

E-lasmo Conference 2021 Abstracts

Day One - Elasmobranch Conservation and Research

Future thermal regimes for epaulette sharks (*Hemiscyllium ocellatum*): growth and metabolic performance cease to be optimal.

Carolyn Wheeler (ARC Centre for Excellence in Coral Reef Studies, James Cook University, Townsville Queensland 4811 Australia)

Climate change is affecting thermal regimes globally, and organisms relying on their environment to regulate biological processes face unknown consequences. In ectotherms, temperature affects development rates, body condition, and performance. Embryonic stages may be the most vulnerable life history stages, especially for oviparous species already living at the warm edge of their distribution, as embryos cannot relocate during this developmental window.

We reared 27 epaulette shark (*Hemiscyllium ocellatum*) embryos under average summer conditions (27 °C) or temperatures predicted for the middle and end of the twenty-first century with climate change (i.e., 29 and 31 °C) and tracked growth, development, and metabolic costs both in ovo and upon hatch. Rearing sharks at 31 °C impacted embryonic growth, yolk consumption, and metabolic rates. Upon hatch, 31 °C-reared sharks weighed significantly less than their 27 °C-reared counterparts and exhibited reduced metabolic performance. Many important growth and development traits in this species may peak after 27 °C and start to become negatively impacted nearing 31 °C. We hypothesize that 31 °C approximates the pejus temperature (i.e., temperatures at which performance of a trait begin to decline) for this species, which is alarming, given that this temperature range is well within ocean warming scenarios predicted for this species' distribution over the next century.

Threats to Whale Sharks and a Roadmap to their Conservation

Alistair D.M. Dove (Georgia Aquarium, Atlanta, Georgia, USA)

The whale shark is likely the largest fish to have ever lived on this planet. But, despite their size, they still face existential threats and were recently changed to "Endangered" status on the IUCN Red List. The biggest negative impacts to whale shark populations come from illegal, targeted fisheries (both commercial and artisanal), bycatch in tuna purse seines and gillnets, ship strikes, plastic pollution, and



poorly regulated wildlife tourism. If we can answer some of the basic life history questions about whale sharks and complete the missing parts of the “demographic pie”, then we can approach an enlightened conservation plan for this species. Whatever we do will certainly require multilateral international agreements, because even single, individual whale sharks are capable of cross-basin movements over thousands of kilometres. We should cultivate the whale shark as the “giant panda of the ocean”; that is, a charismatic species that provides “umbrella protection” to other species in the pelagic zone. The two species have much in common and emulating the success of the panda recovery would ensure the continued presence of whale sharks and all they do to enrich our ocean and our planet.

Sand tiger sharks (*Carcharias taurus*) of ‘The Graveyard of the Atlantic’: an integrative approach to understand habitat use and the role of NC shipwrecks for reproductive ecology

Ara McClanahan (North Carolina Aquarium at Pine Knoll Shores, NC, USA) and Madeline Marens (NC Aquarium at Fort Fisher and University of North Carolina Wilmington, NC, USA)

Interpreting biological drivers of movement from tracking data can be challenging, particularly for highly migratory species in the marine environment. The North Carolina Aquariums presents an integrative approach incorporating acoustic telemetry and citizen-science to identify critical reproductive habitats for sand tiger sharks (*Carcharias taurus*) off the western north Atlantic. Sand tiger sharks are globally listed as threatened due to their coastal aggregating behavior and slow life-history strategy. Aggregations of sand tigers have been observed near previously hypothesized birthing areas along southern US Atlantic waters and presumed to be associated with seasonal reproduction. However, patterns of habitat use at finer spatial scales are lacking. For this study, broad and fine-scale movements of male, female and pregnant sand tigers (n=74) were tracked using passive acoustic telemetry techniques to compare seasonal residency and habitat use. Sand tigers displayed seasonal and year-round residency off North Carolina, with strong site fidelity observed at individual reef sites off Cape Lookout. Overlap of seasonal core areas between sexes and partial migration of pregnant females to offshore habitats in winter suggests artificial reefs play an important reproductive role for sand tigers off the North Carolina coast.

Spot A Shark USA (SAS) is a collaborative citizen-science program in which recreational SCUBA-divers submit photographs of sand tiger sharks encountered off the North Carolina coast at shipwrecks or artificial reefs. The unique spots along the sides of photographed sharks are ‘mapped’ using photographic identification techniques to identify and classify individuals, forming a large database of known sharks and their locations over time. Tracking individual, recognizable animals provides valuable insight into multiple facets of the species’ ecology. SAS USA data is easily integrated into existing acoustic tagging research, and combined, can advance our understanding of sand tiger shark movement and reproductive ecology, enabling informed conservation management decisions.



Sawfish Conservation - a Toothy Topic

Paula Carlson (Director of Husbandry, The Dallas World Aquarium, Dallas, TX, USA)

Revered in coastal cultures for thousands of years, the sawfish's (*Pristis spp.*) toothy rostrum has captivated humans and inspired countless tall tales and legends about these unusual elasmobranchs.

Since the early 1900's when the first sawfish was displayed in a public aquarium, millions of visitors to aquariums around the world have had the opportunity to see and learn about living sawfish, and the connections established during these encounters create the same fascination and awe that would have inspired those ancient myths.

With the continued decline of sawfish species worldwide and the ever-increasing need for conservation of their fragile coastal habitats, public aquariums are in a unique position to build on these personal connections and help to create conservation solutions. Through the publication of regional studbooks and participation in IUCN Global Sawfish Conservation Strategy workshops, aquarium biologists have strengthened their collaboration with sawfish field researchers and conservation agencies and continue to strive to protect and conserve these endangered fishes. The establishment of International Sawfish Day in 2017, celebrated each year on October 17th, provides unlimited opportunities to share information about sawfish with the public in a variety of ways, further strengthening our global connections and helping to ensure that our fascination with these amazing animals will continue. There is more work to do to ensure that sawfish populations can recover and thrive in their aquatic ecosystems. Join us in saving sawfish!

Behavioural and Physiological Response of Bonnethead Sharks (*Sphyrna tiburo*) to Prolonged Hyposalinity

Lindsay Phenix, Michael O'Neill, Kerry McNally (New England Aquarium, Boston, MA, USA)

The bonnethead shark (*Sphyrna tiburo*) is a small-bodied member of the Sphyrnidae family, commonly found along the Western Atlantic and Gulf of Mexico. As frequent visitors to estuaries and shallow coastal habitats, they often encounter and tolerate large fluctuations in environmental factors such as temperature, dissolved oxygen, and salinity. Bonnethead sharks are a vital member of the Caribbean reef community within the New England Aquarium's 750,000 liter (200,000 gallon) Giant Ocean Tank (GOT). Home to a diverse collection of teleosts, reptiles, and elasmobranchs, the GOT has faced recurring outbreaks of *Cryptocaryon irritans* since the early 2000's. Animal Care Staff have used several strategies to manage parasite outbreaks in the exhibit during that time.



In 2015, we began to use hyposalinity (15ppt) as an alternative to copper sulfate and other medications for *C. irritans* treatment in the exhibit. Beginning in 2017, a management strategy employing a reduced baseline exhibit salinity of 22ppt and punctuated treatments to 15ppt during outbreaks was developed. Since 2019, this strategy has provided the opportunity for all elasmobranchs, including the resident bonnethead sharks, to remain on exhibit for the three most recent hyposalinity treatments to 15ppt. Much remains unknown about both short-term and long-term effects of hyposalinity exposure on marine species. While mildly reduced appetite and altered swimming activity were noted, especially during the transition periods in which salinity was increasing or decreasing, the overall health of the sharks remained stable. Periodic blood analysis indicates trends toward modestly reduced sodium, chloride, and urea, though clinical relevance remains unclear. The goal of this analysis is to improve our comprehension of both behavioural responses and osmoregulation by *S. tiburo*, and to consider avenues for future research to advance this understanding.

Keeping up with The Honda's Hammers: Collaborative conservation research for great hammerhead sharks (*Sphyrna mokarran*) in the Florida Keys

Grace Casselberry (University of Massachusetts Amherst, Amherst, MA, USA)

Studies of predator-prey interactions in marine ecosystems are difficult to conduct but essential for effective conservation. Human activities, like recreational angling, can alter the behavior of individuals within populations and facilitate predation events. Research on great hammerhead shark (*Sphyrna mokarran*) and Atlantic tarpon (*Megalops atlanticus*) predator-prey interactions began in 2019, in response to growing concerns about shark-angler interactions in the Florida Keys recreational tarpon fishery from stakeholders, including anglers, fishing guides, and conservation biologists. Our research focuses on comprehensively characterizing the spatial ecology of great hammerheads in the Lower Florida Keys, with a focus on Bahia Honda, a tarpon fishing hot spot. This includes better understanding residency to the Keys, seasonal migratory patterns, and habitat use in relation to tarpon. Great hammerheads were selected as the focus of the study because they are the shark species most often implicated in tarpon depredation by recreational fishing guides in the lower Florida Keys. Further, little is known about great hammerhead spatial ecology, particularly in the Lower Keys and Gulf of Mexico.

In collaboration with Aquarium Encounters and Bonefish & Tarpon Trust we are tagging great hammerhead sharks with both acoustic transmitters (n=30) and popup archival satellite tags (n=11) and tarpon with acoustic transmitters (n=150). Shark tagging and spatial data analyses are ongoing, but preliminary results show that the vast majority of great hammerhead sharks interacting with tarpon aggregations in the Florida Keys are mature females (14:1 female:male). Some sharks remain in the Florida Keys year-round, while others migrate north, primarily along the Gulf Coast in the summer months, returning south the following winter. This corresponds roughly to the tarpon migration, though more detailed analyses will follow. The differing movement patterns observed among hammerheads may



be connected to reproductive cycle, which will become clearer as subsequent years of data are collected and analyzed.

AZA SAFE Shark and Ray Program Update

Hap Fatzinger (Director, North Carolina Aquarium at Fort Fisher, NC, USA)

Day Two - Elasmobranch Reproduction and Medicine

Reproductive surgical procedures in elasmobranchs

Dr Bob George (Consultant Veterinarian to the Ripley's Aquarium group)

Elasmobranchs are known to develop a variety of reproductive problems in managed care. While they may develop some of these problems in the wild there is no way of telling how common they are in a wild population. The most common problems noted in aquariums are the following: dystocia, egg retention metritis, mucometra, and cystic ovaries. While these conditions may occur in any elasmobranch they are commonly found in certain species. Dystocias are most common in *Rhinoptera bonasus* while egg retention metritis frequently occurs in *Carcharias taurus*. Finally, a mucometra/cystic ovary complex is common in *Dasysatis americana* held in single sex populations. The first and last conditions can be dealt with surgically by using a left para-lumbar approach to perform a cesarean section to relieve a dystocia or to do pre-emptive ovariectomies in some Dasysatid species. Egg retention metritis may be successfully treated by performing uterine lavage.

Semen collection and artificial insemination in *Carcharias taurus*

Dr Bob George (Consultant Veterinarian to the Ripley's Aquarium group)



A variety of procedures are being developed to encourage reproduction of elasmobranchs in managed care. In addition to encouraging a natural mating process, artificial insemination (AI) may be employed to not only initiate a successful pregnancy but may allow for bringing genetic diversity to a closed population.

Semen collection is an important part of any AI procedure. It can be done with in situ or ex situ male sharks and rays. There are two approaches to semen collection. The best is by manual expression as this is a non-invasive procedure that can be accomplished in the field as well as at an aquarium. Catheterization, which can be more difficult is useful in a more controlled environment than it is in the field. As it is an invasive procedure it is paramount that good technique be employed so as not to cause male sharks to develop bacterial infections of their ampullae.

Once collected the semen is mixed with salt water to activate the sperm before it is placed in a receptive subject. The activated semen is placed in the the uterus through a large bore red rubber feeding catheter, with half of the material placed in each uterine horn.

A thorough knowledge of the species reproductive anatomy is important for both semen collection and delivery. The timing of an AI procedure is an important factor as well as as obtaining a good sample. Assessing both the male and female to determine if they are ready to be part of an AI event is crucial to success. This is done by evaluating the subject animal's history, behavioral cues and reactions to sharks of the opposite sex, a semen evaluation, and a careful ultrasonographic examination of both the male and female reproductive anatomy.

Artificial insemination in White-spotted Bamboo Sharks

Dr Jen Wyffels (University of Delaware, Center for Bioinformatics & Computational Biology, Newark, DE, USA)

Non-lethal methods for semen collection from elasmobranchs to better understand species reproduction has accompanied the development of artificial insemination. Ejaculates (n=82) collected from whitespotted bamboo sharks *Chiloscyllium plagiosum* (n=19) were assessed and cold stored raw or extended at 4°C. Females (n=20) were inseminated with fresh or 24-48 h cold stored raw or extended semen and paternity of offspring determined with microsatellite markers. Insemination of females with fresh sperm (n=10) resulted in 80 hatchlings and 27.6% fertility. Insemination of females with semen cold-stored 24 h (n=4) and 48 h (n=1) semen resulted in 17 hatchlings and fertilization rates of 28.1% and 7.1% respectively. Two females inseminated with fresh/cold stored) semen laid eggs that hatched from fertilization and parthenogenesis within the same clutch. Parthenogenesis rate for inseminated females was 0.71%. Results demonstrate artificial insemination with cold-stored semen can provide a strategy for



transport of male genetics nationally and internationally, precluding the need to transport sharks. Production of parthenotes in the same clutch as fertilized eggs highlights the prevalence of asexual reproduction in whitespotted bamboo sharks and poses important considerations for population management.

The Little Pups that Could: Raising Cownose Ray Pups

Ashley Neumeier; Abby Perque; Jamie Torres (Audubon Aquarium of the Americas, New Orleans LA, USA)

Cownose rays are a popular display animal that are seen in most aquariums, especially in touch pools. Many aquariums successfully breed and raise cownose rays; however, there isn't a set standard or protocol for raising pups. Within the last 3 years, Audubon Aquarium of the Americas started a cownose ray breeding program. Over time, we have developed specific protocols that allowed us to successfully raise cownose ray pups, even working through the challenges of twin and premature births. We closely looked at the development and growth; and compared their weights, disc width, and growth rates from single births and twin births to help map out key milestones in development. We used the data collected to predict age and growth rates in cownose ray pups; and we compared this data to wild populations.

Overview of Common Monogenean Parasites (Platyhelminthes: Monogenea) of Elasmobranchs in Aquaria and Zoos

Barrett L. Christie (Director of Animal Husbandry, The Maritime Aquarium at Norwalk, Norwalk, CT, USA)

The monogeneans are insidious parasites of fishes held in public aquaria and are commonly implicated in morbidity and mortality of animals. These ectoparasites present a unique challenge to management and quarantine owing to their direct life cycles which enable them to reproduce and reinfect animals on a continual basis, causing secondary infections and general loss of fitness. As many as 200 species are known to infect elasmobranch fishes, though unlike some better known monogeneans of teleost fishes, most tend to display high degrees of species-specificity. This enables aquarists, veterinarians, and other husbandry professionals to tailor prophylaxis in quarantine more specifically in efforts to combat these parasites. While commonly occurring species can often be successfully treated with anthelmintic therapies (e.g. *Benedeniella* spp., *Dendromonocotyle* spp., *Ercocotyle* spp. et al.) other species are much more tenacious (i.e. *Decacotyle* spp., *Dermophthirius* spp.), and the goal for husbandry in these cases is



more often management than treatment. Consideration of the monogeneans known to infect a given species can inform strategies for quarantine, collection planning, and biosecurity.

Design and Construction of Exhibits for Sharks

Mark Smith (Adelaide Zoo, Adelaide, South Australia, Australia)

Sharks have specific anatomical and physiological constraints that influence the suitability of an aquarium for their successful display and flourishing. When designing an exhibit for sharks it is critical to:

- (1) provide a sufficient horizontal swimming dimension;
- (2) provide corners $>90^\circ$ and no obstructions mid-water;

- (3) provide clearance above the water surface;
- (4) ensure no sudden changes in illumination;
- (5) ensure no electromagnetic fields or stray voltage; and
- (6) ensure no noise or low frequency vibrations.

Water treatment systems must: (1) remove toxicants (e.g., chlorine, metals); (2) remove particulates (organic & inorganic); remove dissolved organics (i.e., carbon); (3) remove inorganic nutrients (e.g., ammonia); (4) balance gases (i.e., O_2 , CO_2 , and N_2); (5) disinfect the water; (6) stabilise temperature within an acceptable range; and (7) stabilise pH within an acceptable range. In addition, for sharks to thrive, an appropriate infrastructure, a well-trained husbandry team, and robust standards of practice must be in place.

Day Three - Elasmobranch Training and Conditioning

Welfare and the Five Domains. Do Elasmobranchs feel Pain ?

Dr Rob Jones (The Aquarium Vet, Melbourne, Victoria, Australia)

The Five Domains have in the past decade become the standard by which the welfare of animals cared for in aquariums and zoos is measured. In this presentation, we will examine what the Five Domains are,



and how we can apply them to elasmobranchs in human care. We will also examine the difficult question of whether elasmobranchs feel pain or not.

Adapting Enrichment for the Welfare of Sharks and Rays

Siobhan Houlihan, Sarah Carnell, Kiana Fielding (Sea World, Gold Coast, Queensland, Australia)

Sea World is committed to investing in the health and wellbeing of all animals in its care. This year our team at Shark Bay have been developing a program to improve animal welfare through enrichment.

Enrichment for sharks and rays has presented a range of opportunities and challenges. Requirements vary depending on the species and exhibit parameters, from smaller species of reef shark in our Intertidal and Reef Pools to a Bull shark and a Dusky Whaler in the Predator Pool. How do we effectively introduce enrichment that safely encourages natural behaviours in a multi species environment, each requiring different types of human interaction?

In addition to the recently established enrichment schedule, we are in the process of developing a training program for the rays that live at the Ray Reef exhibit, to assist with our animal husbandry in this area.

What motivates benthic elasmobranchs? Navigating challenges when communicating with animals that live on the ocean floor.

Christina Minniti and Jason Langshaw (New England Aquarium, Boston, MA, USA)

Animal training has become increasingly popular in the aquarium industry as an effective tool for both husbandry and enrichment. Our young training program in the New England Aquarium's Trust Family Foundation Shark and Ray Touch Tank began with only one species of shark, *Chiloscyllium punctatum*, but has quickly grown as additional animals have demonstrated capacity for engagement and potential welfare gains. The incorporation of our two leopard whiptail rays, *Himantura undulata*, has been particularly unique and challenging due to these animals' size, charisma, and relationship with one another. Here we will share our detailed process in learning to work with these intelligent animals, including our starting goals, material construction, training practice, status report, and our goals for the future. We will also touch on what it meant to carry out this work during the COVID-19 pandemic, as well as how this process affected both our animal care staff and the staff from other departments who were on campus throughout COVID-19 closures.



Target and auditory response training of the nurse shark *Ginglymostoma cirratum* in the aquarium field

Carol "Kee" Bligh (Florida Keys Aquarium Encounters, Marathon, FL, USA)

The intelligence level and docile nature of *Ginglymostoma cirratum* makes this species an excellent candidate for the utilization of behavioral training through positive reinforcement. The training has shown not only greatly enhanced elasmobranch husbandry but has also improved guest interactions in a safe and controlled environment. Formal training began by assigning each nurse shark with a unique shape and colored target, along with a distinct acoustic sound. Individual sharks were called to station at their target by ringing the corresponding rattle for approximately 30 seconds. Each shark was reinforced with food via feeding stick while sitting at the target. During repetitive exercises, duration of wait time at the target was increased with the introduction of desensitization training which included light handling and petting on the dorsal side. Over a 3-month process desensitization training continued, progressing to lifting the shark and full rotations exposing the shark's ventral side. Acclimating the sharks to target training permits each individual to be fed independently decreasing potential for aggression, in return

easing stress during husbandry exams. Training has also allowed additional hands-on experience, giving the opportunity for guests to assist with training sessions. During the training sessions guests are allowed to pet and feed the sharks which not only solidifies the reinforcement of the behavior, but in return provides an exciting and educational experience. Overall, the experience demonstrates the intellectual ability of elasmobranchs and disproves stereotypes about sharks being mindless eating machines.

Development and Implementation of a Training and Enrichment Program to Manage Aggressive Behaviour in Potamotrygonidae stingrays.

Mackenzie Ford (ex-Loveland Living Planet Aquarium, Utah, USA)

Aggression has been regarded as a prominent behavioural and welfare concern when keeping freshwater stingrays in aquaria, in particular groups of males, and has typically been thought of as a difficult behaviour to remedy. Three Potamotrygonidae rays cohabiting at Loveland Living Planet Aquarium displayed severe aggressive behaviours towards one another for multiple years. This became so persistent that eventually physical barriers were erected within the system to prevent physical contact between the rays. Over the past two years, a training and enrichment program was developed and implemented for the rays, drawing from the natural history of South American river stingrays with the goal



of providing opportunities to practice natural behaviours such as hydraulic mining, tool use, and navigation in place of aggressive behaviours.

This program resulted in nearly all mitigation of aggressive behaviour. Using behavioural husbandry to manage aggressive behaviours occurring between stingrays in confined aquatic systems has shown itself to be effective at the Loveland Living Planet Aquarium, and has also been successfully applied to other animal populations displaying similar aggressive behaviours. Further implementation of these types of programs offers methods by which to ensure both the provision and evaluation of good welfare of captive populations of elasmobranchs housed in aquaria.

Sharks! Predators of the Deep. The Newest Exhibit at Georgia Aquarium

Ramon Barbosa, Kelly Link (Georgia Aquarium, Atlanta, Georgia, USA)

With shark populations in decline for many species around the planet, the need to educate the public about some of the most charismatic and feared species in our seas and the threats they are facing is becoming more important each day. This need, combined with the fact that Georgia Aquarium did not display a large collection of top predators, created the perfect opportunity for the development and construction of a dedicated gallery and habitat to showcase some of the most misunderstood fish species – sharks. Here is a quick journey through the creation of the concept, design of the gallery and exhibit, construction of the building and life support system, animal acquisitions, transports, and husbandry that provides a holistic view of the entire process of Georgia Aquarium's 2020 Expansion.

Use of Operant Conditioning in the Husbandry and Transport of Great Hammerhead Sharks, *Sphyrna mokarran*

Melissa Paynter, Sarah Crum, Ramon Barbosa (Georgia Aquarium, Atlanta, Georgia, USA)

The use of operant conditioning has been widely used in the husbandry of numerous species of teleost and elasmobranchs in the aquarium industry. Here we will be discussing the ongoing training of Great Hammerhead Sharks, *Sphyrna mokarran*, the various trained behaviours, the challenges we encountered and the use of this training for the transport of 4 individuals. Using a moving target, aquarists were able to guide the sharks throughout the habitat in a controlled manner which provided mental and physical stimulation, customized nutrition, administration of oral medications and supplements, and ultimately allowed us to have them voluntarily swimming into their transport stretcher, therefore reducing handling stress associated with the capture.



Use of Laser Therapy in Wound Management in a Black Tip Reef Shark

Dr Brett De Poister (The Aquarium Vet, Melbourne, Victoria, Australia)

Laser therapy has been used in human medicine since the 1970's to reduce pain, modulate inflammation, assist with wound management and accelerate healing time, and in the last decade it is increasingly being used in veterinary medicine. In this brief presentation, I will discuss the basic concepts of laser therapy and its use in wound management in elasmobranchs.

The Difficulties of Body Condition Scoring Elasmobranchs in Aquariums

Dr Luke Ross (The Aquarium Vet, Melbourne, Victoria, Australia)

We will explore the different techniques currently used to assess body condition in elasmobranchs. Body condition is important, as it is closely linked with health and therefore the animal's welfare. We will then look at how body condition is currently scored and the accuracies and inaccuracies with these methods. Finally, we will examine what possible methods could be used in the future.

Recent Advances in Elasmobranch Transport Techniques

João Correia*, Rui Guedes, David Silva, Pedro Marques, Luís Silva (Flying Sharks, Peniche, Portugal)

Since 2006, Flying Sharks has moved multiple elasmobranch species by road and air, to and from destinations in Europe, the Middle East, and America. Such species include *Mobula mobular*, *Carcharhinus melanopterus*, *Galeorhinus galeus*, *Myliobatis aquila*, *Torpedo marmorata*, *Dasyatis violacea*, *Raja clavata*, *Rhinoptera marmoratus*, and *Carcharias taurus*. While most of the above were moved by air inside sealed containers, a few exceptions – such as *Rhinoptera marmoratus* – were up to six days in transit by road, with the assistance of Life Support Systems powered by an inverter that made 220 Volts available. Preparations for transport are presented, ranging from fasting to pharmaceuticals used before, during and after, as well as water quality monitoring, pH buffering, and ammonia quenching techniques and philosophy.



Elasmobranch Nutrition: Diet, Feeding and Supplementation

Dr Lisa Hoopes (Director of Research, Conservation & Nutrition, Georgia Aquarium, Atlanta, GA, USA)

Proper nutrition is the cornerstone of good health and is considered a key part of a preventative medicine program for zoological institutions. The nutritionally appropriate diet of captive elasmobranchs consists of the essential nutrients (proteins, lipids, carbohydrates, minerals, vitamins, fatty acids, amino acids) found in the wild diet. Choosing nutritionally appropriate diet items, feed amounts, and feed frequency requires understanding of elasmobranch digestive anatomy and physiology, gut transit time, daily ration, and species-specific energetic requirements. Vitamin and mineral supplementation has become routine practice in elasmobranch husbandry, however, there are large gaps in our understanding of dietary requirements, appropriate dosing schemes, and the threshold for deficiency and/or toxicity. Much of this has been extrapolated from studies on teleost fish or research studies on a limited range of elasmobranch species. Recommendations for feeding rations (neonates and adults), tube feeding, and vitamin and mineral supplementation will be outlined in the presentation.

Elasmobranch Handling

Dr Rob Jones (The Aquarium Vet) and Clem Kouijzer (1-2-1 Animal Handling)

Handling of elasmobranchs under human care requires specialized equipment and a professional approach. Some species living in aquariums and zoos around the world pose life threatening capabilities to their human care takers. Handling is a necessity, during veterinary procedures, during collection from the wild, during moves between exhibits, or even during inter-institutional transports, such as breeding loans. The methods used to handle them must take into consideration their life history, biology and behavior, thus ensuring neither party (animal and/or human) are harmed in any way.

Dr Rob will briefly introduce large elasmobranch handling circa 2000. Clem (1-2-1 Animal Handling) will show a more modern approach.

Growth Rates, Morphometric Analyses, and Ageing Techniques for Elasmobranch Fishes

Barrett L. Christie (Director of Animal Husbandry, The Maritime Aquarium at Norwalk, Norwalk, CT, USA)



Many elasmobranch fishes in aquaria and zoos are wild-caught, confounding attempts to place an accurate age on the specimen. As husbandry advances have brought forth increased rates of reproduction, greater numbers of species maintained, and substantial increases in life expectancy in the aquarium, the issue of accurately estimating age and tracking growth and size is an increasingly important area where data can inform husbandry practices.

The application of fisheries data to aquarium specimens, including growth curves (von Bertalanffy functions), length-weight equations, and body condition scoring (Fuller's Condition Factor K) for elasmobranchs are discussed as tools to improve husbandry. Also discussed are techniques for post-mortem ageing of elasmobranchs such as quantification of vertebral growth annuli; the significance of bio-fluorescent chemotherapeutics and radiometric isotopes in ageing are also presented. Meristics, morphometrics, and other empirical observations have great potential to be combined with fisheries data to advance the standard of care and welfare for elasmobranchs.

Elasmobranch Anaesthetics and Phenoxyethanol (an oldie but a goodie)

Dr Rob Jones (The Aquarium Vet, Melbourne, Victoria, Australia)

Phenoxyethanol has been used as a fish anaesthetic for many years.

In the past three years, The Aquarium Vet team have used it in multiple elasmobranch species, including some large animals up to 300 kilograms. We have used it to assist with handling and preparation for transports, as well as for sedation for minor procedures and surgery. The results have been excellent with a very smooth induction as well as recovery.

Doses range from 0.15 ml/L up to 0.30 ml/L and our protocol will be presented.

