral chloramphenicol (AdvaCare Pharma, Cheyenne, WY; 250 mg capsules; 50 mg/kg PO in tube feedings every 3-4 days for 2-3 weeks).

At recheck in June of 2019, the surgical site was healing appropriately. The external sutures were removed at recheck in August of 2019, and the surgical site was topically flushed with diluted povidone-iodine (Betadine) (Purdue Pharma, Stamford, CT). An additional dose of ceftiofur (Zoetis, Kalamazoo, MI; 200 mg/mL; 6.6 mg/kg IM once) was administered at time of suture removal and once more a week later. Oral antibiotics were continued for two weeks following suture removal.

The shark remained clinically well for a year with no further surgical site complications. In June of 2020, the shark presented for one week's duration of anorexia and loss of righting reflex, wherein the shark would invert its body posture and rest in dorsal recumbency. Incidentally, it was also noted at this visit that the swell shark had a right pectoral girdle mass-like lesion that was later diagnosed through cytologic examination of a fine needle aspirate sample as an inflamed cyst. The shark was prescribed a course of ceftazidime (Novartis International AG, Basel, Switzerland; 20 mg/mL; 20 mg/kg IM every 3 days for a total of 7 treatments).

By July of 2020, the shark remained anorexic and the righting reflex had not normalized. To investigate a focus for the vestibular signs, a localized ultrasound of the left orbit, appropriately healed at this time, was performed, and no anechoic regions consistent with fluid pockets or draining tracts were observed. No abnormalities were noted on physical exam. Antibiotic treatment was changed to chloramphenicol (AdvaCare Pharma, Cheyenne, WY; 250 mg capsules; 50 mg/kg PO in tube feedings every 3-4 days for 2-3 weeks) to treat suspected encephalitis. Euthanasia was recommended if no clinical improvement were noted.

At recheck in August of 2020, the anorexia and loss of righting reflex had not improved. Due to challenges in providing medicated tube feedings, the treatment protocol was changed from oral to intramuscular delivery of chloramphenicol. However, by September of 2020, the shark's anorexia and loss of righting reflex had not improved, and the shark had developed a severe left-sided head turn and body curvature. Euthanasia was performed for humane and diagnostic purposes.

The shark was first anesthetized with 90 mg/L MS-222. Once the shark became unresponsive to tactile stimuli and opercular rate had slowed, 5 mL of sodium pentobarbital (SomnaSol) (Henry Schein Animal Health, Dublin, OH; 390 mg/mL pentobarbital) was administered into the caudal vein. Immediately following euthanasia, necropsy was performed, and tissues collected during necropsy were fixed in formalin and submitted for histologic analysis.

MATERIALS AND METHODS

Necropsy

At necropsy, two major findings pertinent to the neurological and ocular abnormalities were noted. The left orbit was filled with soft but solid off-white to tan material with areas of white, 0.5 cm or smaller nodules. The material tracked deep along the optic nerve to the optic foramen. In contrast, the right orbit and right optic nerve appeared normal. Additionally, a 10 cm x 10 cm irregular, tan, soft subcutaneous mass in the cranio-ventral body wall extended from the subcutis deep into but not through the muscle layer and did not breach the body wall.



Figure 1.
Excised calvarium with left orbit (lower side of photo) filled with white, firm, irregular tissue that extends into the calvarium. Grossly normal brain tissue is visualized between the orbits in the section. Partially-dissected normal right orbit with optic nerve visualized on upper side of photo. (Ruler numbered in centimeters)

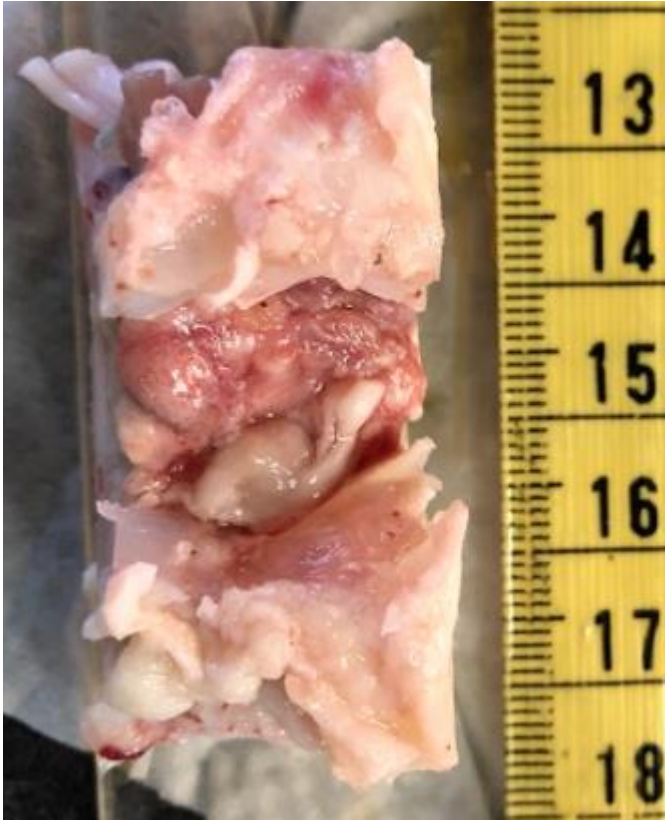


Figure 2.
Dorsoventral visualization of excised calvarium with abnormal space-occupying tan, left-sided intracranial lesion at ventral aspect of photo. Normal right orbit with optic nerve at dorsal aspect of photo.

Histologic examination

The ocular and cerebral invasive, mass-like lesion was described histologically as a poorly-differentiated sarcoma of the brain and meninges characterized by spindle cells with scant eosinophilic cytoplasm, mild to moderate anisokaryosis, vesicular nuclei, and a mitotic index of approximately 30. Occasional binucleated cells were seen. The neoplastic cells were arranged in interlacing streams, bundles, and short stacking palisades. Pseudorosette-like structures were noted in the neuropil. In some areas, cells were rounded and organized in loosely aggregated, disorganized sheets, and a few swirls of neoplastic cells were noted. The tumor was variably necrotic. There were a few metastatic foci of the tumor in the deep interstitium of the gill lamellae associated with fusion of the affected lamellae. Metastases of this tumor were also noted in a section of skin and the underlying skeletal muscle (the cranioventral subcutaneous mass), a mucous membrane lined by ciliated epithelium presumed to be endolymphatic duct, and one undetermined location that had no identifiable tissue boundaries.

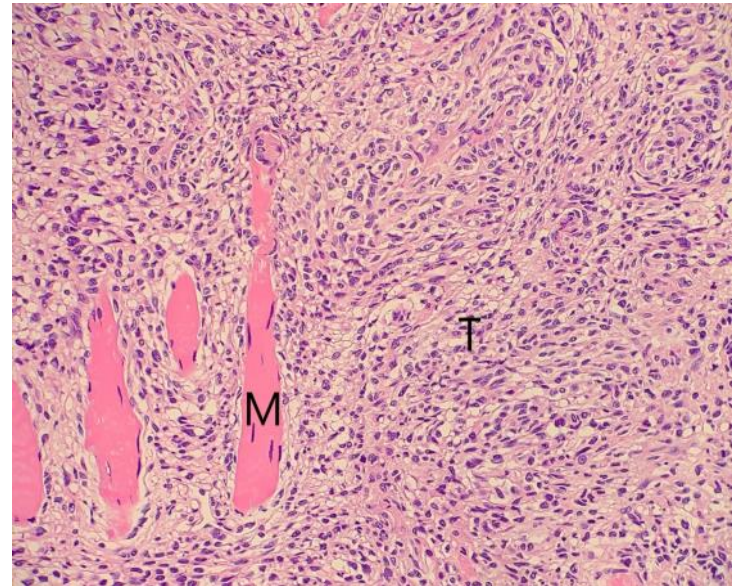


Figure 3.
Neoplastic spindle cells (T) infiltrating and separating the muscle (M).

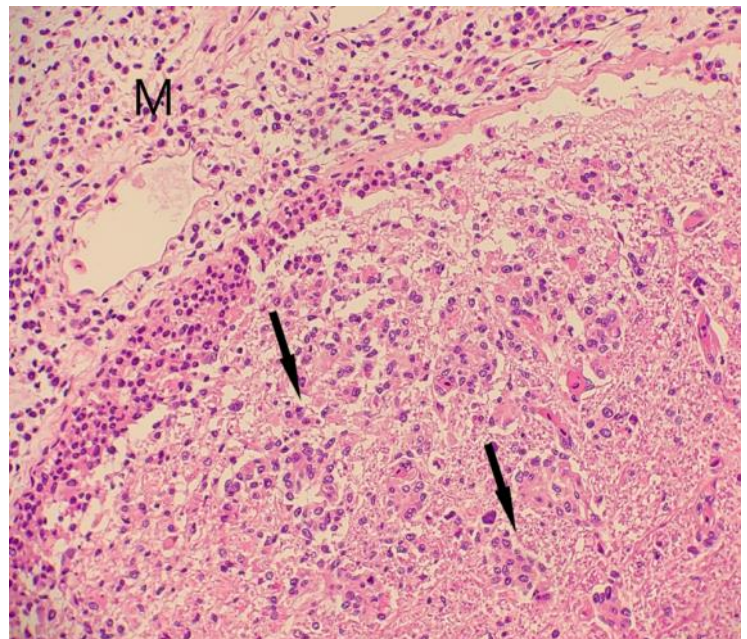


Figure 4.
Neoplastic cells extending into the meninges (M) and brain (arrows).

DISCUSSION

The term “spindle cell sarcoma” comprises any malignant tumor of connective tissue origin. Subsequently, spindle cell sarcomas can arise anywhere in bone or soft tissue. In small companion animal medicine, spindle cell sarcomas are often noted as a slowly-growing mass that palpates as fixed to the underlying tissue but with indistinct borders, correlating with a primary lesion and “tendrils” that extend into the surrounding normal tissue.⁴ Spindle cell neoplasms have been reported in elasmobranchs and have all been described as having a similar visual appearance and texture. Specifically, they have been described as white, off-white, or tan with firm but often irregular margins and occasional nodular appearance.^{2, 9-12} It is suspected that the ocular lesion was a slow growing neoplastic process, which eventually projected “tendrils” throughout the orbit and into the meninges and brain. The visual appearance of the metastatic muscular lesion was similar. Unfortunately, the enucleated eye was not examined histologically.

While the overall reported incidence of neoplasia in elasmobranchs is small compared to that in companion animal medicine, the *Registry of Tumors in Lower Animals* has reported a total of seven incidences of neoplasia within the family Scyliorhinidae, two of which were reported in swell sharks. The tumors included an enteric adenoma/carcinoma, a cutaneous odontoma, a cutaneous osteoma, a cutaneous epithelioma, a cutaneous chondroma, and the two tumors that were reported in swell sharks specifically were a hepatic fibroma and a hypodermal lipoma.^{2, 3}

Other neurological tumors reported in elasmobranchs, all of which have been benign, have included an olfactory neuroblastoma in a spotted ratfish (*Hydrolagus colliei*), a neurofibroma in a longnose spurdog (*Squalus blainvillei*), a choroid plexus papilloma and a vertebral chondroma in spiny dogfish (*Squalus acanthias*), a lumbar vertebral chondroma in a shortspine spurdog (*Squalus mitsukurii*), and a pituitary adenoma in a zebra shark (*Stegosotoma tigrinum*).^{2, 3, 5}

Other spindle cell sarcoma-like neoplasms reported in elasmobranchs have included cutaneous fibrosarcoma in a blacktip shark (*Carcharhinus limbatus*), gray skate (*Dipturus batis*), and bull shark (*Carcharhinus leucas*); a cutaneous or other fibroma in thornback skate (*Raja clavate*); cutaneous myxofibroma in a thornback skate (*Raja clavate*); cutaneous chondroma in a small-spotted cat shark (*Scyliorhinus canicula*), and a subcutaneous fibrous hemangioma in a stingray (*Dasyatis*, no species indicated). A fibroepithelial lip polyp in a great white shark (*Carcharodon carcharias*) has also been reported.^{2, 3, 6}

Based on the suspected primary location, progression, and histologic characteristics of the spindle cell sarcoma noted in this swell shark, the primary tumor is suspected to be a neuronal embryonal tumor, such as a neuroretinoblastoma. Other neuronal embryonal tu-

mors include medulloepitheliomas, neuroblastomas, retinoblastomas, ependymoblastomas, and primitive neuroectodermal tumors (PNETs). Neuronal embryonal tumors arise from neuroectodermal progenitor cells within the subependymal matrix layers. They share a common morphology and aggressive behavior.⁷ While neuronal embryonal tumors are common in teleosts, they have not yet been reported in elasmobranchs.^{1, 5, 8}

Of speculative interest for the case reported here is that while the meloxicam is not a verified sole therapy for spindle cell sarcoma, in small animal companion medicine, one treatment for spindle cell sarcomas is metronomic chemotherapy, in which a non-steroidal anti-inflammatory drug is administered along with a daily dose of chemotherapy.^{4, 13} The swell shark did receive meloxicam as part of its initial treatment, prompting the question of whether this aspect of treatment may have slowed the growth of the sarcoma and/or ultimate onset of neurological clinical signs. This observation suggests that it may be worthwhile to investigate whether non-steroidal anti-inflammatory therapy alone may slow growth of some tumors in sharks.

ACKNOWLEDGMENTS

The authors wish to thank the Cabrillo Marine Aquarium staff for their dedicated care of this animal and for their collaboration. The authors also wish to thank the Aquarium of the Pacific for support of this project and of the externship program.

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FAI Launches World's First Tilapia Welfare App

International food animal solutions company FAI Farms (FAI) has launched an online application for fish farmers around the world in an effort to improve welfare and profitability, beginning with tilapia farms. The company is now seeking partners in the hatchery, farming and processing sectors.

Working with scientists and farmers in Brazil, Thailand and China, FAI has developed a farmer-led bottom-up approach to improve fish welfare and profitability. FAI's free to use Tilapia Welfare App operationalizes scientifically validated welfare indicators for health, environment, behaviour and nutrition. This allows farmers' own observations to help determine what good welfare for tilapia looks like.

"Who cares the most about tilapia welfare? We believe farmers are the most important actor to drive welfare improvements in aquaculture. Farmers are an untapped force for good whose power can be unleashed through practical farm assessments that align business and welfare objectives," said Øistein Thorsen, CEO of FAI.

The Tilapia Welfare App integrates well-established animal welfare science into farmers' daily routines. The app monitors progress, identifies improvement opportunities and provides real-time insight to users, supported by online training in multiple languages.

"We are now looking for partners – farmers, production companies, hatcheries and processors – who want to trial the app and start assessing their fish in order to improve welfare, production outcomes and profitability. Our experience is that assessments kick-start a positive spiral of improvements," said Murilo Quintiliano, FAI Director.

Through real-time feedback the Tilapia Welfare App helps tilapia farmers achieve win-win improvements for the benefit of farmers and animals alike. It is designed to be applied by farmers at the hatchery, farm and slaughter stages in any part of the world.

Early collaborators, like Paolo Tahara, owner of Brazilian tilapia farm Tahara Pescados, are already seeing the benefits: "I supply tilapia to the local market, and I am using the knowledge from the FAI assessment to reduce losses, secure constant improvements and stay on track."

The mobile app can be used as a farmer self-assessment, or as a second- or third-party assessment tool, and results can be shared with customers and stakeholders, including certification bodies. The app monitors progress, identifies improvement opportunities and provides real-time insight to users, supported by the free e-learning suite.

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Questions & Answers from the WAVMA Listserv
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Protozoal parasites in an ornate cowfish

Hello WAVMA,

I am hoping for some clever help in identifying two types of parasites that I found in very large number on skin scrape of tissue from a deep wound on an ornate cowfish (*Aracana ornata*) that lives in a zoo collection.

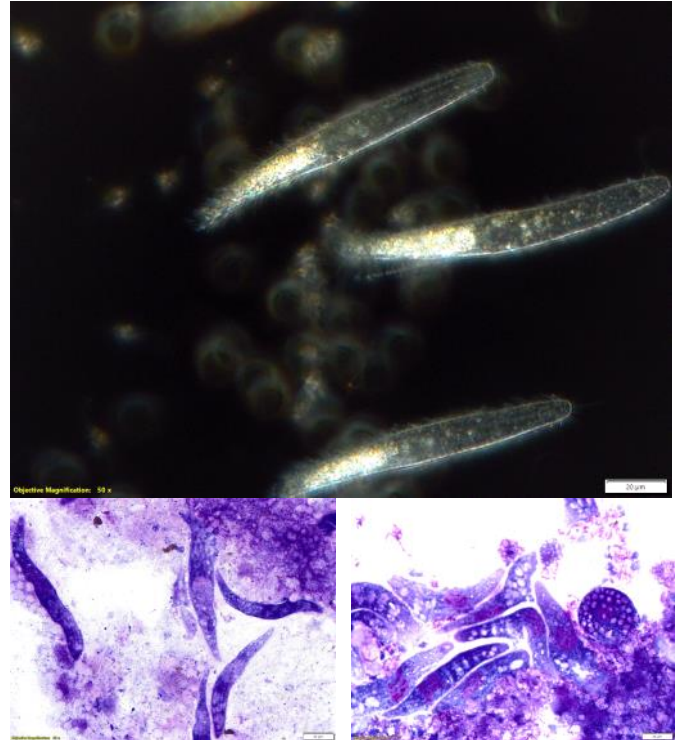
One organism appears to be a large, elongate ciliate with a "mouth-like" feeding structure. The second organism appears to be a much smaller, ovoid flagellate with a fast-moving "whip" at one end. I hope these photos and videos attached will help with their identification, but I haven't had much luck so far from just browsing fish medicine and protozoa textbooks.

I have been trying to treat this wound topically with a metronidazole-infused polymer dressing, and florfenicol for secondary bacterial infection. But the wound is getting larger despite my attempts at treatment.

Much appreciate any help or advice on this case. Or if anyone could point me towards a good key/resource that could help me work out what kind of protozoal creatures I am looking at.

Kind regards,

Dr. Christina Cheng
BVSc, MMarAntSc, MVSc (Microbiology),
MANZCVS (Medicine of Zoo Animals)
Veterinarian
Melbourne Zoo (Zoos Victoria),
Melbourne, Victoria, Australia
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zoo.org.au



Photos above: motile, elongated and ciliated organism found on cowfish skin scrape biopsy.

If the elongated organism is in range of a few tens to few hundred micrometers, it is closely resembling oncomiracidia life stages of some Microcotylinae (marine fish parasites) trematodes.

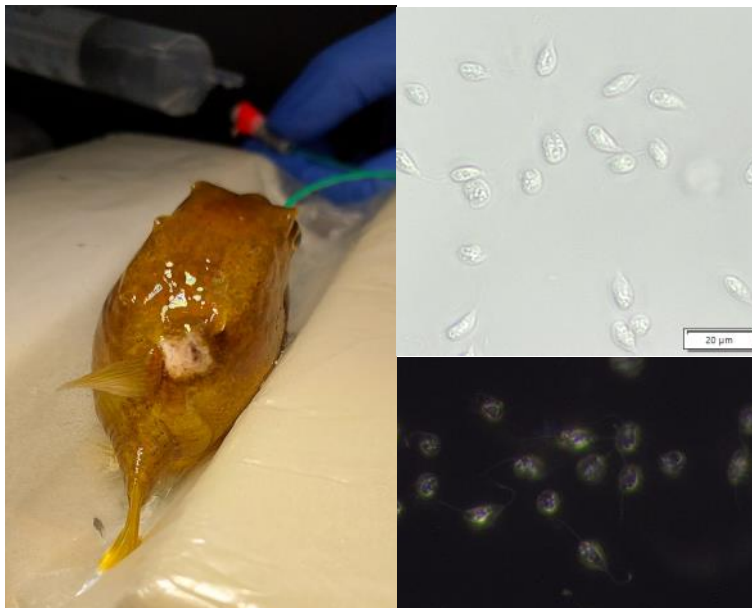
Best,
Dušan Palik, DVM, CertAqV

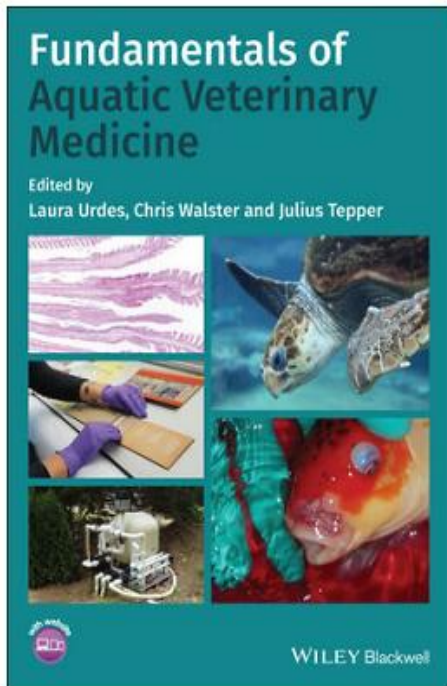
You can try treating the fish orally (tube feeding) with Praziquantel 5-10 mg/kg BW daily to reduce the trematodes. It can also be added to the water at 10 mg/L, but is broken down by biofilter bacteria, so dose needs to be repeated. The flagellated protozoa can be treated with the Metronidazole orally as well, adding 10 mg/gram of food. Feed daily for 10 days. Metronidazole can be added to the water at 50 mg/L daily for 5-10 days.

Nick Saint-Erne, DVM, CertAqV

Photo far left: Ornate cowfish under anesthesia for examination of wound on back.

400x magnification of light-field and dark-field images of flagellated protozoa found on skin biopsy.





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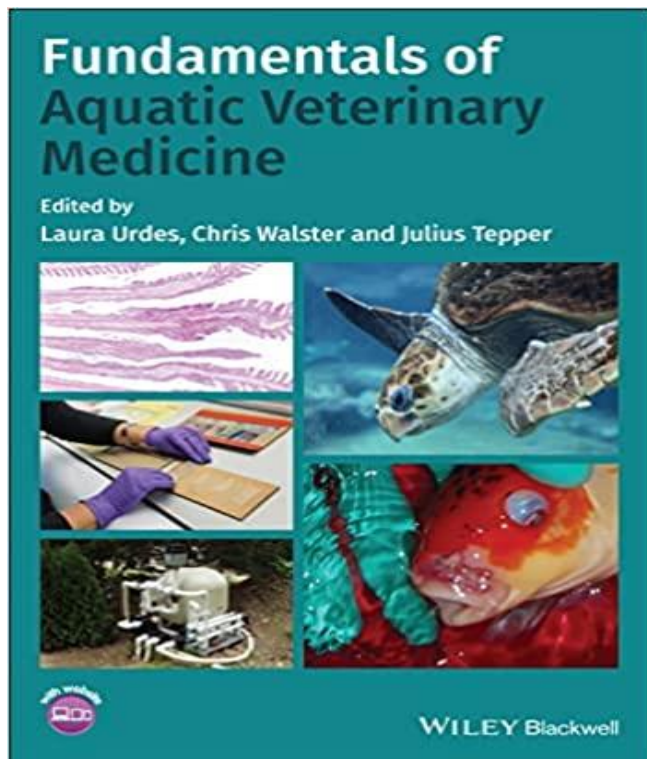
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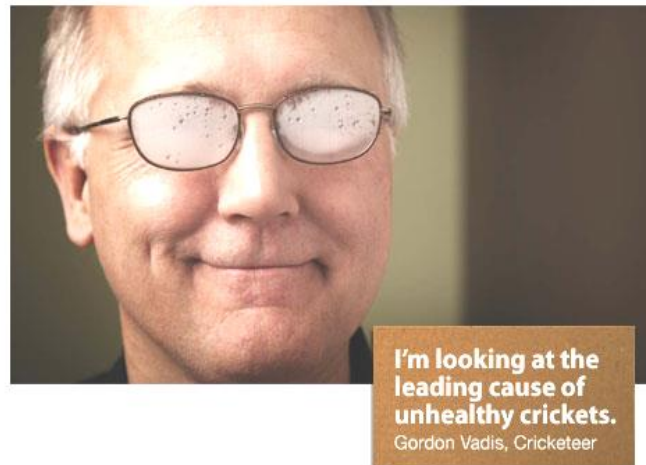


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The Aquatic Veterinarian 2022 Index:

[Key = Volume (Issue) Page Number]

Editorial

Editor's Note 16(1)4, 16(2)4, 16(3)4, 16(4)4
Advertising Rates 16(1)4, 16(2)4, 16(3)4, 16(4)4

Executive Reports

President's Report 16(1)5, 16(2)5, 16(3)5, 16(4)5
Secretary's Report 16(1)6, 16(2)7, 16(3)8, 16(4)6
Executive Board 2022 16(1)7
Executive Board 2023 16(4)7
Executive Board Responsibilities 16(1)7, 16(2)6,
16(3)9, 16(4)8
WAVMA Conference and AGM Update 16(3)6-7
New WAVMA Members 16(3)9, 16(4)8

Committee Reports

Join a WAVMA Committee 16(1)8, 16(2)8, 16(3)10,
16(4)18
WAVMA Committees 16(1)8, 16(2)8, 16(3)10, 16(4)18
Meetings Committee 16(2)9, 16(3)11, 16(4)19
Fellows Advisory Council 16(1)9, 16(2)9, 16(3)11,
16(4)19
WAVMA Fellows 16(1)9, 16(2)9, 16(3)11, 16(4)19
Credentialing Committee 16(1)10, 16(2)10, 16(3)12,
16(4)20
Certified Aquatic Veterinarians 16(1)10-11, 16(2)10-11
16(3)12-13, 16(4)20-21
WAVMA Student Chapters 16(1)12, 16(2)12, 16(3)14,
16(4)22
New WAVMA Student Chapter: St. Matthew's
University 16(1)13
St. George's University Chapter Report 16(1)14
New WAVMA Student Chapter: Makerere University,
Kampala, Uganda 16(2)19
Turtle Shell Repair Wet Lab at The Ohio State
University, by Zixin (Andy) Yu 16(1)18
WAVMA Student Chapter Report: Murdoch
University 16(1)13, 16(3)15
WAVMA Student Chapter Report: Michigan State
University College of Veterinary Medicine 16(4)23
John L. Pitts Aquatic Education Committee 16(4)17

Pitts Aquatic Veterinary Education Award Reports:

Kristina "Krisy" Kelley 16(1)16
Sampada Devkota 16(2)13
Maural Sowlat 16(2)14
Danielle Scott 16(2)16
Jake Veilleux 16(2)18
Annie K. Clift 16(2)20
Michelle Greenfield 16(3)16
Carrick Anderson 16(3)18
Jill Western, DVM 16(4)26-27
Pablo Morón-Elorza 16(4)28-29
Emi Retter 16(4)30

Conference Reports

WAVMA Conference and AGM Report 16(4)9-15
47th WSAVA Congress in Lima, Peru 16(4)16-17
71st IVSA Congress, São Paulo, Brazil 16(4)24-25
11th International Aquarium Congress 16(4)34-37

Aquatic Vet News

Public Comments Invited for Fish Practice
Specialty Board Certification 16(1)19, 16(2) 17
Syndel's Syncaine® approved in the UK 16(1)19
AQUAVET 1 Report by Nick Saint-Erne 16(2)26-27
AQUAVET 2023 Information 16(3)24, 16(4)
FAI Launches World's First Tilapia Welfare App
16(4)50

Colleague's Connection

Dr. Greg Lewbart 16(1)20-21
In Memoriam: Dr. Sam Ridgway 16(2) 22-23
In Memoriam: Dr. Donald Abt 16(3)25
Dr. Stephen Reichley 16(3)26-27

Centerfold

Koi Pond at Iguanaland 16(1)22-23
AQUAVET students during the fish anesthesia and
surgery session, 16(2)24-25
Shark Reef Aquarium, Las Vegas, Nevada
16(3)20-21
Sea nettles at the Nausicaá Aquarium, France
Photos by Komsin Sahatrakul 16(4)32-33

Aquarium Reports

Iguanaland, Punta Gorda, FL 16(1)24-25
Shark Reef Aquarium, Las Vegas, Nevada
16(3)22-24
Nausicaá Aquarium, France
by Komsin Sahatrakul 16(4)32-37

Grand Rounds Cases

Treatment options for resistant Monogeneans
(Gyrodactylids) 16(1)26
Koi Body Deviation 16(1)27
Water Turtle Shell Disease 16(2) 28
Guppy Mortalities 16(2)29
Angelfish Lesions 16(3)30
Protozoal parasites in an ornate cowfish 16(4)51

Research and Case Reports

Utilization of Photobiomodulation to heal a
Chronic Wound in a Plecostomus 16(1)28-29
Maroon Clownfish (*Premnas biaculeatus*) infested
with *Uronema marinum*: A case report
by Alex J. Hall 16(3)28-29
Determination of *Edwardsiella tarda* Median
Lethal Dose (LD50) in Nile tilapia 16(4)38-42
Microplastics, by Greta Van De Sompel 16(4)43-45
Cephalic Sarcoma with Metastasis in an Adult
Swell Shark 16(4)46-50

Literature Review

New Book: Fundamentals of Aquatic Veterinary
Medicine 16(1)30-31, 16(2)30-31, 16(3)32-33,
16(4)52-53

Aquatic Veterinary CE & PD

International Symposium of Fish Parasitology 16(1) 32,
16(2)32

E-lasmo Conference 16(1)33

Health and Colony Management of Laboratory Fish
16(1)34, 16(2)36

Aquaculture Europe 2022 16(1)34 , 16(2)36

47th World Small Animal Veterinary Association
Congress & XVIII FIAVAC Congress 16(2)33,
16(3)34,

Antimicrobial Resistance Workshop 16(2)34

AAFV 10th Anniversary Conference 16(2)35, 16(3)34,
16(3)36,

World Aquatic Health Conference 2022 16(3)6, 16(3)31

38th World Veterinary Association Congress 16(3)35,
16(4)55

WORLD AQUACULTURE SINGAPORE 16(3)35

Connectivity for good webinar: why better connected fish
farms will lead to healthier fish 16(3)35

AQUAVET 2023 Information 16(4)54

International Aquarium Congress 16(4)55

Project Piaba 16(4)56

Sponsors

WAVMA Shop 16(1)9, 16(2)9, 16(3)11, 16(4)19

AquaDocs Podcasts 16(1)18, 16(2)15, 16(3)17, 16(4)25

Syndel 16(1)19

The Bug Company 16(1)31; 16(2)31, 16(3)33, 16(4)53

API Mars Fish Care 16(1)35, 16(2)37, 16(3)37, 16(4)57

ZooMed Laboratories 16(1)36, 16(2)38, 16(3)38, 16(4)62



*More photos from the WAVMA Conference
in Pretoria, South Africa, December 2022.
Conference photos in this issue are by
Gillian Taylor, Roy Yanong, Julius Tepper,
Bart Gorgoglione and Nick Saint-Erne.*

The Aquatic Veterinarian Comprehensive Index:

Selected Compiled Articles from *Aquatic Vet News* (AVN) and *The Aquatic Veterinarian* (TAV)

[Key = Volume (Issue) Page Number]

Featured Public Aquariums

Vancouver Aquarium, Canada - AVN 2(4) 21
 New York Aquarium, New York - TAV 7(1) 33
 Waikiki Aquarium, Hawaii - TAV 7(2) 12
 Melbourne Aquarium, Australia - TAV 8(1) 32
 Mote Marine Lab and Aquarium - TAV 8(4) 20-21
 The Georgia Aquarium, Atlanta, GA - TAV 9(1) 22-26
 The Shedd Aquarium, Chicago, Illinois - TAV 9(2)29-30
 Monterey Bay Aquarium, California - TAV 9(3) 28-30
 OdySea Aquarium, Scottsdale, Arizona - TAV 10(4)32-35
 S.E.A. Aquarium, Singapore – TAV 10(4)40-43;
 12(4)26-29
 National Aquarium, Baltimore, Maryland -11(2) 17
 A Visit to River Safari, Singapore - 12(1) 20-21
 New England Aquarium, Boston, Massachusetts -12(2)23
 Dallas North Aquarium, Dallas, Texas – 13(1) 18-21
 Florida Aquarium, Tampa, Florida—13(2) 20-23
 South Carolina Aquarium, Charleston, SC - 13(3)20-23
 Wildlife World Zoo and Aquarium, Litchfield Park,
 Arizona— 13(4) 22-25
 Arizona-Sonora Desert Museum, Tucson,
 Arizona – 14(1) 18-23
 Sharks at the OdySea Aquarium, Scottsdale,
 Arizona - 15(1):18-19
 Ribeiro Frio Aquaculture Station Tour - 15(3):20-21
 LiveAquaria, Rhinelander, Wisconsin - 15(4):20-21
 Iguanaland, Punta Gorda, FL - 16(1)24-25
 Shark Reef Aquarium, Las Vegas, Nevada -16(3)22-24
 Nausicaá Aquarium, France by Komsin Sahatrakul -
 16(4)32-37

WAVMA Annual General Meeting Reports

Washington, DC, USA - July 18, 2007; AVN 1(1):1-2
 Vancouver, BC, Canada - July 27, 2008; AVN 2(3):1-6
 Seattle, WA, USA - July 14, 2009; AVN 3(3): 6-7
 Athens, Greece - July 14, 2010; AVN 4(3): 26-27
 St. Louis, MO, USA - July 18, 2011;
 San Diego, CA, USA - August 6, 2012; AVN 6(3): 5
 Prague, Czech Republic - September 18, 2013;
 TAV 7(3): 7, 10-11
 Denver, CO, USA - July 24, 2014; TAV 8(3): 4-6
 Istanbul, Turkey - September 15, 2015; TAV 9(4): 12-15
 San Antonio, Texas USA – August 6, 2016;
 TAV 10(3):12-13
 Targu Mures, Romania—September 13, 2017;
 11(3) 14-15
 St. Kitts, BWI—November 10, 2018; 12(4) 12-15
 Toronto, Canada—July 15, 2019; 13(2) 7 and 16
 Virtual AGM—November 7, 2020; 14(4) 10-11
 Virtual Meeting - December 22, 2021; 15(4):5
 University of Pretoria, South Africa - December 2022;
 16(4)9-15

Index to WAVMA Member Profiles in the Colleagues' Connection and Student Committee Reports

AVN = Aquatic Vet News (2007-2012)
 TAV = The Aquatic Veterinarian (2013-2021)
 SC = Student Committee Report

Key = Volume (Issue) Page number

Listed in alphabetical order by last name

Donald Abt - 16(3)25
 Jessira Amesquita-Sosa - TAV 15(2):16 SC
 Carrick Anderson - 16(3)18 SC
 Kurt Arden – TAV 9(3) 20 SC
 Barry Baker – AVN 6(1) 6 SC
 Kendra Baker – TAV 9(2) 18 SC
 Meg Baker – TAV 10(1) 14 SC
 Elizabeth Bamberger – TAV 8(4) 19
 Wes Baumgartner – TAV 8(3) 17
 Brandon Boren – AVN 5(2) 6 SC
 Shane Boylan - TAV 13(3) 16-19
 Lydia Brown – TAV 8(2)18; TAV 8(3) 18
 Alyssa M. Capuano - TAV 12(3) 22 SC
 Julie M. Cavin - TAV 11(1) 16
 Erica Chang - TAV 15(1)14 SC
 Bryony Chetwynd-Glover –TAV 13(3) 24-27 SC
 Hui Nee Chin – TAV 8(4) 18 SC
 Leigh Clayton - TAV 11(2)16
 Annie K. Cliff - 16(2)20 SC
 Lori Corriveau – AVN 3(1) 7
 Brett De Poister – AVN 6(3) 6 SC
 Emily Denstedt – AVN 6(2) 6 SC
 Sampada Devkota 16(2)13 SC
 Jessica Dewar – TAV 8(2) 16 SC
 Kyle Donnelly – TAV 7(3) 12 SC
 Devon Dublin – AVN 4(2) 9; AVN 4(3) 11;
 TAV 8(3) 16; TAV 11(3) 12
 Azureen Erdman – TAV 14(1) 14-17
 Mohamed Faisal – TAV 9(4) 24
 Susan Fogelson – TAV 8(3) 14 SC
 Ari Fustukjian — TAV 13(2) 18-23
 Ian Gardner – AVN 5(3) 13
 Joe Gaydos – TAV 10(4)21
 Michelle Greenfield - 16(3)16 SC
 John Griffioen - 10(3) 15 SC
 Chad Harris – TAV 8(3) 18; TAV 9(4) 25
 Leighanne Hawkins - TAV 13(4) 19
 Ashley Heard-Ganir – TAV 9(4)20 SC
 Nora Hickey – TAV 8(1) 16-17 SC; TAV 9(4) 21 SC
 Rob Hildreth – AVN 2(3)29
 Nicole E. Himebaugh—TAV 12(3) 20 SC
 Elizabeth Hodges – TAV 8(3) 14-15
 John Howe – AVN 6(2) 10; TAV 13(2) 17
 Sara Huckabone – TAV 8(2) 15 SC
 Ericka Johnson - TAV 15(2):22-23
 Sharmie Johnson – TAV 13(4) 20-21
 Colin Johnston – AVN 3(3) 11
 Timothy Jones – AVN 5(1) 9 SC
 Kirstin Kamps – AVN 4(4) 6, SC; AVN 5(1) 7 SC;
 Myron Kebus – AVN 2(4) 14-15; TAV 7(4) 12-13

- David Kestenman – AVN 5(1) 18-19
 Sangwha Kim – TAV 10(2) 18 SC
 Ashley Kirby – TAV 9(3) 18 SC
 Kristina “Krisy” Kelley 16(1)16 SC
 Sarah Knowles – TAV 9(3) 23 SC
 Laura Krogman - TAV 15(1)16 SC
 Manuel Kunzel - TAV 12(3) 18-19 SC
 Austin Leedy – TAV 8(1) 10-12
 Veronique LePage – AVN 5(1) 8 SC
 Greg Lewbart - 16(1)20-21
 Barbara Linnehan – TAV 8(4) 16 SC
 Noelle Litra – TAV 9(2) 19 SC
 Eric Littman – TAV 9(1) 16 SC
 Richmond Loh – TAV 7(3) 14-17; TAV 10(2): 23-25
 Shelby L. Loos – TAV 9(4) 18-19 SC
 Terra MacDonald – TAV 14(2) 18-19
 Doug Mader – TAV 10(3) 18-19
 Sarah McConnachie -12(2) 18-19 SC
 Christina McKenzie - 10(3) 16-17 SC
 Peter Merrill – AVN 5(2) 12-15; TAV 10(2) 19
 Tim Miller-Morgan – AVN 2(3) 29; AVN 2(4) 13-14;
 AVN 4(4) 11
 Pablo Morón-Elorza 16(4)28-29 SC
 Timothy Mullican – TAV 9(1) 22-26
 Jenny Munhofen – TAV 8(2) 14 SC
 Michael Murray – TAV 9(3) 28-30
 Ross Neethling – TAV 9(3) 21 SC
 Nicole Nietlisbach - TAV 12(1) 16-19 SC
 Brian Palmeiro – AVN 3(2) 8
 Samara Parker – AVN 5(3) 5 SC
 Anna Penacchi – TAV 10(2) 17 SC
 Kaylee Perry – TAV 9(3) 22 SC
 Ayanna Phillips Savage - TAV 15(1):20
 John Pitts – AVN 3(4) 1; AVN 4(1) 7; TAV 10(2) 13
 Caryn Poll – TAV 7(3) 9 CR
 Jena Questen – AVN 3(1) 1; TAV 8(1) 14-15;
 TAV 11(3) 12
 Stephen Reichley – AVN 6(3)10; TAV 8(2)12 SC;
 TAV 11(3)12; 16(3)26-27
 Emi Retter 16(4)30 SC
 Nuno Ribeiro - TAV 15(3):22-23
 Julianne Richard – TAV 9(4) 22-23 SC
 Christine Richey – TAV 9(3) 22 SC
 Dr. Sam Ridgway -16(2) 22-23
 Helen Roberts – AVN 2(4) 14; AVN 6(1)10-11;
 TAV 12(3)15
 Ronald Roberts – AVN 5(4) 12-13; TAV 12(1) 14-15
 Abe Robinson – TAV 8(4) 20-21
 Hamish Rodger –TAV 11(1) 16
 Jenna D. Roseman – TAV 9(2) 21 SC
 Nick Saint-Erne – TAV 7(1)12-13; TAV 7(2)12;
 TAV 8(3)16; TAV 11(3)12; TAV 14(4)24-25
 Elizabeth St. Germaine – TAV 13(3) 28-29 SC
 Jessie Sanders – TAV 10(1) 15-17
 Maya Sawyers – TAV 7(4) 11 SC
 A. David Scarfe – TAV 10(2) 20-22
 Karissa Sciacca – TAV 8(2) 16 SC
 Danielle Scott - 16(2)16 SC
 Najim Sekh – TAV 9(2) 20 SC
 Sunita Shrestha —TAV 13(4) 16 SC
 Wesley Siniard – TAV 8(3) 12 SC
 Maura Sowlat 16(2)14 SC
 Justin Stillwell – TAV 9(1) 17 SC
 Megan Strobel – TAV 10(2) 16 SC
 Helen Roberts Sweeney - TAV 12(3) 15
 Julius Tepper – AVN 5(3) 12-13; TAV 14(3) 18-21
 Sharon Tiberio – TAV 8(3) 17
 Laura-Daniela Urdes – TAV 7(4) 14-15; TAV 8(3) 18;
 TAV 12(2)14
 Jonas Vaitkus – AVN 5(1) 10-11 SC
 Bill Van Bonn – TAV 9(2) 29
 Jake Veilleux - 16(2)18 SC
 Vasile Vulpe - TAV 11(4) 14-15
 Zac Waddington – TAV 8(4) 17 SC
 Chris Walster – TAV 7(2) 10-12
 Holly Ward — TAV 13(4) 14 SC
 Scott Weber – AVN 3(4) 9; AVN 6(4) 10-13;
 Tatiana Weisbrod - TAV 11(1) 14-15 SC
 Peter Werkman – TAV 9(3) 26-27; TAV 10(4) 20
 Jill Western, DVM 16(4)26-27 SC
 Sophie Whoriskey – AVN 5(4) 5 SC
 Jen Wilson-Cohen – TAV 8(3) 13 SC
 Hillary A. Wolfe – TAV 9(2) 18 SC
 Courtney Wright (WDFW) - TAV 12(2) 20-21 SC
 Courtney Wright (IDFG) - TAV 12(2) 22-23 SC
 Sarah Wright - TAV 12(1) 19-20 SC; TAV 13(4) 15 SC
 Kathryn Ziegner —TAV 13(2) 24-25 SC
 Josh Zlotnick —TAV 12(3) 21 SC

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